FARU PROCEEDINGS – 2017

"Design that cares"

multi disciplinary approaches to creating sustainable and meaningful built environments

Volume 02

The peer reviewed and accepted research papers of the conference are included in this volume Selected papers from the proceedings will be invited to publish in Special Issues of Archnet-IJAR, Architectural Science Review, International Journal of Disaster Resilience in the Built Environment and Construction Economics and Buildings in 2018

About FARU

FARU is the research unit of Faculty of Architecture, University of Moratuwa, Sri Lanka. FARU which consists of four academic departments (architecture, town and country planning, building economics and integrated design) organizes international conferences for the past nine years. It attracts academics, students, and practicing professionals.

FARU 2017 is held in Colombo (Blue Waters Hotel in Wadduwa) for the tenth year and co-sponsored by University Grants Commission, Sri Lanka Insitute of Architects, True Value Products (Pvt) Ltd, J-Lanka Technologies and Sripalee Construction. The FARU Organizing Committee acknowledges the support extend by the University of Moratuwa, University Grants Commission, Srilankan Airline and all sponsors.

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Editor's Note

Architecture (and built environment) provides refuge from the external environments but has a multitude of needs and functions to perform and care. The domain of architecture is thus diverse and includes responses to various needs underlining the essential role research has for the furtherance of and sharing knowledge for the practice and discipline. The impact of architecture as a social product, environmental, contextual and technological entity and economic discipline on quality of life leads to policy relevance, practice and further research. While to a certain extent, these concerns are independent domains of knowledge, they interact together in the design process and performance during occupancy and usage. Architecture thus involves team work and multi-disciplinary (and inter disciplinary) approach for innovation – hence the need to understand the art and science of creating meaningful built environments.

Theme of FARU 2017 recognizes design as a discipline that cares and serves a multitude of concerns and functions through its life cycle within a broader context of built environment involving architecture, town and country planning, building economics and product design. FARU 2017 invites research papers from academics, researchers, students and practitioners from all these disciplines and allied fields.

FARU 2017 highlights the significance of architecture (built environment) in caring environmental, physical, energy, socio-cultural, and economic concerns and needs, and thus the quality of life of people. Annual 10th International Conference of FARU in 2017 invites contributions on research and intellectual developments as well as on innovative case studies in the following areas:

Environment and energy People, socio-cultural and physical context Technology and materials Cost, management and life cycle Urban environments, planning, urban health and climate Integrated design Landscape architecture

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Keynote speeches in Volume 01 of FARU Proceedings For more details of keynote and guest papers please refer Volume 01

KEYNOTE ADDRESS 5

ENSURING VALUE FOR MONEY IN LARGE AND COMPLEX CONSTRUCTION PROJECTS: AN INTERDISCIPLINARY APPROACH

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Abstract

Ensuring value for money in large and complex construction projects is both challenging and critical to the success of these projects. This keynote address will introduce an interdisciplinary approach to ensure value for money in construction projects. It will cover the latest development in both research and practice in this field, by drawing the author's 30 years' experience in undertaking a large number of research projects funded by the Research Grants Council in Hong Kong and other sources, and experience in providing consultancy services to a wide range of Government Departments in Hong Kong as well as large corporations in the private sector. In addition to ensuring value for money in large and complex construction projects, this interdisciplinary approach can also help create ownership and commitment among the major stakeholders of these projects.

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BRINGING WATER TO NEW HEIGHTS

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Abstract

Several attempts have been made at supplying water into informal settlements, although none investigate bringing the water into each individual home. Our proposition is to form a pipe network connecting to node units attaching to each home as a sponsored/crowd funded initiative. This system is designed to be implemented without uprooting the current residents. Two node designs would be available, which are metamorphic to the individual's requirement. Facilities such as showers and sinks clip onto this "water wall." A foldable washing line is also located at the top of the node to conserve space and is accessed with a small ladder and a pulley system. The nodes contain a fire sprinkler. Moreover, the nodes stabilize the houses by having a small foundation. Borehole and rainwater is our focus. The water is retrieved from the borehole and travels through the water system which is set in place before reaching the individual homes. The system includes elements that facilitate both the movement of water using natural energy as well as creating public spaces for the inhabitants of the informal settlement to interact. The concept is located in South Africa, although can be adjusted to be applied in communities worldwide.

Keywords: Water, Sustainability, Cleanliness, Informal Settlements

1. Introduction

"BRINGING WATER TO NEW HEIGHTS" is a concept in which we investigate supplying individual homes of an informal settlement with a clean source of water. Modern settlements face the problem of having insufficient services as well as facing major social issues which influence the physical and mental health of the inhabitants. The aim of our concept is to improve both the social and physical challenges which the citizens of informal settlements face by providing them with a service that many people take for granted; water.

This is done through sourcing water from a borehole and rainwater collection points. These collection points serve purposes of water collection as well as kinetic energy production. The borehole is directly linked to a playground/outdoor gym facility which allows for a natural produce of kinetic energy which is used for the pumping of the water through the system. The water is then fed into a water purifier and subsequently into a water tower. The water tower supplies water pressure in the homes and also allows for the water to be moved by gravitational energy into a pipe network which then transports the water to each home within the settlement. The pipe system is based above the ground as the informal settlements are generally already well established, and placing the network underground would require the removal homes in the area to create the infrastructure.

2. Locality analysis: Introducing Imizamo Yethu

South Africa has developed many *informal settlements* over the years as there is insufficient housing in the cities. In this essay, we will focus on Imizamo Yethu, an informal settlement based in Hout Bay, near the city of Cape Town.

Imizamo Yethu, which means "Through our collective efforts" or "Our collective struggle" in Xhosa, which is the native language of the settlement, was established in 1991/1992. Today it is one of the most poorly serviced informal settlements in Cape Town. This is due to the settlement being located on a gradient slope which makes waterborne sanitation difficult (Louw, 2016). Currently the estimation is that 394 homes share access to a single tap.

The community faces a number of social, environmental and health problems which greatly diminish the quality of life of the approximately 25 000 inhabitants (Louw, 2016). Many of these issues concern water and sanitation in the settlement. In the past, these issues have been addressed through a number of clean-up programmes, which were successful for a period, but the settlement referred back to its original state soon afterward. (Foestad, 2005).

Imizamo Yethu struggles with a number of social issues which greatly diminish the quality of life of the inhabitants. Main issues include unemployment, lack of sanitation and lack of trust between inhabitants.

We aim to address these social and environmental issues through developing a design concept to improve the overall living conditions in Imizamo Yethu by focussing on supplying each home with its own water source.

Aside from environmental and social issues, health issues are rife in the area. Research shows that people living in informal settlements are far more likely to develop mental health issues as a result of not feeling a sense of belonging and thus not being satisfied in the environment in which they live (Newton and Scheurmans, 2013). (Foestad, 2005)

The University of Cape Town has always had a focus on developing Imizamo Yethu and hence many projects have been implemented in the settlement over the years. This allowed us to easily place our concept in context. Previously the university developed the water points in Imizamo Yethu to create a communal water supply area for the inhabitants use (Louw, 2016). Our concept further

BRINGING WATER TO NEW HEIGHTS



Figure 1, Aerial Views of Imizamo Yethu (Schabert, March 2017)

develops this idea by bringing water to the individual homes within the settlement.

This is exactly how our concept can aid this link. Although providing a formal house to each family in Imizamo Yethu is an impossible feat, bringing water, facilities and fire prevention to each '*shack*' without the conversion of that '*shack*' to a formal home can help to bridge the gap between "formal" and "informal" housing. This will heighten each member's sense of belonging to their home and give them more security in the fact that their household has dignity and worth, in turn providing a small show of the results brought by converting shacks into formal housing. (*Hammett, November 2013*)

3. Public Spaces

Apart from improving the environmental standards within Imizamo Yethu we wish to focus on improving the quality of life of its inhabitants on a social level.

Incorporating communal spaces into the settlement creates a sense of pride within the community which has an array of positive effects. Public spaces encourage social integration among the residents and introduce a range of social values into the settlement. In the case of Imizamo Yethu, the relationship between the settlement and Hout Bay can be strengthened, creating a more positive overall environment. By improving the quality of existing public spaces or creating new ones, the programme assumes that systematic improvements will follow throughout the community. In this context, the improvement of public spaces plays a relevant role not only in promoting social integration and boosting residents' self-esteem, but also keeping the upgrading process alive (Hernandez, 2012).

4. Water Supply

The idea of installing the borehole pump and rainwater collectors into Imizamo Yethu originated from the aim of creating a sustainable water source in order to improve the water distribution equity issues highly prevalent in Imizamo Yethu. Sustainable water sources has arisen as a real concern, particularly

during this time of drought in the Western Cape. In this informal urban dense community it would be impossible to uproot and implement the conventional methodology of setting in place piping beneath the ground.

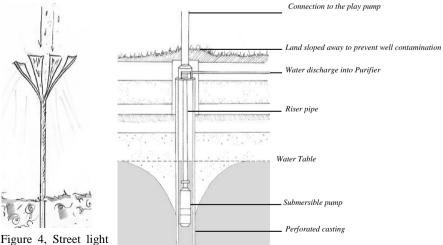
In attempt to combat this issue, seven water platforms have been implemented within Imizamo Yethu to date, although these water points



Figure 1, Locality Map showing Water Points (Masureik, 2017) (Anon., 2017) (Louw, M., 2016.)

are the only establishment put in place for the estimated 9464 households to access water. (Anon., 2014) (Zaremba, 2017)

Therefore, this concept is an abstract potential solution to these complex problems. The source of water would be a number of borehole pumps within the settlement, as well as rainwater collection units. The water will then be stored and distributed into the individual homes of Imizamo Yethu. The borehole pump would be powered by a kinetic energy source, in this case an outdoor gym facility/ children's playground. The rainwater collection units would be multifunctional and form street lights. The rainwater that is collected would partly flow into the ground and replenish the groundwater level from the borehole usage, partly enter the distribution system.



(Duncan, 2017)

Figure 2, Submersible Borehole Pump (Drilling, 2017)

BRINGING WATER TO NEW HEIGHTS

The submersible borehole pump works on the specifically designed and patented idea of the Playpump. This is a conventional borehole pump which is driven by a roundabout. We adapted this concept to be applied to an outdoor gym facility to allow adults to also participate in the process of pumping water in a dignified manner. The notion of having to "earn the water" through exercise/ play, will give the residents a sense of appreciation of the valuable asset they will be receiving.

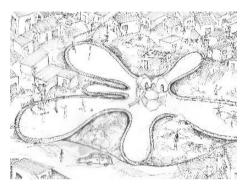


Figure 7, Conceptual Sketch of the Playground/ Outdoor Gym Facility Atmosphere (*Duncan*, 2017)



Figure 6, Playpump in Use (*Playpumps 2017*)

All the systems of the outdoor gym and roundabout are specifically designed to convert the rotational movement of the roundabout into linear motion, inadvertently pumping groundwater through a system of pipes and into a water tower. (How it works | Play pumps, 2017)

This water tower is a polyethylene tank which would stand a minimum of 7 metres above ground level. Our concept would be covering a higher water tower as to ensure adequate pressure being allowed into the piping network overhead the settlement itself. In favour of the concept is the characteristic of Imizamo Yethu being situated on a gradient, hence gravity can be used in the process of water distribution. Any excess water is forced back down into the borehole and forms groundwater once again. (Playpumps | Roundabout water solutions, 2017)

This concept can only be implemented in an area with a borehole supply fit for human consumption, tested before implementation, hence the site will have to go through thorough testing prior to construction of the playground. Our solution to this, even if the water is of an adequate quality to drink, we would install a purification plant underneath the park/ outdoor gym area which the water would run through, be cleansed and finally pumped into the water tower. Hence, any water entering the system would already be pure and clean.

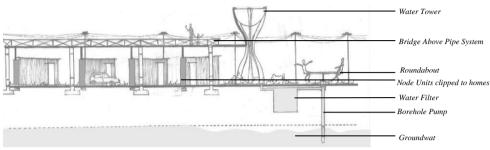


Figure 5, Water Transportation Diagram (Duncan, 2017)

Space for billboards would also surround the water tower, hence providing advertising opportunities for any large corporations who decide to invest in this crowd funded initiative and ensure that this concept remains a sustainable design, and can be continued into the future.

To date, there are over 900 Playpumps currently implemented in South Africa, as well as multiple in other African countries (Playpumps, 2017).

"Play" is an incredibly essential part of a child's mental and physical development. The skills developed through interaction with other people, especially children of a similar age, are an invaluable source of life skills and happiness. "Playing" is so unique in the fact that it comes so naturally to young

children. In environments such as Imizamo Yethu, playgrounds are limited and providing safer spaces for children to play off of the streets is always required. This is why we feel that the Playpump is such an advantageous solution.

The outdoor gym concept has been implemented in other informal settlements worldwide. Sport facilities in high density areas allow for the chance of integration and co-operation among the community (Hernandes, 2012). In the case of an informal settlement in Caracus where a gym was implemented, crime has dropped sharply with the result of the number of homicides dropping from 25 to 5 homicides per weekend.

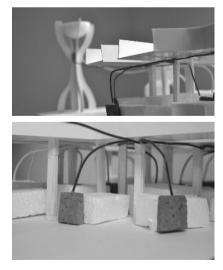


Figure 7, Concept model illustrating elevated walkway and piping (*Duncan, N, 2017.*)

5. Distribution and Connection to Homes

Multiple playground/outdoor gym facilities would be implemented throughout the settlement, each supplying a different area of Imizamo Yethu with a clean, reliable source of water. The water would be distributed from the public space by pipes above the ground to each individual home. The piping would also act as an interactive platform for the inhabitants to make use of. The aim would be for the pipes to create a fresh "characteristic" of the settlement. With different colours leading to and from different water distribution points. The pipes would be colourful and aim to be a feature that the residents can be proud of.

The piping would become *architecture* in the settlement. In some cases the pipes would run underneath an elevated walkway, granting refuse collection

access and providing extra mobility to the inhabitants. In other cases the piping would run along the ground and be load-bearing in order to function as outdoor furniture. The piping design can be adapted to the areas surrounding each playground/outdoor gym facility.

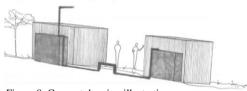


Figure 8, Concept drawing illustrating alternative piping structures (*Isola, T., 2017.*)

6. Node Units and What They Entail



Figure 9, Models representing the Node Units (*Isola*, *T.*, 2017.)

The material used in the construction of the node is recycled plastic which is melted and moulded into its form. This is ideal for the constructive elements of the node unit as it is strong, can withstand extreme weather conditions and is cost effective.

The node wall replaces a section of the informal house and the home is then secured to the node, hence allowing the node to

stabilize the house. The water enters each node and gets utilised in a sink, shower and geyser.

There are two different node options available. Option 1 is a standard unit that includes a sink. Option 2 includes both a sink and a built-in shower on the exterior of the node. Both of these node options can be characterised according to the buyers' needs, by adding additional units. These units include a geyser, a shower on the interior of the node and shelves and cupboards and come at an additional cost. Each node is installed with the necessary plumbing for all of the additional units. Each item is clipped into the wall of the node using a

coupling which is installed in the wall of the node. The coupling fixture secures the extension units to the node as well as supplying the extension with both hot and cold water.

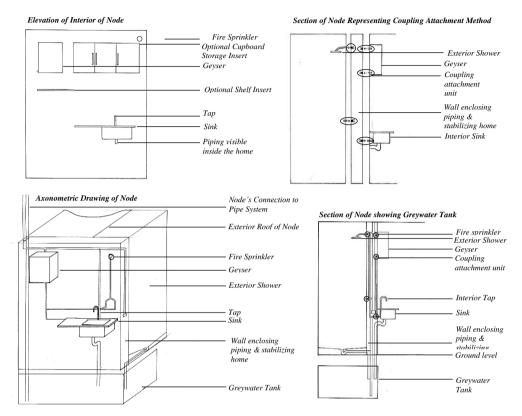


Figure 10, Detail Line Drawings of Node Units (Isola, T., 2017)

The fact that each item clipped into the node is bought by the residents, allows them to feel a sense of achievement upon receipt of the item. The nodes' facilities and the production, installation and maintenance will provide employment opportunities within the informal settlement. This will help combat the high unemployment rate that Imizamo Yethu regrettably suffers from.

The grey/waste water is stored underneath the node in a small tank. The greywater produced by each household would be collected and pumped using the pump situated underneath the node. The water is sent back into the nearest playground/ outdoor gym facility and filtered to be purified and reused again in the water system.

Fire is a huge threat to Informal settlements in Cape Town. Imizamo Yethu has experienced devastating fires over the past few years. The most recent and deadliest fire was to date started on the 11th of March 2017, taking 3500 homes and displacing up to 15 000 people. (Anon., 2017) Due to the tightly packed nature of this urban community, there is limited access for emergency vehicles, making it incredibly difficult to keep fires under control.





Figure 11, Fire Devastation (Lee, C., 2017)

Figure 12, Satellite Photograph of Imizamo Yethu Showing Fire Damage (Louw, M., 2016)

Therefore, in reaction to this limited mobility of fire prevention in the area, the node unit acts as a self-acting fire prevention, as each node contains its own fire sprinkler. Thus the node unit forms an immediate self-aid system once the temperature in the node reaches 58,7°C.

The wet pipe fire sprinkler installed in the node units (Fireline, 2014) is the most appropriate for Imizamo Yethu as it involves the least amount of maintenance, is composed of the least amount of parts, is the least expensive and is quick acting. It releasing the water instantly after reaching the required temperature, activating the sprinkler. (Systems, n.d.) (Corp., n.d.)

To conclude, we feel that our concept is a potential effective stepping stone towards upgrading and rethinking the informal, urban cities of the future.

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SUSTAINABLE NATIONAL DEVELOPMENT THROUGH COMBINING CSR ACTIVITIES WITH ACADEMIC PROJECTS

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Abstract

Corporate Social Responsibility (CSR) has become an integral part of business now a days and getting more popularity. Companies are now more concerned about integrating social responsibilities into their business practice. As the fund is also increasing in this field, sustainable management of this fund is getting momentary. It is not one time funding/ ad-hoc system. The impact of the activities need to be rethought, how far it is contributing to the society, getting feedback of the fund provided, lasting impact on community, whether it is bringing social change etc. This study describes a loom shed design project under academic course work and how company's CSR activities can make it into a reality. At first the recent trend in CSR, Architecture school design projects have been discussed. Then the context of the project location and description of academic project is discussed in detail. The socio-economic change that can be brought through this type of investments is analyzed. At last two alternative business model has been proposed involving academy/ institutions, for a sustainable development of national economy.

Keywords: CSR, Academic Design Project, Sustainable Development

1. Introduction

In Bangladesh, the existing CSR process deals with the company deciding where they can contribute. Most of the companies find their own way of doing CSR or fund governmental/NGO projects as their contribution to the social responsibility. But As Atiur Rahman (2013) stated how far the impact is concerned, it is yet to be measured.

Now as we, Bangladesh dream of being a middle wage earner country in 2021, we need to focus more on the impacts of our actions based on these financial responsibilities because this support can restructure a countries economy. With

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help of these corporations, we can accommodate business, expand trade, revive almost extinct cultural businesses etc. These corporations sometimes struggle to conduct a research on activities or the people, the CSR that they are doing or willing to do. The CSR activities might also be in vain if the corporation cannot find out data. As a matter of fact, sometimes these CSR activities do not have any positive impact on the economy or the person.

Architecture academic assignments/ studio projects are totally practical based works which involves use of tools, resources and knowledge. While conducting the studies, architecture students and academicians find a lot of businesses and projects where little funding can create a huge change in the business structure. The Loom Shed project at Narshingdi is a similar project that has many fold impact. Investments in this sector will revive the tradition of our handloom industry, it will ensure employment in that area, good architectural interpretation will increase productivity and income, the workers family will be benefitted, student's will get practical knowledge which means professionally they have the opportunity to enter in the field earlier, the project will improve skill of the academician etc. As this is done as a class project, there are scope to see many hypothetical options of one problem, from where both client/ company can choose the most feasible one. Rodney Reed (2013) hoped this type of investments that brings greater social change should be the focus of CSR activities as this is sustainable.

2. Objective of the study

- The objective of this study is to rethink the broader scope of CSR activities that will actually contribute to the sustainable development of national economy.
- The study also propose a model based on case study of how academic projects can contribute in effective use of CSR fund.
- The benefit that can be gained from both side.

3. Framework of the proposal

The CSR, individual/group beneficiary and the academy involvement are in tripartite relationship. They are the three major players in the development process. Two types of relationship are in here, primary and secondary relationship. Primary relation is focus here on the academy involvement and the beneficiary individual/group. And later, secondary relation is the interaction among the three bodies.

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CSR:

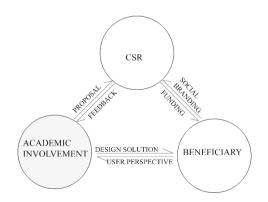
- As a part of the corporate responsibility, the body fulfils its duty of social responsibility by involving itself in the academy given proposal.
- The constant feedback from the progress of the academy project in social arena will make the project more sustainable.
- CSR gives the necessary funds to the development of the project.

ACADEMY INVOLVEMENT:

- The most important role is to gather the correct information from a suitable area, design a project which will enhance the development.
- The academy design project will create knowledge generation and will give a proper solution.
- Plays a secondary role as a regulator and facilitator for the development of this academy project. Constant feedback
- The constant feedback through academy involvement will guide the project towards a successful completion.

BENEFICIARY INDIVIDUAL/GROUP:

- This group will be benefited from the both other parties. But the main focus on the project they will initialize will involve in social sustainability
- To the academy involvement, they will give the proper information and guidelines from a user perspective which give the academy a greater chance to design a sustainable project.
- TO the CSR, this group will give them a position if proper social involvement with the chance from promote themselves.



4. Methodology

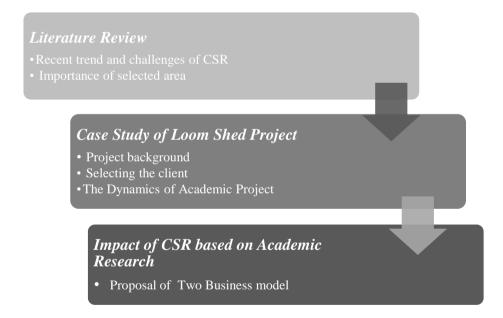
At first it is very important to know about the current scenario of CSR Fund allocation and experts view about it. Through literature survey this study is done. The selected area of the loom shed area is also important. The area should be selected keeping in mind, this example can be replicated.

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Also the area to be a standard selection due to its socio-economic/ cultural values. That's why an overview of the selected region is also presented.

The project is done as a part of academic project, that's why the background is very important. Though the selection of the client was random, but the interaction between course teacher and the client is very important to have a space of respect and responsibility. The success of this class work is also dependent on this initial interaction. The dynamics of studio activity is presented here to show that the process is standard enough to be counted as a research work with intellectual depth and the company interested to fund will have confidence on this nature of dynamic education system.

At last the class work looked for a tripartite relation between The Company, the Educational body and the beneficiary. Two possible business model is discussed that make the concept more concrete.



5. Literature review

5.1. RECENT TREND AND CHALLENGES OF CSR

The banking sector plays important role in practicing CSR in the country. Besides improving their own standards they are taking social actions of other businesses. Banks are now increasingly engaged in social and financial inclusion of underprivileged people. Other than the bank many companies also contribute in CSR. In recent years there has been strong emphasis on gender equality, environment, governance, ethics and much more.

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According to Moazzem Hossain (2013) presented in CSR review 2013, As companies or businesses undertake CSR activities keeping a particular eye on sustainability, it becomes all the more important to integrate responsible business practices into their core operations... Developing inclusive business models in which communities are integrated and their needs are accommodated in the CSR programs/ projects into the supply chain as suppliers, distributors or consumers or stakeholders has therefore, assumed a great deal of significance in order to create sustainable opportunities.

				ii	n million taka	
Sectors	2008	2009	2010	2011	2012	
Humanitarian & disaster relief	58.60	125.10	460.41	188.03	788.37	
Education	30.50	94.80	400.79	612.48	983.69	
Health	112.10	245.50	689.07	520.42	435.43	
Sports	49.80	1.20	265.23	359.07	183.85	
Art & culture	0.80	0.30	328.91	171.52	213.31	
Environment	-	-	59.78	138.07	140.23	
Others	158.90	86.90	125.58	198.73	301.81	
Total	410.70	553.80	2329.80	2188.33	3046.69	

Table 1: CSR	fund	distribution	in	sectors	by	Bank
					- ,	

5.2. NARSHINGDI- WEAVING POCKET OF BANGLADESH

Narsingdi, an area North West of Dhaka is one of the main weaving pockets for the industrial weaving production. They produce grey fabric, (plain cotton) which is then dyed and processed for the ready-made garment industry. Narsingdi is also known for its handloom weaving, normally done on a 2 shaft or dobby loom operated with a fly shuttle.

The district especially Sadar and Raipura upazila are famous for producing different artistic sarees such as Jamdani, Katan and Bruket. Different lungi, saree, bed sheet, napkin, towel and mosquito nets are also produced here.

Weavers in Narsingdi are facing hurdles to maintain their families and the handloom industries are on the verge of closure due to high prices of raw materials including. The gradual decreases of demands of their products and lack of running capital have threatened the profession and livelihood of the people depended on the industry. Many weavers are going through hardships to

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maintain their families and trying to leave their ancestral profession because of low income.



Figure 1, Present condition of loom shed building and worker

The handloom industry in Bangladesh is having a glorious past, questionable present and confusing future. This is the time to consider the Handloom sector as an integrated industry rather than small segregated cottages. They cannot sustain any more without such kind of incentives. Authorities should try to take financial and marketing supports from the global sustainability projects and effects. An integral project can earn money from carbon trading as well.

6. Description of Academic project of DIU at Narshingdi, Dhaka, Bangladesh

6.1. PROJECT BRIEF

The sessional course in Architecture department is called-Design studio, where a student has his own drafting table and locker. The project was given to the students of L/T-2/2 as a part of their sessional course Arch-204 Design Studio IV in 2016. This is a 6 credit course, that means students have to spend at least 6X2=12 hour class/weekly. In each studio courses, they practice diversified project. They design, make drawings and model, go through several assessments. Then they have to present their final design in front of internal and external juror in an open public jury session to get open feedback.

In the face of ecological exacerbation, architects should be sensitive about their design to be more vernacular. The buildings should not only be adorned with aesthetic qualities but also be contextual and sustainable. Traditional materialuse and techniques are developed for many years of trial and error process in local context and environment. This process is constantly and slowly evolving and progressing. There is always an opportunity that we can learn from the past and can advance it to the future. Contemporary use of these techniques can create an architecture which would be sensitive towards these processes. For architects to have deep understanding of their own environment and local

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context is a must. These learning can show him/her how to be responsive to their own context and progress it reflecting the traditions.

6.2. PROJECT BACKGROUND

The site was in the village-Tulatoli, in Raipura Upazila, Narshingdi district. The client was Jamal Kazi who owns a loom shed of 12 workers.

In this specific course, following the curriculum we wanted to do something that helps to practice sustainability as well as introduce with real situation. So we gave them real client who has a plan to expand his loom shade in a real site

6.3. METHODS

6.3.1 Meeting with client

The client is selected by analyzing data of that area found from national level data. Narayanganj, Narshingdi has rich tradition of weaving. The average income of a handloom factory owner is analyzed. The client was selected randomly from average income group of Narshingdi. At first the client was approached personally by studio teachers. They met Jamal Kazi and came to know about his future plan of extending the loom shed for more 12 workers. Since many are leaving this profession he struggled a lot to survive. He was given the idea of designing the loom shed by the university students guided by the teachers. He was very happy to have this kind of proposal.

So, students met the owner in Narshingdi later and talked with him about his requirements that are expressed through figures. Main three requirements were: Low maintenance, low cost, easily buildable. Students found out the space provided for the workers is not sufficient, daylight level in the central area is poor etc. Students also visited the site, took measurements and studied the context. They also went to nearby material store to know about the cost. Since the client had a fixed budget of 1,00,000 BDT for the extension, they needed to be very careful about material use. Client got the idea of costing as he previously built one.

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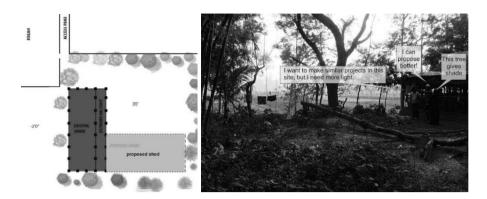


Figure 2, Site plan

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Figure 3, Site and context analysis



Figure 4, Loom shed visit and discussion about process of weaving

Students also had to know about the industrial process of making cloth as it is directly related to space dimension. They also talked to the worker about their problems and requirements. The surrounding trees, built structure also give important information for design.



Figure 5, Existing building analysis

Figure 6, Meeting with owner/client

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6.3.2 Working in Design studio

Students came back to their studio and searched for options that will meet clients 3 requirements as well as will ensure a better environment for the worker, which were very much neglected in the existing building. Due to cost limitation they tried to use the same material, but in a different way that will be functional and aesthetically good. They were also asked to consider the climatic aspects too. Teachers guided them during this two weeks and a prototype model and drawing was made.



Fig 7: Student work (model+ drawing)

6.3.3 Presenting design to Client

Students then again went to Narshingdi and shared their design with the client and presented their models and drawings. Jamal Kazi didn't expect that students will be back with design. He appreciated the idea. But these designs cost around 150,000 BDT, which exceed his budget. Though he is worried about the extra cost, he seemed happy to see some options that fits his requirements and designed for him at free of cost. Due to this 50,000 BDT gap, he couldn't implement the total design.



Fig 8: Student presenting his designed building model and drawing

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7. CSR and academic study

From the case study, we have found that a loom shade project couldn't be fully operational because of a little funding deficit. This funding might not be an issue to the corporate business holders which they can spare as their CSR activity to develop the situation of a loom shade. If we evaluate the in the aspect of loom shade case study, any corporate house can accommodate a amount of 50,000 taka to build a particular shade. And if this can be done for one village, one corporation can support approximately 10-15 loom shades being built.

For this purpose, we propose a framework for CSR activities being conducted or evaluated as a better choice based on an academic research done by academicians or an existing research proposed by academicians. As academic studies such as architecture projects have a highly practical function and the students conduct field study to find a real-time solution these projects can be an impactful place of CSR to invest.

8. Dynamics of academic assignments

The case study that has been discussed here - the loom shade project, it is the family business of the locality. Almost 50 families still do the hand loom business. Each loom has the ability to make a profit of average 40,000-50,000 taka per month. Return on investment is approximately 30%. One loom can employ 10 people with a wage of 4,000-5,000 taka. If the owner wishes to expand the loom it takes approximately 150,000 taka.

If one loom shade is built, it generates i) 40,000 taka profit ii) employs 5 people iii) generates a enough return on investment to build another shade in 10 months. Upon these impacts it has the ability to contribute .2% to GDP and overall in the economy. This is the estimate of one loom shade and one owner. If this can be done for all 50 hand loom business in the area, then the outcome would multiply to 50 times. On the other hand, the cultural heritage would also be restored to its former position.

Academicians as they move to places to accommodate better learning experience for the students. They can be a great source of CSR project as accumulators and consult the corporations for better CSR investment in future which in terms helps the whole economy and the corporation as well to promote the CSR as an impactful activity.

9. Impact of CSR based on academic research:

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From the introduction of CSR activities in Bangladesh, corporations were encouraged to invest in the activities in which social aspects can be developed and benefited. But nowadays, CSR activities have become more of a marketing stunt and even sometimes the investment has no direct impact to the social cause whatsoever. It is high time; the concern bodies should focus on the impact and the outcome of the CSR activities. If measured and collected enough information on the investable social cause, these monetary assistances can be a strong tool to build a better or improved socio-economic scenario for our country. As a solution to this uprising issue, we propose two models by which education and CSR can be involved in developing a strong economy.

As per our discussion above, (Fig. 9) when an architect academician will be preparing academic projects, he will be conducting a practical assessment throughout the project and create a research paper on the project. The assessment of the projects will be detailed enough and by guidance of the academicians the architect students will create a thorough report. These reports will be accumulated and made a research paper by academicians afterwards. Then the corporations who are looking for CSR investment opportunities will call upon the academicians and their research papers on the case studies. With more analysis or field visits the projects then can be assessed to be used as an impactful CSR investment.

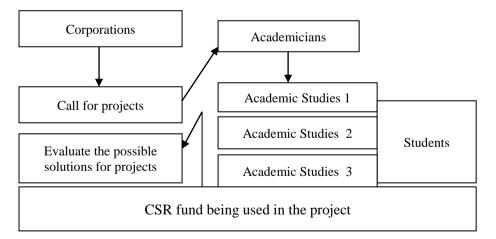


Fig 9: Proposed CSR project selection model 1

Another model is (Fig. 10) just the opposite to the previous one, the academicians while going for academic projects after the assessment of the resources needed to land the projects will look for funds. These funds can be CSR funds from the corporations. The academicians should have the access to

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the corporations to pitch the project idea where the corporations can invest. It will be depending on the academicians to evaluate the scope of the projects that the corporations can be also interested to invest and assess the outcome of the investment. Further research can also be conducted based on the understanding between two parties.

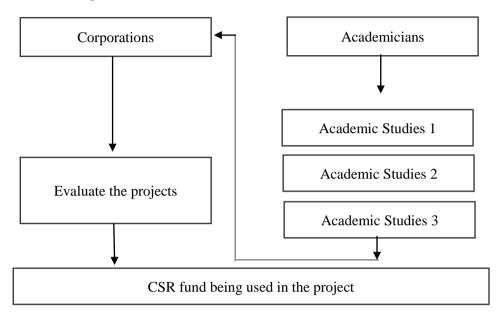


Fig 10. Proposed CSR project selection model 2

Based on the case study presented in this paper, the later model (Fig. 10) can be implemented. As the academicians has found that there is a large amount of hand loom shed, worker can be benefitted and community can be developed with the CSR fund being used here. This case study can be presented to the corporations with proper assessment.

10. Conclusion

Though the study is based on a particular businessman's situation. It is quite evident that the situation is quite common for the hand loom community. Even the corporations can also send a team to evaluate the aspect of the investment. But in this way, the students would be more inclined to do a thorough report and the projects being funded can also accommodate more clinical large projects. This particular framework for working together with the corporations can benefit all three parties' academicians, students and the unprivileged community. On one hand the corporations will not have to worry about the positive impact of the CSR investment and other the education system will be

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able to accommodate more strong studies and projects which in future will develop the whole economy on a geometric rate of development progression.

Acknowledgement: L/T-2/2, course code: Arch-204 Design Studio IV in 2016, DoA, DIU.

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A DIVERSITY OF THERMAL COMFORT LEVELS AND BEHAVIORAL ADAPTATIONS OF OCCUPANTS IN NATURALLY VENTILATED HOUSES IN DIFFERENT CLIMATIC ZONES OF SRI LANKA

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Abstract

The study highlights a scenario in respect to a range of neutral temperatures specific to naturally ventilated residential buildings in climatic zones of Sri Lanka and occupants' behavioural adaptations such as clothing, window opening and use of mechanical ventilation. A field study was conducted during April – May in three different climatic zones of Sri Lanka. A total number of 90 data sets were obtained from all zones. Transverse type questionnaires were used to collect the sensations and preferences of subjects on ASHRAE seven- point and five-point scales related to temperature, relative humidity and air velocity. Griffith's method was used to determine the neutral temperature. Griffith's comfort temperature for all zones was found as 27.23 °C. Controlling air velocity was found more preferable as a thermal adaptive opportunity over adjusting clothing and opening windows and doors.

Keywords: Behavioural adaptation; thermal sensations and preferences; comfort temperature; adaptive controls.

1. Introduction

Literature suggests that architectural designs with passive climate control strategies have great potential to modify indoor environments and thus reduce the energy consumption. The relationship between energy consumption and achieving comfort has become a main issue for the Sri Lanka as well. The electricity demand of the country is increasing 8% by annum (Attalage & Wijetunge 1997). The domestic sector uses 40% of the electricity generation, from which most of it used by houses (CBSL 1999). This energy is generally used for the operation of fans and various other appliances, and lighting.

Sri Lanka is located in tropical region, between latitudes 5°55' and 9°51' and longitudes 79°43' and 82°53'E. It comprises three climatic zones, namely wet zone, the dry zone and the hill country (Attalage & Wijetunge 1997). They have differences in temperature and humidity levels. But the distinct seasonal changes are not evident.

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In a naturally ventilated building, occupants use several adaptive opportunities and controls such as operable windows, doors, blinds, curtains and to make themselves comfortable in the changing thermal environment. Uses of these adaptive controls are also affected by climatic variations in indoor conditions (Kumar 2016).

The study was intended to find out the range of neutral temperature specific to naturally ventilated buildings in climatic zones of Sri Lanka and occupants' behavioral adaptations in the context of control strategies such as adjusting clothing, window opening and use of mechanical ventilation.

2. Methodology

2.1. DESCRIPTION OF FIELD STUDY

The field study was conducted during April – May in three different climatic zones of Sri Lanka namely wet zone, dry zone and hill country. April – May is one of the hottest time periods in Sri Lanka hence it gives the worst-case scenario in terms of indoor climate is concerned. In wet zone,dry zone and hill country, Rathnapura Anuradhapura and Diyathalawa were selected respectively. Table 1 shows the maximum and minimum temperatures, relative humidity, latitude and longitude, and altitude above sea level in each of the selected areas.

Parameter	Zone						
	Wet zone	Dry Zone	Hill country				
	Rathnapura (29-30.05.2017)	Anuradhapura (03.05.2017)	Diyathalawa (05.05.2017)				
Average Maximum Temperature (°C)	34 - 35	31 - 35	27 - 28				
Average Minimum Temperature (°C)	23 - 24	23 - 25	17 - 18				
Average Relative Humidity (%)	80 - 88	73 – 76	58 - 85				
Latitude – Longitude	6° 41' N - 80° 24' E	8° 20' N - 80° 25' E	6° 50' N - 80° 59' E				
Altitude above sea level (m)	86	89	1225				

Table 1: Details of Environmental and geographical parameters in the selected areas in each zone

Data Source: https://www.weatheronline.co.uk

2.2 BUILDING SELECTION AND DATA COLLECTION

In each zone, houses in residential streets were selected which have the North – South orientation in the long axis (houses with North – South orientation has the largest amount of wall surface area which are exposed to East and West hence gives the harshest indoor environmental conditions) to prevent the orientation factor from affecting the indoor thermal environment. In the selected houses, walls were constructed of brick with 0.25m thickness and the roofs were asbestos sheets. Windows were mainly single, clear glass panes of 4 - 6mm in thickness. All the surveyed houses were naturally ventilated which provide opportunities for occupants to use adaptive controls.

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Transverse type questionnaires were used to collect data. Section A of the questionnaire consisted of sensation and preference votes of air temperature, relative humidity and lighting level on ASHRAE seven-point sensation and five-point preference scales. Section B questioned the environmental parameters, surrounding conditions of the study subjects such as the condition of doors and windows (weather open or closed), usage of fans, window types, trees, sky condition...etc.

A brief introduction on research and its purpose was given to subjects to minimize the chance of human errors. Functioning conditions of the building and occupants weren't modified during the survey. The occupants participated in the survey were not informed earlier to get a genuine dataset.

2.3 SAMPLE SIZE AND DESCRIPTION

Subjects surveyed were Sri Lankans who were well acclimatized to the according climate for more than one year and aged between 18-70. Each subject was surveyed after he/she was settled in the surveying environment for more than 20 minutes. Details of subjects were summarized in Table 2 with the information of sample size, age, weight, clothing insulation and metabolic rates.

Variables	Zones	8						
	Wet zone		Dry zone		Hill country		All zones	
	М	SD	М	SD	М	SD	М	SD
Age (years)	41	15.28	39.1	15.6	47.8	15.6	42.75	15.79
Weight (kg)	65.6	12.7	63.7	12.7	61.5	9.8	63.6	11.8
I _{cl.tot} (clo)	0.35	0.16	0.33	0.15	0.48	0.37	0.39	0.25
Activity (Met)	1.62	0.81	1.46	0.76	1.52	0.73	1.53	0.76

Table 2: Summary of subjects' details

M: mean value; SD: standard deviation; Icl.tot: Clothing insulation value; Met: Metabolic rate

In each zone, 30 subjects were surveyed and a total number of 90 fully completed surveys were taken across all zones. Clothing insulation values were taken from E.A. McCullough's "A Comprehensive Data Base for Estimating Clothing Insulation". Clothing values for 'sari' and 'sarong' which are not available in the above-mentioned document, were taken from studies done in India (Indraganti et al 2016). Metabolic rates were taken from standard checklists provided in ASHRAE 55.

2.4 MEASUREMENT OF INDOOR AND OUTDOOR ENVIRONMENTS

Measurements of environmental variables such as outdoor temperature, indoor temperature, wall surface temperature, relative humidity, air velocity and light intensity were recorded using high-accuracy instruments. Details of the instruments used for the study were given in the Table 3.

No.	Parameter	Instrument	Make	Range	Accuracy
1	Outdoor temp.	HOBO UX100-003	Onset	-20° to 70°C	±0.21°C from 0° to 50°C
2	Indoor air temp.	HOBO UX100-003	Onset	-20° to 70°C	±0.21°C from 0° to 50°C
3	Indoor surface temp.	HOBO UX100-014M Thermocouple	Onset	-20° to 70°C	±0.21°C from 0° to 50°C
4	Relative Humidity	HOBO UX100-003	Onset	-20° to 70°C	±0.21°C from 0° to 50°C
5	Air Velocity	VelociCalc Model 9565-P	TSI Inc.	1.27 to 78.7 m/s	±1.5% at 10.16 m/s
6	Lighting Level	HOBO U12- U12	Onset	1 to 3000 (lumens/ft2)	± 2.5%

Table 3: Details of instruments used in the field study

Data source: Equipment used for investigation

Measurements were taken 1.1m above the ground level (Class-II protocol of ASHRAE Inc. 2013). Environment parameters, personal parameters and environment controls in subject's surroundings were recorded at the same time and placed when the subjects were doing the questionnaire.

The operative temperature was calculated by using the following formula;

 $(T_1 + T_2 + T_3) / 3 =$ Mean Radiant Temperature (MRT) (1) (*T*₁: Surface temperature of the floor; *T*₂: Surface temperature of a nearby wall; *T*₃: Surface temperature of the roof)

(MRT + Indoor air temperature) / 2 = Indoor Operative Temperature (T_{op}) (2) (Source: Szokolay (1997))

3. Results and Discussion

3.1 ASSESSMENT OF HYDRO-THERMAL PARAMETERS OBSERVED

During April – May in three different climatic zones of Sri Lanka, the maximum and minimum outdoor temperatures (T_{out}) recorded were 37.59 °C and 20.48 °C respectively. The operative temperature varied between 19.91 °C and 35.90 °C while the relative humidity recorded between 45.31% and 90.42% across all zones. The maximum and minimum air velocities recorded were 1.15 ms⁻¹and 0.01ms⁻¹ respectively. Table 4 shows the statistical analysis of indoor and outdoor environment parameters observed during the field study.

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Parameters	Zones								
	Wet zone		Dry zone		Hill coun	try	All zones	5	
	Μ	SD	Μ	SD	М	SD	Μ	SD	
T₀ (°C)	33.97	1.54	32.96	2.15	25.87	3.04	30.93	4.29	
T _a (°C)	33.79	1.6	33.05	1.64	25.46	3.09	30.76	4.38	
MRT (°C)	31.66	1.19	31.58	1.72	25.14	3.74	29.46	3.93	
T _{op} (°C)	32.72	1.29	32.31	1.6	25.3	2.99	30.11	4.0	
R.H. (%)	56.52	6.42	59.71	6.95	68.88	10.45	61.7	9.62	
V _a (m/s)	0.16	0.15	0.24	0.23	0.12	0.06	0.17	0.17	
L _a (Lux)	37.58	28.91	32.33	24.3	57.03	48.8	42.31	35.95	

Table 4: Statistical analysis of indoor and outdoor parameters observed

 $T_{o}: Outdoor \ temperature (^{\circ}C); \ T_{a}: \ Indoor \ air \ temperature (^{\circ}C); \ MRT: \ Mean \ Radiant \ Temperature (^{\circ}C); \ T_{op}: \ Indoor \ operative \ temperature (^{\circ}C); \ R.H.: \ Relative \ Humidity \ (\%); \ V_{a}: \ Indoor \ air \ velocity \ (m/s); \ L_{a}: \ Lighting \ level \ (Lux); \ M: \ Mean \ value \ ; \ SD: \ Standard \ deviation$

The buildings observed in the study had experienced relatively high operative temperatures in wet zone (mean T_{op} = 32.72 °C, SD = 1.29) and dry zone (mean T_{op} = 32.31 °C, SD = 1.6), but rather lower temperatures in hill country (mean T_{op} = 25.3 °C, SD = 2.99). Since the temperatures in wet zone and dry zone were high, occupants in those zones were more responsive to adaptive controls. There was less variation in the relative humidity and mean air velocities in climatic zones.

3.2 EVALUATION OF SENSATIONS AND PREFERENCES

Sensations and preferences of occupants were accessed by using questions "How do you feel right now?" and "How would you prefer to feel?" on the basis of temperature, humidity and air velocity (Table 5).

Variables	Zones							
	Wet zon	e	Dry zone	y zone Hill country			All zones	
	М	SD	М	SD	Μ	SD	М	SD
TSV	+2.13	0.97	+1.43	0.73	0.00	0.45	+1.19	1.16
TPV	-1.53	0.51	-1.13	0.35	-0.30	0.53	-0.99	0.69
HSV	+0.8	1.92	+1.57	0.97	+0.23	0.43	+0.87	1.37
HPV	-0.67	1.24	-0.87	0.82	+0.1	0.84	-0.48	1.06
ASV	-0.97	1.87	-0.33	1.56	+0.27	0.91	-0.34	1.57
APV	+1.3	0.79	+1.23	0.43	+0.53	0.73	+1.02	0.75

Table 5: Statistical analysis of sensation and preference votes across zones

TSV: Thermal Sensation Vote; HSV: Humidity Sensation Vote; ASV: Air velocity Sensation Vote; TPV: Temperature Sensation Vote; HPV: Humidity Preference Vote; APV: Air velocity Preference Vote; M: Mean value; SD: Standard deviation

3.2.1 Sensations and preferences for temperature (TSV & TPV)

From the thermal comfort questionnaire survey, thermal sensation of the building occupants was obtained by using the question "On the basis of Temperature, how do

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you feel right now?". Across all zones, the thermal sensation value (TSV) varied between slightly cool (TSV = -1) to Hot (TSV = +3). About 33%, 63% and 100% of the subjects' sensation votes on temperature were found to be in the comfort band (within \pm sensations) in wet zone, dry zone and hill country respectively. Overall, 65% of the subjects were within the comfort band. But there was only one subject from each wet and dry zone whom TSV = 0 (neutral). Figure 1 shows the cross tabulated summary of thermal sensation and preference votes.

It can be observed that all the sensation votes which are either slightly warm, warm or hot, prefer either a bit cooler or much cooler indoor thermal conditions. So, cooler indoor conditions were preferred across all zones in Sri Lanka.

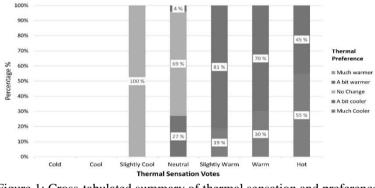


Figure 1: Cross-tabulated summary of thermal sensation and preference votes in all zones combined

3.2.2 Sensations and preferences for humidity (HSV & HPV)

Sensation votes on humidity were obtained by using the question "On the basis of Humidity, how do you feel right now?". Across all zones, the humidity sensation value (HSV) varied between very dry (HSV = -3) to very humid (HSV = +3). About 30%, 50% and 100% of the subjects' sensation votes on humidity were found to be in the comfort band (within \pm sensations) in wet zone, dry zone and hill country respectively. Overall, 60% of the subjects were within the comfort band.

From the Figure 2, it can be observed that about 48% of the subjects accepted the prevailing humidity conditions and preferred no change. Similarly, 24% and 33% of the subjects preferred no change in the prevailing humidity conditions even though they voted the sensation as slightly humid and moderately dry respectively. Overall, 24% of the occupants preferred slightly humid conditions rather than neutral or dry.

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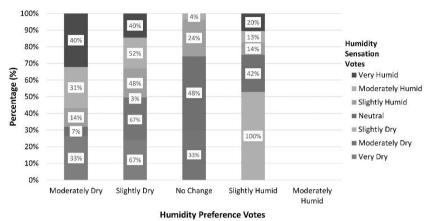


Figure 2: Cross-tabulated summary of humidity sensation and preference votes in all zones combined

3.2.3 Sensations and preferences for air velocity (ASV & APV)

Sensation votes on air velocity were obtained by using the question "On the basis of Air velocity, how do you feel right now?". Across all zones, the air velocity sensation value (ASV) varied between very still (ASV = -3) to moderately moving (ASV = +2). About 43%, 76% and 100% of the subjects' sensation votes on air velocity were found to be in the comfort band (within \pm sensations) in wet zone, dry zone and hill country respectively. Overall, 73% of the subjects were within the comfort band and slightly moving or moderately moving air velocity preference dominated in all zones. However, during the field study, the mean air velocities in prevailing indoor conditions remained very low (wet zone – mean $V_a = 0.16$ m/s, dry zone - mean $V_a = 0.24$ m/s, hill country - mean $V_a = 0.12$ m/s). As the outdoor temperature got warmer, a slight increase of air velocity could be observed, but still the values were very much lower than the preferred. This may be due to the fact that, 75% of the subjects kept windows closed when the survey was administered.

3.3 COMFORT TEMPERATURE

The comfort temperature was found out in two ways by using thermal sensation votes and indoor operative temperatures. Those are linear regression method and Griffith's methods.

3.3.1 Linear regression method

Linear regression between thermal sensation votes of subjects' and corresponding operative temperatures has been found out collectively for all zones and separately for each of the three zones.

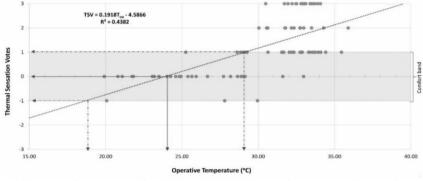


Figure 3: Linear regression between thermal sensation votes and operative temperature collectively for all zones

Collectively for the whole data set, the neutral temperature has been found out as **24.1** °C as shown in the above figure (i.e. corresponding to the 0 thermal sensation vote). The comfort band which is corresponding to the -1 to +1 of TSV was found as **18.8** °C – **29.1** °C.

Regression model collectively for all zones - TSV = $0.19T_{op} - 4.58$ (3) (TSV: Thermal Sensation Vote; T_{op} : Operative temperature)

Equation (3) shows a 0.19 °C⁻¹ slope which indicates that every 5.3 °C change in the operative temperature, thermal sensation vote would have a unit change. Since the slope is rather low, the comfort band is relatively big. Which indicates higher adaptation of subjects to the indoor environmental conditions. Neutral temperature or a comfort band could not be acquired from the linear regression analysis for wet and dry zones as the regression lines were well above the comfort band. That indicates the fact that indoor thermal conditions in wet zone and dry zone were **over-heated**. However, in the hill country, a neutral temperature of 25 °C could be found out. Since the 80% of the subjects voted thermal sensation vote as neutral, it could be observed that large range of operative temperature was comfortable for the subjects in the hill country which means they were more respondent for the adaptations.

3.3.2 Griffith's comfort temperature

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From the studies done in similar areas over the years pointed out that the linear regression method cannot be applied for naturally ventilated buildings where there are opportunities for adaptive behavior. So, the comfort temperature was calculated again collectively for all zones and separately for each zone by using the following equation.

$$\mathbf{T}_{c} = \mathbf{T}_{op} + (\mathbf{0} - \mathbf{T}\mathbf{S}\mathbf{V}) / \mathbf{G}$$
(4)

(T_c: Griffith's comfort temperature; T_{op}: Operative temperature; TSV: Thermal Sensation Vote; G: Griffith constant $(0.5 \circ C^{-1})$

For the above equation, 0.5 was used as the Griffith's constant since it has the least standard deviation. The Griffith's comfort temperatures found in this study are listed in Table 6. The Griffith's comfort temperature for all zones was found as 27.23 °C and it was used as the Griffith's comfort temperature for further analysis in this study.

Mode	GC (°C ⁻¹)	T_c (°C) (for operative air temperature)				
		N	Mean	SD		
Naturally ventilated	0.25	90	25.36	3.6		
mode	0.33	90	26.51	3.12		
	0.5	90	27.73	3.02		
	Voting Neutral	26	25.48	3.32		

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GC: Griffith constant (C⁻¹); T_c: Griffith's comfort temperature; N: Sample size; SD: Standard deviation

3.3.3 Comparison of comfort temperatures

Table 7: Linear regression neutral temperature, Griffith's comfort temperature and mean indoor operative temperature when voting neutral across zones

		1	1		U		
Zone	Ν	Regression Model	R ²	T _n (°C)	Mean T _{op} (°C)	Nn	Mean T _c (°C) (GC = 0.5 °C ⁻¹)
All Zones	90	TSV = 0.1918T _{op} - 4.5866	0.4382	24.1	25.48	26	27.73
Wet Zone	30	TSV = 0.0718T _{op} - 0.2171	0.0091	-	32.97	1	28.46
Dry Zone	30	$TSV = 0.0415T_{op} + 0.0936$	0.0083	-	31.61	1	29.45
Hill Country	30	$TSV = 0.0205T_{op} - 0.5183$	0.0181	25	24.92	24	25.30

N: Sample size; TSV: Thermal Sensation Vote; Top: Indoor operative temperature; R: Regression coefficient; T_n : Regression neutral temperature; N_n : Sample size voting neutral on thermal sensation scale; T_c : Griffith's comfort temperature; GC: Griffith constant (C -1)

Regression neutral temperature, mean indoor operative temperature when voting neutral and Griffith's comfort temperature showed a closer agreement in the hill country as shown in Table 7. But in the other zones and collectively for all zones, that agreement was not visible due to the less no of subjects have voted neutral on the sensation scale (wet zone -1 subject, dry zone -1 subject).

2.1.1. Comfort temperature: Zonal variations

The mean Griffith's comfort temperature for wet zone, dry zone and hill country was found as 28.46 °C, 29.45 °C and 25.3 °C respectively (Table 7).

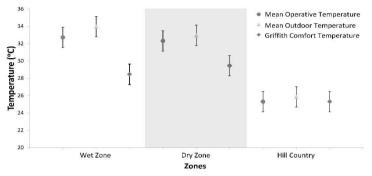


Figure 4: Zonal variation of comfort temperature in naturally ventilated buildings across zones in Sri Lanka

As the mean outdoor temperature and mean operative temperature decreased from wet zone to hill country, Griffith's comfort temperature also decreased. (Figure 4). Highest zonal variation of mean comfort temperature can be found as 4.15 °C between dry zone and hill country.

2.2. ANALYSIS OF OCCUPANTS' BEHAVIORAL ADAPTATIONS

In this study, behavioral adaptations of occupants have been analyzed via changing clothing level, opening of windows and doors and use of fans.

2.2.1. Adaptation through clothing

Figure 5 shows that when operative temperature rises, clothing value tend to gets low. The mean clothing value collectively for all zones was found 0.39 clo (SD = 0.25). The mean values of clothing insulation for different zones were found 0.35 clo (SD = 0.16) for wet zone, 0.33 clo (SD = 0.15) for dry zone and 0.48 clo (SD = 0.37) for hill country (Table 2). The mean value of clothing insulation in hill country was higher than that of wet zone and dry zone. It suggested that changing clothing was one of the major behavioral adaptations done by occupants to make themselves comfortable (proportion of changing clothing is 0.72 for all zones). Although the indoor conditions were acceptable in hill country, people tend to wear additional cloths like sweaters and t-shirts all the time. Another reason for the slightly lower mean clothing values in wet zone and dry zone was 44% of the male subjects surveyed did not wear an upper wear

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while the questionnaire was administered. The mean value of the clothing was found a bit higher for male occupants than female in all zones.

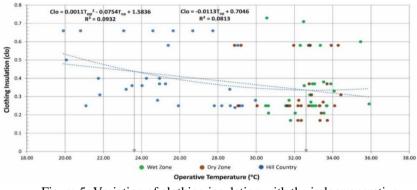


Figure 5: Variation of clothing insulation with the indoor operative temperature in zones

2.2.2. Use of controls: windows, external door and fans

In the questionnaire, the adaptive behavior of occupants for use of controls such as opening windows, external door and use of fan was recorded as binary data (i.e. - 1: open/in use; 0: close/ not in use). From the surveyed data, mean proportion of windows and external doors open to the external environment and the use of fan were calculated both as collectively for all zones and separately for each zone.

The mean proportion of windows and doors open was found out to be 0.6 and 0.93 in wet zone respectively and 0.83 and 0.96 in dry zone respectively. But in hill country, those were lower (0.4 and 0.56 respectively). That means even though the outdoor environmental conditions were harsh in wet and dry zones, people preferred to open windows and doors more than the hill country. However, the proportion of windows open when the questionnaire was administered was a bit lower than the preference of occupants (0.23 in wet zone and 0.46 in dry zone). This was due to the facts of safety, dust, pollution and prevent the heat from coming inside.

2.2.2.1. Window and door opening behaviour in relation to operative temperature

For the analysis of window and door opening behavior in respect to operative temperature, all the data were divided into 10 groups called deciles (ranked and aggregated group of data as done in Kumar (2016) in an ascending order of operative temperature as presented in Table 8.

 Table 8: Deciles of operative temperature with respect to proportion of windows and doors open and use of fans

Decile	N	Top (°C)				Pw		Pd		Pf	
		Max	Min	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	9	23.50	19.91	21.69	1.26	0.22	0.42	0.44	0.50	0.00	0.00
2	10	25.93	24.02	24.98	0.57	0.30	0.46	0.40	0.49	0.00	0.00
3	10	29.04	26.68	28.35	0.72	0.60	0.49	0.80	0.40	0.10	0.30
4	9	30.63	29.06	29.82	0.62	1.00	0.00	1.00	0.00	0.44	0.50
5	9	31.95	30.64	31.59	0.35	0.78	0.42	1.00	0.00	0.89	0.31
6	9	32.51	32.04	32.29	0.14	0.67	0.47	1.00	0.00	0.67	0.47
7	9	32.89	32.74	32.81	0.05	0.56	0.50	0.78	0.42	0.89	0.31
8	8	33.33	32.94	33.12	0.16	0.50	0.50	1.00	0.00	0.50	0.50
9	9	33.71	33.35	33.56	0.13	0.78	0.42	1.00	0.00	0.89	0.31
10	8	35.90	33.90	34.51	0.70	0.75	0.43	0.88	0.33	0.50	0.50

N: Sample size of the decile; T_{op} : Operative temperature; P_w : Proportion of windows open; P_d : Proportion of doors open; P_f : Proportion of fan in use; SD: Standard deviation.

From the Figure 6, it can be observed that the proportion of windows open rises as the indoor operative temperature increases until the fourth decile (corresponding mean $T_{op} = 29.82 \text{ °C}$) and then there is a slight decrease until the 8th decile (mean $T_{op} = 33.12 \text{ °C}$). This may be due to the harsh environmental conditions outside so occupants preferred to prevent the heat from coming inside.

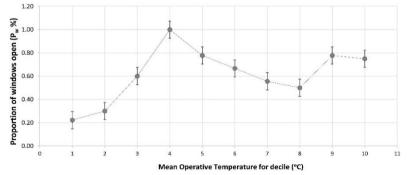


Figure 6: Proportion of windows open with the mean decile operative temperature

Similar kind of increase until the 4th decile could be seen between the proportion of doors open and operative temperature (Figure 7). But until then, P_d remains almost the same (mean $P_d \approx 1$). That means occupants preferred door as an adaptive opportunity at higher temperatures than windows.

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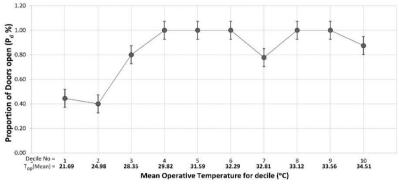


Figure 7: Proportion of doors open with the mean decile operative temperature

Subjects in this study were found to have a 2.62 °C higher comfort temperature (Tc) under both 'windows and doors open' than they were close (28.23 °C against 30.85 °C).

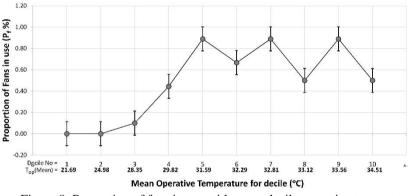


Figure 8: Proportion of fans in use with mean decile operative temperature

2.2.2.2. Use of fans in relation to operative temperature

The above figure shows the relation between the proportion of the use of fans and indoor operative temperature. The proportion of 'fans in use' reached a maximum of 89% when the indoor operative temperature reached 31.59 °C. The mean proportion of fans in use was found out to be 0.73 and 0.66 in wet zone and dry zone respectively. But in hill country, that was very much low (mean $P_f = 0.03$). That was due to the comfortable indoor environmental conditions in the hill country.

Subjects in this study were found to have a 1.04 °C higher comfort temperature (T_c) under 'fan on' than when 'fan of'. (28.51 °C against 27.48 °C)

Overall, 88% of the subjects collectively for wet and dry zones have used fan as an adaptive control. That was higher than the proportion of changing clothing found (i.e. 72%). That indicates that controlling air velocity was preferred as a thermal adaptive opportunity over adjusting clothing and opening windows and doors.

3. Conclusion

A total of 65% of the occupants in selected naturally ventilated in varous climatic zones in Sri Lanka were within the comfort band (within \pm sensations) at prevailing indoor conditions. Linear regression neutral temperature has been found out as 24.1 °C and the comfort band which is corresponding to the -1 to +1 of TSV was found as 18.8 °C - 29.1 °C.

Proportion of windows and doors open in wet and dry zones were higher than the hill country. That means even though the outdoor environmental conditions were harsh in wet and dry zones, people preferred to open windows and doors more than the hill country. Subjects in this study were found to have a 2.62 °C higher comfort temperature (Tc) under both 'windows and doors open' than they were close (28.23 °C against 30.85 °C). Subjects in this study were found to have a 1.04 °C higher comfort temperature (Tc) under 'fan on' than when 'fan of'. (28.51 °C against 27.48 °C). Overall, 88% of the subjects collectively for wet and dry zones used fans as an adaptive control. That was higher than the proportion of changing clothing found (i.e. 72%). That indicated that controlling air velocity was preferred as a thermal adaptive opportunity over adjusting clothing and opening windows and doors.

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CITIES ARE LOSING HERITAGE VALUES

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Abstract

The aim of the research paper is to focus on the diminishing 'heritage values' of the city which causes impact on human intellect. Whilst city is a multipart of its inherent traditional and historic manners. With the rapid pace of urbanization, cities in the South East Asia are losing its rooted cultural heritage, the consequences of this trailing; inhabitants or the city dwellers are disappearing their memories and images of their own locale. That eventually causes unfilled to belong with the time, place and memory. City has its own distinctiveness everywhere in the world. Delta-hinterland Bangladesh is no exception from them; the country is dotted with enormous ancient and historic settlements. Some are completely dilapidated by the natural and man-made disasters, some are keep hold of as the ruins and few of them are still remain as the identical historic districts. The historic districts of a city are running down by the negligence of the city authority, inattentiveness, lack of maintenance and lastly the policies statements. The paper would deeply focus on a particular historic city Rajshahi, Northern part of Bangladesh, where the historic morphology of the town has disgraced the values of heritage in a short period of time. Through the Timeline analysis this dilapidation could be seen. On the other hand, the paper would address the meaning of image of a place that communally praises the personal understanding. Finally, urbanization is the necessity, everyone should appraise this phenomenon, however on the other hand the traditional values and cultural heritage of a locality or a city remain unique and it clarifies the area's dignity and entity. It gives a good memories and understanding of own imaged territory.

Keywords: Five key words- maximum

1. Introduction & historical background

Every city got a nickname, all these nick-name eventually settled by the nature and pattern of the city. Cities have its own identity to portray her image, city's 'nick- name', for instance city of joy- Kolkata, city of love- Paris, city of Old smoke-London, city of future- Lisbon, city of seven hills- Rome etc. Nicknames are even popular than the cities original state of names, from where these ideas come from? Was it evolved, grew, experienced or originated? These two questions have distinct patterns, the pattern of grace of the city and other is the inherent values and the quality of the city. Yes, city is combined with values and entity. What actually named from the nickname; perhapsregion owns the values and entity of a city. So- values and entity is nothing but

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the traditional ethics, continuity of cultural legacy, historically rich, pattern of lifestyle, climate and precisely when a city's morphology is harmonious with the rooted-districts¹. City is an ever-changing phenomenon, it grows, get young and other part of the city fall into the twilight. We may possibly call them 'old city'. The old city captivates and propagates 'solutions' to erect a new vocabulary & concepts. The research is all about rethinking tangible and intangible continuity along the parts of the old city or old locality, which are fading away.

Urbanization is the must for a civilization. Cities in Southeast Asia are boosted up with promising economical viability. Meanwhile they are blooming up with smart & bold city concept. Eventually, this (Southeast Asia) region is dotted with enormous historic and ancient cities as well, which are unique from one another. Jaipur, Jaisalmir, Banaras in India, old town hall market area in Colombo, or Bashantapur Darbar area in Nepal are embedded with different contents, situation and settings. Even Old Delhi is familiar in this settings and situation, having said that- what is this situation and settings? Actually, city or locality generates from a certain point, the point perhaps would be river, or the any sort of junction of communication hubs. Sometime city starts evolving by religious circumstances. So above mentioned old parts of the cities are fundamentally positioned and development starts considering the old area as the protected or controlled by the city authority. Cultural Heritage of the core area disseminates insight to the younger city. In Southeast Asia, cities are bonded with two manners, one is the historic /old urban core and other is the new or extended part of the city. For European cities, could have exception, historic urban core or the old city is a bit separated or the historic city itself capable to the criteria of adaptive reuse. This two poles apart and contain distinctive differences, and obviously consequences population impact as well. The developing country like Bangladesh is limited to expand the economic involvement none other than to the basic needs, where the heritage values, preservation along with the old city maintenance is a tertiary approach to rethink as the nation, even we are distant to make it up with skills and strategic issues. Infrastructural development and neo-urbanization in country like Bangladesh is a pacing happening, where old city protection act is missing in the concern organizations as well as in the ministries. Bangladesh is having the ministry of cultural Affairs, under this ministry Department of Archaeology is a protocol organization to take care on these issues. Coordination and proper strategic plan is necessary to secure all those old localities or the towns in Bangladesh.

¹ Inherent area of a township or a city. Historically embedded

As Bangladesh is a middle power and major developing nation in the south East Asia², the time has arrive to rethink and to protect the historic territories with force full laws and empowerment. On the other hand, city contributes a lot to the inhabitants. Commitments, sensitiveness, sharing and belongingness gradually develop among the local of the city. Old city is the main stream to start a new-network. On the contrary, Local people grow to be the asset of the place through their cultural continuity, rituals and heritage values. Cities are like the twitching organism that constantly inventing, re-inventing and adjusting itself to its ever-evolving demographics³. This might be alarming while a city is losing the coherent own urban entities- it could have a defused impact on the dwellers. This capacity perhaps threat on the continuity of cultural substance as well as on the behavioral pattern of city life.

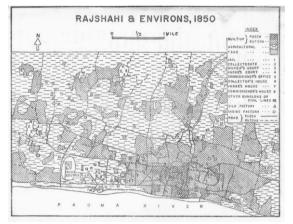


Figure 1, environs of Rajshahi during 1850 (Source: VRM)

Rajshahi city is located on the northern bank of the Padma, main river stream of Ganges. The city is enriched with long historical continuity. once the city was vividly connected by the river network as Padma is the prime river in the country, however by the course of time the importance of trade and commerce along with religious notion shifted, while the city's old settlement pattern remain around and adjunct the historic commercial area.

The educational and cultural tradition of Rajshahi is not only rich but old as well. Long before the district came under British administration, it had been, as the part of Varendri *Mandala* and Pundravardana—*bhukti*, successively ruled by

² https://en.wikipedia.org/wiki/Bangladesh

³ Mehrotra, Rahul, (2000)Making Indian Cities: Urban Design in the New Millennium, p-111,

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the Mauryas, Guptas, Palas and Senas, and subsequently by the independent sultans of Bengal and the imperial Mughals, also contact with Jain-ism, Buddhism and Aryan Hinduism in the ancient period when it absorbed much of the Aryan civilization and culture. Similarly, following the conquest of Gauda by Iktiyar-ud-Din Muhammad bin Bakhtiyar Khalji, the inhabitants of this district came in close contact with Islam and Islamic civilization and culture.

At a given point in space and time, the form of an old town expresses the forces and circumstances which shape it. In its physical sense, the form is the ordered arrangement of city elements like sectors forces. Form of an old city, typically, is a dense mass of built forms made porous by house courts, public



Figure-2, spatial, thoroughfare pattern of historic distirct of Rajshahi (Source: Google map and redone by author)

spaces and winding narrow streets. Related to topography, climate, technology and cultural pattern, these forces imbibe qualities of particularity and generality in city forms. These qualities polarize into many cities in the country, given similar contexts. And when the contexts change, the city forms also change. It is these components of context which generate 'City Form' and also the elements of a city.

If climate played an important role in the form making process of a city, it also played significant role in form making process of the house and all that is inbetween the city and the house, Structuring is the manner in which the component parts of the complex whole are arranged and interrelated to make an entity. In this case they are the elements of physical urban environment amid the entity thus structured is the city. Structuring involves the process of organizing

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these elements together with or without the possibility of their subsequent growth. It is the actual fabric of built forms, open spaces and streets resulting from human effort to resolve the natural and social forces to create a suitable and sustainable environment for habitation. Due to variations in natural and social context, different patterns of urban structuring have emerged. Community structuring also expresses evolution of form right from the beginning of a town or a city to the present day. In this process, man has created a variety of environments, both consciously and sub-consciously. He being a social animal, the final result of his efforts reflects a life style and culture of which he is a part. Role of geometry is important in the study of city forms. Yet a lot could be learnt from cities which were built on organic principles of planning. Basically, there are two types of plans which could be related to the form concepts. The 'organic plan' and the 'geometric plan'. Most of the towns of our country are based on organic principles and preparation, relatively often the drainage channels on the surface of a piece of land were covered to make streets - this generally resulted into a branching pattern of street lay-out. A kind of street hierarchy similar to a drainage hierarchy. With few predetermined elements located strategically in relation to land, the design of these cities was a process of step by step development. A kind of infill within the broad framework. This, however, does not exclude rational thinking and considerations for relative forces. As a matter of fact, organic planning yields beautifully to the context in an almost hand and glove relationship. Free of preconceived formalistic patterns, it emerges as a most natural form.

The city of Rajshahi came about as a result of ancient Gaur. The form of the city is somewhat semi-circular with main commercial hub bazaar at the centre. The shape is obviously affected by the river and is typical of town developed on a river bank but now a day the thing are different, the river Padma is



Figure 3, environs of Rajshahi-2, the detailed and embedded façades were the legacy of the city of Rajshahi (*Source: author's painting*)

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fading its courses and properties. The old town has a mixed pattern of activities and street layout. The branching street pattern of old town of Rajshahi is typical and can be classified in a hierarchical organization with the three categories of street. The old town is a dense mass of built form made porous by small house courts, public spaces and winding narrow streets accentuated by a temple and major civil structure at almost every major turn of the street. The old city and the new city are almost two separate entities by the spatial environs and cultural activities. There is a very sharp difference in the density pattern in the old city and the outer newer city. Old city is completely built with two to four storied structures closely knit with and winding lanes. Small, but numerous house courts give it a honeycomb texture. The outer city on the other hand is sparsely built with society houses invariably independent house type structures on plots with marginal spaces around the houses. The form idea has reversed the open court in the core of the older city house has disappeared. The built form is at the core with open space around the house in the new city. This is generally due to the building code and not climatic or social factors. Wider streets and fair amount of plantation give a very different character to the outer city with a very loose city texture. The two segments of the city have nothing in common.

2. Objective of the paper

Firstly, the aim of the paper is to address the destruction of heritage value without knowing the process of practice. Secondly, to understand the scale, proportion and 'image of the old city' 20 years before and latest dates, after demolition of those fabric of the city. And thirdly, the cultural continuity of the city inhabitants- how it is disappearing in course of time when city lose its legitimate cultural heritage.

3. Methodology of the study

The research methodology would be to lay-outing the ancient fabric of the city by surveying, identifying the core socio traditional pattern of the city. Theo methodology would be to reinvestigate toe intangible part of the locality, to secure the tangible maters. By random queries and with the help of the local councilor relevant and authentic data could be gathered. Live/living heritage – could be another source of communication. Local libraries are the perfect references of literature reviews and historic museum of the city is contained with the information of the city. Lastly, a pictographic analysis would be a part of the methodology to understand the situation vice versa.

4. Losing heritage value: Old town, heritage value, inhabitant's impact and urban development: critical analysis on Rajshahi old town

These keywords are chronologically involved to each other. However, there would be balanced in implementing the rules and regulations while respecting

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the cultural values and ethos. In this paper it was clarified before that- 'cultural values are interrelated with intangible and tangible matters, even as a city contributed these phenomenon a long way back, historically embedded city would get priority in strategic forecast, respect to its form, hierarchy of streets, spatial order and lastly the morphological aspects.' Urban development and rapid action plans⁴ that projects the urban infrastructures and other else, however- in the case of Southeast Asia, the city edges are different from the European walled cities. This complexity became the art of Southeast Asian cities. Where the old/heritage core city is reconciliation with the expanding possibilities of the new cities. The term complexity here used to pinpoint the physical state in the two different entities-the old and new. Having said that with the changing habit & disappearing of profound cultural values- people of the city leaving the practice of the predecessor's learning and continuity of the rituals. For the case of Rajshahi old town, unfortunately the traditional city lost its identity 90%. Remaining 10% is left as discarded properties and ruins. The city corporation authority, development authority and roads and highways division have no suggestions to secure or to protect

the area, as they have did not remark the historic core area of the city as well as the old town. To understand and to analyze the situation, the paper comes up with critical investigation with the pictographic information of some important localities, including the timeline matters.

Instinct	Heritage Value & Degradation	
/indicators to consider	12 years back	Present day situation
Instinct one: City's historical nodal point & identical visual presence- 10- 12 years back the city was elaborated with traditional nodal points along with historic façade.		

⁴ Rajshahi local authority: programme title and nature of the programme.

Narrative	The old gity is logated with	Present day is paglaganas of
Inarrative	The old city is located with traditional valuea and ehos.	Present day is neglegence of historic districts and the
	traditional valuea and enos.	
		thoroughfare netwoek
		designed wothout considering
T C (1		core elements.
Image of the	The RAJ-Boarding was the	The image is missing at the
city/local	city's landmark in the busy	same time the historic area lost
mapping	bazaar locale. This area was the	its point of nodal attraction
	City's mental mapping as well	
	as served as the vital nodal	
	point to connect new and old	
	town.	
Impact on	Memories of the inhabitants are fa	
human being	city is disconnected with its cultur	
Remarks	Proportion of the city scale in-term	
T (*) (with the human being have been s	standoffish
Instinct two:		MBCARCE JAK M
Contentious		
line of		Contraction of the states
historic fabric		
is missing		
Narrative	The old town of Rajshahi	However, the same locale 10
	contained with historic urban	years later failed to retain the
	fabric. This character used to	characteristics as because the
	generate by the occupational	infrastructure (road network)
	situation, continuity of religious	interrupted and destroyed the
	and commercial interests. A	chain of contentious historic
	unique case evolved due to	canvas.
	these issues and city achieved	
	intrinsic fabric pattern	
Image of the	A humble relation in-between	The area act disappeared.
city/local	A numble relation m-between	The area got disappeared;
mapping	street and façade used to	The area got disappeared; scale, proportion, texture and
	street and façade used to	
		scale, proportion, texture and
	street and façade used to contain in the area, passive –	scale, proportion, texture and materials of the facades changed without continuing
	street and façade used to contain in the area, passive – integral and neighborhood attitude helped to portray city	scale, proportion, texture and materials of the facades
	street and façade used to contain in the area, passive – integral and neighborhood	scale, proportion, texture and materials of the facades changed without continuing the legacy of the traditional
Impact on	street and façade used to contain in the area, passive – integral and neighborhood attitude helped to portray city image and memory as the	scale, proportion, texture and materials of the facades changed without continuing the legacy of the traditional senses.
	street and façade used to contain in the area, passive – integral and neighborhood attitude helped to portray city image and memory as the human story.	scale, proportion, texture and materials of the facades changed without continuing the legacy of the traditional senses.
Impact on	street and façade used to contain in the area, passive – integral and neighborhood attitude helped to portray city image and memory as the human story. Lack of 'identity of the historic di	scale, proportion, texture and materials of the facades changed without continuing the legacy of the traditional senses.
Impact on	street and façade used to contain in the area, passive – integral and neighborhood attitude helped to portray city image and memory as the human story. Lack of 'identity of the historic di cultural support. Eventually, inha	scale, proportion, texture and materials of the facades changed without continuing the legacy of the traditional senses.

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Instinct three: Backdrop façade on the end of organic street axis		
Narrative	Like all cities in the subcontinent: Rajshahi city is no exceptation than a organic one. Form of the city was densed and dotted with nunerious small buildform and crisscross streets & lanes. Those thoroughfares possibily hit elaborated historic buildings. Which perhaps used to be as the setback planes of the axis.	the same area after 10 years, which is a vandelism and shoking as well. City is dead with all vertue. Demolished by the authority without putting concern on the Valued area.
Image of the city/local mapping	This case clearly be evidenced for cultural heritage, on the other har quality on 'local mental mapping 'addresses and the landmarks'- w practice and cultural habit area co icon or image of the city. Unfortu not well equipped and trained kno neighborhood and community.	nd this city used to have the '- old bindings are the ithin the old town, through the buld identify in the city with the mately, the new generation are
Impact on human being Remarks	The fetchers of the town were the emblems of historic urban landsca nevertheless- deficits of urban cul the phenomenon of intangible and The city people used to peruse an	ape on human mind, ltural patterns restrain to create d tangible matters further on. d belong within the city,
Instinct Four: Enclosure, traditional building masses & scale of the old town	however now possibilities to split the rituals and practice of the area	

Narrative	The old town had harmonious formal expression dated back,	Now – widen street, new unidentical structures by
	shadow pattern casts on the	demolishing the heritage vigor.
	streets, thermal comfort used	City lost its childhood, and get
	to retain on the city fabric	attack by the heat and rain.
	which is also a process of	attack of the near and runn
	sustinable approch. By giving	
	this ration for both in the street	
	and buildform old town valus	
	of solution becomes enrich.	
Image of the		e is a vital issue; while a tradition
city/local	city starts losing the historic bloc	
mapping	'sporadic nature' of the historic a	
mapping	image of the area found.	area districts. No mapping of
Impact on	Behavioral pattern of inhabitant i	may affect lifestyle circle of
human being	dwellers of the area could change	
inum being	own territory may shift or split.	e permups and berongingness on
Remarks	Both the tangible and intangible a	area of the city could have gone
	through the disappearance of cult	
Instinct		
Five:		
Conflict in		
continuance		
towards		
'stylistic		
gratitude'		
and absence		
of regulation		
& code of		
conducts		
Narrative	'Stylistic appreciation' -is an	The old town approaches
	imperative virtue within the	phenomenon changed with
	aged city; where the city people	outthought, height of the
	find their locale influence and	structure, minimum setback
	aesthetical essences. During	area and the stylistic
	2004-2008, the above	continuity all related concerns
	significant and linear dwelling	are completely away from the
	house was one of the medieval	historic site. City and its
	city's characteristics that	inherent form would be
	flashed toward street.	preserved with all respect to
		evaluate the chronology of
		urbanism.
Image of the	This situation clearly states the d	iscarded approach, where old
city/local	town creates an ancient face-lifting	**
mapping	historic city becomes robust that	
	mapping, a sense of chaos.	

Impact on	City guides people; it creates aspirations to human's mind. The
human being	situation today in the historic city is all about a deep issues of
	frustration and disorientation.
Remarks	Proper continuation of heritage protection acts are needed to be
	addressed.

5. Heritage values of a city is disgraced-Discussion:

Compassion of the city lays on the heritage legacy; people set vision within the city. So city generates ambition to the commoners. Tradition, cultural longing, and heritage value of the locality enrich the livelihood as well as shape the new generation. Time immemorial factors are engaged with the traditional city, which are factor with multidiscipline. City is a story of collective memories as well and obviously it is not one dimensional. City sometime resists the practice of critical bureaucratic power which appears in the image and the mapping of technical necessity, while sometimes are not. City authority of Rajshahi consciously needed to realize the social and physical conditions that are the 'integral' in making-redeveloping city, which promotes human possibilities. For the case of Rajshahi city the city authority and the stakeholders would rather get involve with the city rejuvenation, which shows the ambition – 'making of a city of human possibilities.'

This perception would be highlighting people's expressions and aspirations while historic built form would be appreciated, in the historic core. Urban morphology of Rajshahi has an engagement with the inhabitant since decay; the latest infrastructural development impacted a cultural void in defining the continuity of historic substances, a finished edge city is not desired in all aspects, however the definite historic gesture and the streets in the variety of the traditional urban form are needed to embedded with the new story of the city. But in the above mentioned indicators are the vital issues to uphold the historic city parameters. In addition it is also most important to look for constitutions and writing building guidelines at the historic sites, cultural landscape and other infrastructural form along with the legislation. However, the most called for shifting in the strategic planning approach. Abruptly and unplanned development ruins the root of the historic texture. Understanding the implication problems of development control rules that may directly affect the historic urban core, political framework has the dominant situation in very places.

6. Conclusion

Eventually, human behavior in a city life is shifting, people are getting stressed, and becoming impassioned, finally people are detached from the cultural narratives and colorful ethos. Consequences- individuals are disintegrated from

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social life and absence of togetherness within the neighborhood are witnessed. Intangible activities carried out by the human beings, are the starting place of the historic districts. Place-enclosure shapes and glows with intangible matter around the community. to some extent- performing intangible activities, space and place enroll vital catalysts, if tangible location is absent, it do not harmonize with any other else. So, human intelligence interrupts without the historic values of the city and town, it is like the flowing stream of young river, on the journey path it changes its own directions, followed by the sequences, but never stop down, river flows. Cultural longing is like a river, it continues, it grows with other parameters, it becomes imperative and cultural pattern carried out with generation to generation. Finally historical area and its people are the assets of the city. New development are obvious, on the other hand a city can never give-up its childhood, as childhood is always precious and enriching.

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DYNAMIC OASIS: THE EPHEMERAL CITY FOR REFUGEES

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Abstract

This paradigm regarding architecture focuses on the people as being the pivotal line of focus therefore we designed an ephemeral city for refugees in times of the pressing refugee crisis. This concept of 'urbanity in motion' has been named the Dynamic Oasis, as it is a form of hydration to the parched lives of refugees. Our project focuses on three main components: layout, shelter and communal area. The strategically designed 8km², circular layout promotes a sense of community, unity, functionality and organisation. This city utilises a *micom*, which is an abbreviated term of microcommunity, where each micom has an area of no more than $5000m^2$ containing 50 shelters and micro-communal areas for washing. The concept of the shelter, derived from the armadillo's layered effect of the scales (bio-mimicry), takes on the shape of a cocoon. The efficiency of the shelter design renders it foldable and thus effectively portable. Adjacent to the micoms, distributed throughout the camp, are communal spaces serving functions such as resource distribution points, recreation, education and medical centres. The design of the communal spaces found inspiration in irregular shapes of forest landscapes. The component structure of the shelter and communal area are prefabricated using tensile membrane and steel framework.

Keywords: Ephemeral; refugee; tensile; self-sufficiency; community.

1. Introduction

One of the most undervalued states of affairs in the world today is the refugee crisis. The number of refugees has been increasing in the past few years due to situations of dispute in South Sudan, Syria, Democratic Republic of Congo, etc. By the end of 2016, there were 65.5 million displaced people in the world, of which 22.5 million are refugees (United Nation High Commissioner for Refugees [UNHCR], 2017).

UNHCR was founded in 1950 to assist the refugees displaced by WWII. The organisation aimed to help the displaced people to meet their basic needs as well as to aid them in repatriation, integration or resettlement (Herz, 2013). Today, the organisation has expanded to assist in global refugee emergencies.

However, according to Betts (2016), the system is defective and the application process is tedious, which results in refugees being 'stuck in limbo'. More and more refugees are accumulating in refugee camps and living conditions are deteriorating, often becoming inhumane and thus violating the human right of living in dignity.

The intention is that a new paradigm for refugee camps needs to be produced; instead of there being a stagnant and hopeless population who just about survives in a large expanse of land, the people could be in an area in which an individual could be upgraded, develop skills, regain their human dignity and be emancipated through independence.

2. Research Methodology

The methodology used in this paper is of qualitative nature within which we predominantly analysed secondary sources, otherwise known as desktop research (Byrne, 2017). Thus, for the purpose of this study, a definition of Punch (2014: 86) was adopted where qualitative research is seen as analysis of "empirical information" such as journal articles, audio-visual materials, artefacts, document records and various other sources of data. The inability for the orchestration of field research in context to the project is a constraint within the qualitative paradigm where various methods or techniques can be utilised. This paper reviews various authors' research relating to existing refugee camps and the concept of 'ephemeral' in the context of urban lavout (Mehrotra & Vera, 2017), communal spaces (Gilchrist, 2000; UNHCR, 2008) and shelter designs (Herz, 2017; Perkins, Adam-Bradford, & Tomkins, 2017). The focus was to design and develop an integrated urbanistic/architectural/ constructive concept, with speculations from literature sources used to gain background information. As part of the research, the prospect of sustainable communities and ephemeral urbanity merged in order to apply the potential methods that could be used to improve the lives of refugees. The guidance and insight from these sources were methodically included in all of the constituents of the design. Constant feedback and reviews from lecturers were given during the concept and solution development phase.

3. Utilisation of the term, ephemeral city

Refugee camps are places where refugees take shelter. Theoretically, these intended to serve as temporary sanctuaries. In practice, however, it was a different story: war still waged on and not many countries were willing to provide "long-term" refuge on their land, resulting in refugees' prolonged stay in the camps.

When one attempts to view a refugee camp, the main notions that one describes equate to that of the contemporary discourses that exist in the media-scape (Herz, 2013). Furthermore, the connotation of the term, refugee camp, makes it appear to be a place of confinement and misery. Some camps were managed so poorly that they reflect characteristics of informal settlements, slums and even prison camps (Herz, 2013).

Cities are often well thought out by urban planners and revised many times before a system is implemented. Much thought is put into customising life into

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non-living constructs (Herz, 2013). The plan of the ephemeral city provides liberty to those inhabiting the space, in the same way as cities do. Moreover, just like any other city, it should have facilities to build a community. According to Maslow's hierarchy of needs, human beings have a hierarchical tendency towards their biological needs (Maslow, 1968: 153).

Fulfilment of these needs brings individuals closer to self-actualisation thus leads them to reaching to their full potential of being (Maslow, 1968). Thus, working according to this theory, the project focuses on fulfilling the basic and psychological needs of the refugees, as well restoring their right to live in dignity just as any other human being. The city should go beyond providing physiological needs; it should be able to provide for psychological needs as well.

4. Permanence versus temporality

Unlike permanent cities, temporary cities possess a range of elements that maintain their continuity and are usually structured around one main purpose. The purpose is not the focal force that configures the entire city, rather there are other elements that aid in the layout. These are:

- the city's dimensions and level of complexity
- its material composition and its position in the process of place making
- the paradigm it creates through the cultural lens of the people

Ephemeral cities respond to a diverse range of contexts with the guarantee of an expiration date. In the context of ephemeral cities, Mehrotra and Vera (2017:9) state: "they represent an entire surrogate urban ecology that grows and disappears on an often extremely tight temporal scale."

One of the aspects to consider was how long was this ephemeral refugee city going to last? In an ideal emergency situation, it could provide shelter for refugees for up to five years. It acts as a space in the transitory period for refugees before they would be integrated back into society. The lifespan of one location is determined not by the lifespan of the construction but by the psychological needs of their inhabitants.

The structures could then be transported to accommodate emergencies elsewhere. They would be reusable and could be implemented for natural disaster relief.

5. Layout

The layout design (Figure 1) was envisioned to be 8km² and accommodating around 70,000 people. It was inspired by temporary cities namely those for

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Kumbh Mela and Burning Man Festival. These ephemeral cities were created for religious and celebratory purposes. There are numerous benefits of having a focal purpose in an ephemeral city from a religious taxonomy. People treasure these temporal religious landscapes. Furthermore, it provides space in order to conserve social traditions and synthesise a cohesion between public and private space by subduing the threshold and rendering social hierarchies obsolete (Mehrotra & Vera, 2017). In addition to this, Mehrotra and Vera (2017:11) state that religious ephemeral cities, [allow] for interactions in the form of cathartic gatherings."



Figure 3 Conceptual Model of Layout Design depicting two categories: the micoms (yellow) and the communal spaces (blue). [scale 1: 8000] (Authors' own

The taxonomy of refuge in an ephemeral landscape is described as a neutralising landscape. The characteristics include: disposal of expression of identity, grids and units, and expression of the discourse of bare and minimal living (Mehrotra & Vera, 2017). Most refugee camps followed the grid layout. It could be interpreted as a desire for stability in times of precarious conditions (Herz, 2013). However, its similarity to a layout of a military base often sends out ambiguous signals. The refugees are granted shelter but are supervised by organisations and are limited in where they are able to go. Complicated policies restrict them to the campgrounds, unable to resettle, unable to find employment. The dependency on organisations, as well as the long time spent on waiting, cause frustration among many refugees (Herz, 2013).

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The ephemeral city layout sets out to adopt a more organic form as an intention to find the balance between uniformity and chaos. This semi-uniform arrangement would stabilise the refugees' chaotic lives, and the hint of spontaneity would provide them with a sense of freedom. The sense of freedom is not a design of pretence. It is designed to implement synthesis of community and to improve social well-being. The layout is circular to give the temporary city a communal atmosphere. By uniting, the refugees could assist each other through traumatic times.

Community is emphasised throughout this city as seen by the layout, which consists of two main categories: the micoms and the communal area.

6. Shelter design within the Micom System

As stated before, a 'micom' is a micro-community with an area of no more than 5000m². Thus, a semi-micom has no more than 2500m². Each micom contains 50 shelters with washing areas (Figure 2). The micom creates an equilibrium between freedom and restriction resulting in social emancipation within an organised system. Although a certain number of people will be designated to an individual micom, they have sovereignty over the position of their shelters within it. The micom provides the platform for social networks to occur and broaden into a sustainable community. According to Gilchrist's perspective, social interaction can contribute to the shaping of one's social identity and enhance the diversity and connections between individuals resulting in social solidarity. It also improves mental and physical health making one resistant to diseases and tribulations (Gilchrist, 2000). They further emphasise that these benefits are vital for people who are "struggling at subsistence level or living in situations of great uncertainty" (Gilchrist, 2000).

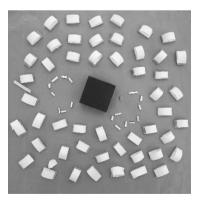


Figure 2, Concept Model Showing the Arrangement of Shelters within a Micom (Authors' own image)

Shelters are vital in times of crisis and displacement while also performing a colossal role in the restoration of an individual's dignity during these times. In

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this notion, the intention is to provide comfortable and progressive inhabitation from the beginning thus rendering the trauma of displacement obsolete and creating a dynamic atmosphere by making self-sufficiency and development the paramount aspects that influence the shelter design.

Although the term, comfortable, has connotations of permanence, and ephemeral cities should display temporariness in all aspects, it thus synthesises a paradox. However, this concept of comfort can be incorporated into temporary building elements. Evidence of this is displayed in the camps of the Western Sahara situated in Tindouf on the western border of Algeria.

These areas find a way to integrate the permanent and the temporary within the architectural elements. This ability creates a co-existence between the two concepts, which ultimately contribute towards one motivation: to synthesise an environment that supports personal development and expression from the first day (Herz, 2017).

Shelters that are prefabricated and packed then delivered to site where the refugees can assemble them in personal contribution, whereby supporting appropriation of self-sufficiency and temporality which complement the archetype of ephemeral. The concept of the shelter design is derived from the armadillo's layered effect of the scales. Together with the art of paper folding (origami) and tessellations, the shelter contorted into a form that incorporates triangular tessellations that bunch up at the rear of the shelter thereby creating an encapsulating feel to the space within it as shown in figure 3 and 4.



Figure 3 Model of Shelter Design on Corkwood Platform (Authors' own image)

A capsule has connotations of enclosure and comfort, therefore the form is described as a cocoon that houses and protects rather than just covers and demarcates a living space. Herz (2017) argues that it was clear that the choice of architectural elements produced additional perceptions of the duration of inhabitation in a camp, which connote a range of additional meanings from political and social taxonomies. In addition to this, Herz analyses the tents in the camp from a lens of symbolism. He states that the tents signify temporariness and, as though the architectural elements mirror the political

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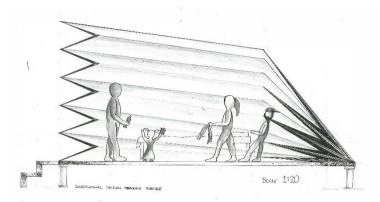


Figure 4 Drawing of Shelter Design with Occupants (Authors' own image)

state of affairs, he writes that they reflect the unsettled nature of the political situation, namely, the situation of the Sahrawis seeking refuge in western Algeria (Herz, 2017). The ability to make a claim from a social or political discourse through an architectural type renders the shelter design more significant than its initial aim to house people.

7. Materiality of the structures

The principal material that will form part of the structure of the shelter and the communal areas will be tensile membrane. The inclusion of tensile architecture into our design is due to the wide spectrum of benefits that this construction method possesses. The structural and sustainable benefits of the tensile membrane are as follows:

Tensile membrane is environmentally and economically sensitive material. The lightweight structure is cost-effective and due to its ability to span over large areas, there is no need for many steel supporting columns, enabling long spans of column-free space making it ideal for the widely open communal areas (Hovraluck & Roth, 2014).

Furthermore, the company, Birdair, Inc. has stated more properties of the tensile membrane:

- It allows approximately 8-20% of natural daylight to permeate it therefore there is no need for artificial lighting during the day, reducing the energy consumption and as a result there is a reduction of solar energy and heat gain within the structure.
- There are a few permutations of the tensile membrane: namely PTFE (polytetrafluoroethylene) and ETFE (ethylene tetrafluoroethylene), both extremely durable lasting no less than 30 years, with the former having fibreglass woven into it and the latter not degrading due to temperature fluctuations, harsh pollution or UV light.

BROWN. N, HO. C & WAHID. H

• Tensile membrane is waterproof, abrasion resistant and has a superior fire performance making it low maintenance and it eliminates the glare and enables broad illumination.

Due to the myriad benefits of tensile architecture, the actual shelter is composed of a tensile material, however, the structure holding the shape in place. The tensile membrane that forms the sides and part of the roof of the shelter is PTFE. Tensile membrane is lightweight and affordable, thus there is no need for heavy supporting columns. The triangular openings around the entrance of the shelter will be composed of transparent ETFE film. The major ingredient is fluorite, which is commonly found (Birdair, Inc.).

The need for flooring is important because, due to the dynamic nature of an ephemeral city, one cannot anticipate every type of terrain. According to *designboom*, at times, refugees were forced to suddenly relocate, and set up their tents directly on the ground with no protective barrier between them and the terrain other than the thin material base of their tents.

This often led to a multitude of afflictions such as waterborne diseases due to flash floods, hypothermia due to ground freeze and parasitic diseases. Furthermore, Scott Key and Sam Brisendine from Good Works Studio in Pennsylvania have developed the concept of modular flooring using shipping pallets to raise the refugees above the ground, which was a success.

Therefore, due to the scale of the ephemeral city, the combination of the shipping pallets with the corkwood placed on top of them is a sustainable solution. The decision to include corkwood in the platform is because it is an epitome of sustainable flooring. The multiple benefits are listed in the website, Unique Wood Floors Blog. The benefits include: a long life cycle, requiring less maintenance, durability, provision of thermal insulation, and flame and mould resistance.

The concept of shelter can extend beyond the perception of shielding oneself from the outside climate: it could promote an increase in self-sufficiency, human dignity, address any shortages in nutrition. In addition, it could enable the development of both the place and the people who utilise it (Adam-Bradford, Perkins & Tomkins, 2017). Due to the global amplified refugee situation, the search for beneficial living from the start has initiated the concept of urban agriculture in camps. The implementation of greenery into the city can promote self-sufficiency and, in turn, improved psychological health of the people. The greywater produced by the people could be used to water these gardens thus producing an environmentally favourable solution to greywater disposal, which will also cut down on the costs required to remove wastewater.

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8. The communal space

The sizes of the communal spaces vary and serve many functions. It is a public space that initiates interaction across micoms. The space is utilised to fulfil their need for a sense of purpose.

Taking into account the objectives of the UNHCR, the three broad aims of the community-focused design are:

- to build a sense of community;
- to promote the dignity and self-esteem of people occupying the city
- to protect and ensure the human rights of all the occupants.

All refugees, irrespective of nationality, age, gender, religion or ethnicity would be encouraged to participate in the activities taking place in the communal space (Figure 5). However, the UNHCR puts forward the idea that occupants of refugee camps could possibly come from a wide range of nationalities and have a variety of religious, language and ethnic backgrounds. This could cause a reduced sense of community attachment to prevail.

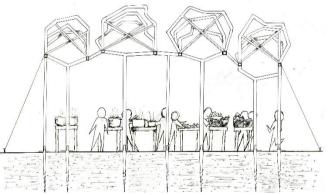


Figure 5, Conceptual Drawing of Communal Space Showing How Space Would be Used (Authors' own image)

Purpose of the communal space

Refugee camps are generally overcrowded and therefore space is at a premium. Consequently, space is not allocated for community recreation and leisure activities (UNHCR, 2008). This ephemeral city, on the other hand, incorporates large open spaces of between $250m^2$ to $500m^2$, which would serve as communal areas.

Herz (2015:60) puts forward the idea that refugee communities should have the daily activities of a functioning city. Therefore, the layout design allows for

spaces that people from the surrounding micro-communities could utilise for activities such as:

- the distribution of resources (e.g. food, water, blankets);
- medical stations (e.g. for primary health care);
- education and skills development centres;
- sport and recreation; and
- cultural activities (e.g. youth theatre or art projects)

The inspiration for the design of the communal space

The overall design of the ephemeral city as well as its individual components such as the shelters and the communal spaces is based on the concept of biomimicry. Biomimicry is characterised by the irregular shapes found in forest landscapes and was used with dramatic effect in the open-sided shelter designed in 2015 by Ron Shenkin Studio Architects of Pardesiya, Israel (Figure 6).



Figure 6, Open-Sided Shelter Designed by Ron Shenkin Studio Architects (Source: archdaily.com)

Figure 6 shows a structure where the roofline is not at a uniform height, which is indicative of the trees in a dense forest where all the trees are at different heights. A forest generally symbolises growth, regeneration, rejuvenation and healing – and every aspect of our design reflects these fundamental principles.

The structure of the "trunks of the trees" would consist of upright steel tubing ranging from 4m to 5.5m in height. The upright steel poles would be placed about 2.5m to 4m apart, depending on the size of the communal space. The "foliage" would be made of tensile material attached to the steel framework. Cross bracing on the interior roof structure would give the effect of the branches of a tree but would actually provide support for the tensile member.

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9. The scaffolding and anchoring systems

Each upright steel pole will be anchored in the ground by means of a screw foundation and the tensile membrane will then be attached to the steel framework to form the roof or façade (Hovraluck & Roth, 2014).

The system of construction has been used successfully by Jose Selgas, Ignacio Peydro and a group of MIT students in the Turkana Vaccination and Educational Clinic, Konokono ("African project Konokono Clinic", 2015) on a refugee camp commissioned by the United Nations (Figure7 and 8). The design makes use of generic scaffolding components, which are readily available around the globe, as the underlying supporting framework. The strategy is to make custom and accessible architecture from a kit of common construction parts ("African project Konokono Clinic", 2015).



Figure 7 & 8 Scaffolding Framework of the Turkana Clinic Built by Jose Selgas and Ignacio and MIT students (Fig 7, source: http://www.arquitecturaviva.com/es/Shop/Issue/Details/425, Arquitectura Viva 185 PARA NIÑOS, Fig 8, Iwan Baan, source: http://www.beomki.com/konokono-center/)

According to the website Paalup iste (Finland), installation of the screw foundation starts with digging a 20cm to 30cm deep hole in the ground. Thereafter the screw pile is anchored in the ground by twisting it with an iron bar in a clockwise direction to the desired height. The screw foundations are easy to install and they are perfect for locations where only a few piles are needed or where machine installation is impossible due to difficult terrain.

10. Strategy for constructing the communal spaces

By having the refugees assembling the structures themselves, a sense of teamwork and achievement will develop in the community.

According to the UNHCR, "participation" refers to the full and equal involvement of all members of the community in decision-making processes and activities that affect their lives. Depending on how rewarding the refugees find the experience and how they will benefit from it will determine their level of participation (UNHCR, 2008: 15).

In community work, communication and cooperation are important when enabling people to work together on a common task or towards a common goal. When working on the construction of the structures, two-way communication among the participants would be promoted as information is then shared and feedback from the workers would be encouraged (UNHCR, 2008:96).

11. Conclusion and discussion

The paramount focus of the paper was speculated from the notion of sustainable communities within an ephemeral landscape. Furthermore, the authors suggest a possibility of the excogitation of the design in real-life situations in order to enable self-development and efficiency of the refugees because sustainable communities enable social emancipation as conjectured by the authors. However, the conceptual project has yet to be put into practice; therefore, many adjustments still have to be made to resolve unforeseen factors and limitations.

The proposed layout is an innovative design but due to its maze-like arrangements, it is uncertain if it would be an easily navigate-able city plan.

The construction of the communal space is based on a successful construction of the Turkana Clinic. Although the proposed layout is in sync with the ideology of sustainable communities and the conceptual discourse of social revitalization through communal areas, the physical and economic factors are not directly tackled thus the city's adaption to various environments and its socio-economic contribution is open to speculation.

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SUSTAINABILITY OF URBAN PARKS PLANNING POLICIES IN BANGLADESH: A COMPARATIVE ANALYSIS

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Abstract

Urban parks, the key domain of sustainability of the community, integrate social, economic and ecological benefits. Current research are consistently concerned in planning for sustainable and resilient cities through preserving urban green areas are mainly concerned with a large, bio-diverse and relatively endangered ecosystem. While such efforts act as benchmarks for assessing progress towards sustainability and resilience goals, obviously much less attention is being paid to that type of small-scale green areas more specifically urban parks in cities and their benefits to societies. Thus, the extension of these benefits whether or not is equitably distributed across diverse urban populations in cities is a remarkable quarry in urban design policies and practices, especially in developing nations. This research, therefore, aims to analyze of conventional urban design practice on sustainability, more specifically on ecosystem services. Since ecosystem services are vary geographically, the policies even under national guidelines, need to be localized to appreciate the strength of local ecology. Hence, first, this paper develops a theoretical framework of a sustainable urban park with arguing that beyond biodiversity and socio-economic status, urban parks can also inform urban planning policy and practices to promote sustainable urbanism through practices of urban form. Second, it assesses sustainability of urban parks to compare similar urban parks in two different topographies like biodiversity with varied ecosystem services. This qualitative research adopts deductive approach and case study method to evaluate and compare the planning policies of such two parks in two different cities in Bangladesh. Thus, Hadis Park in industrial city Khulna and Biplob Uddan in coastal seaport city Chittagong respectively have taken from two different ecological viewpoints. Multi methodological approaches, including questionnaire survey, interviews with academics and professionals, observation and document policies of the urban park in terms of ecological and planning viewpoints, have been accompanied. Findings reveal that urban park planning policies in both cities mostly focus on generating social and economic activities only relatively for short-term basis rather than on promoting ecological sustainability and biodiversity for long-term maximization. The study, therefore, concludes that traditional urban design practices merely motivated, or supportive to provide sustainable urban park design policies by municipalities and professionals. Further, multi-disciplinary efforts including ecology, landscape architecture, urban planning and urban design simultaneously well informed by locals are essential to assess and develop ecologically sensitive urban design and planning policies.

Keywords: Biodiversity, Ecosystem-services, Urban Park, Urban form, Khulna

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1. Introduction

Urban parks, a green infrastructure, provide of a diverse range of ecological, socio-physical, socio-economic benefits, and contribute to urban resilience and sustainability. Primarily, sustainability is broad term and mainly concerned with long-term permanence, balance and maintenance of social, economic, and natural resources (Goodland 1995) in relation to biodiversity as well. Well-organized, designed and sustainable urban parks can serve as a host of a city's ecological benefits by providing ecosystem services through a wide range cultural (Haase et al. 2014), social (Bedimo-Rung et al.2005) and economic value (Irwin 2002). But within cities, inadequacy and undesirability of urban parks can decelerate achieving the sustainable efforts since 80s', while urban park movement was considered as social urge in history.

In history, the urban park movement generated during 'industrial revolution 'was mostly related to the garden design by municipalities of European countries specifically in Britain 1980s and In USA, and Canada in 1985s.While, such planning and practices mostly focused to extreme social problems and expressed various ideas for associating human-nature interaction, but they pay little concentration for real ecological fitness (Cranz, G. and Boland, M.2004.)While, De Sousa (2003) stated that in North America and Europe, both policymakers and planners have been concentrated to assess the design and progress towards sustainable development in urban areas through urban green space like urban park. Yet, these studies based mainly upon developed countries while few have been discussed in urban planning and design discipline in developing nations.

In most developing countries, the urban parks had a great struggle to get place in policy level (Faizi 2006). The planning policies of the urban area in developing country mostly based on infrastructure solution and analysis and measurement of urban park governance and management models are very limited (Hanna 2006). Jim and Chen (2006), for instance, stated that most of the urban development policies in developing countries have not only eliminated or degraded some public parks but recent planning policies have also failed to preserve natural green corridors, even the development continues to consume natural green fields. In Africa, where most cities are growing and developing without effective institutional control and land-use planning policies (Arku 2009), and in Brazil directly use the western policies and planning method (Fernandez 2007). In Contrast, Furukawa, T, et al. (2016) argue that many cities in Asian and Africa have also concentrated to use green space as a positive sign of human –nature interaction and well-being of people. Nevertheless, this argument rarely observed in other developing countries more particularly in Bangladesh, where the importance of sustainable urban park

policies and practices towards in the achievement of MDG or SDG have rarely been discoursed in latterly.

In Bangladesh, the urban planning practices mostly based on infrastructure layout (road network, zoning and land use allocation) were highly influenced by the type physical planning practices influenced by western planners (Khan & Swapan 2013) and merely consider the topographical features. Many cities in Bangladesh is undergoing rapid urbanization and transformation by consuming urban green space like parks and playgrounds (Dewan and Yamaguchi 2008). However, several researchers have been conducted within this decade about urban parks and green space through the lens of urban planning and policies mostly concentrated to the capital city of Bangladesh, while other cities with different topographical considerations have been ignored often and pose a persistent research gap.

Within these persistent ongoing debates and research gap of sustainable urban planning, policies raised aims to explore the impact of conventional urban design practice on sustainability, more specifically on ecosystem services. In doing so, this research meets three objectives:

- To develop a conceptual sustainable urban park design framework
- To assess the sustainability of urban parks
- To generalize possible applications of the framework for planning, design and practice of urban park design

To do so, two urban parks in Khulna and Chittagong cities have been taken from two different ecological viewpoints. Although both are interestingly located close to CBD (central business district) area, but the contrast with ecosystem services and topographic features specifically, micro cooling system, distribution of contours, valleys and mountains and biodiversity are completely dissimilar of two parks. Due to geographic location (in between hilly tracts and Bay of Bengal) of Chittagong city and even park within it, the urban heat, sound radiation, and landscape are even dissimilar.

This paper includes four sections. First, this paper critically reviews the peerreviewed journals on the sustainability of urban park in relation to biodiversity, ecosystem services, spatial- physical, environmental and socioeconomic aspects. Which is followed by identifying the gaps and challenges of existing theories and practices urban park design to find out approaches to balance tradeoffs and enhancing useful synergies between the multiple goals of sustainable urban parks. Second, it is attempted to build a sustainable urban park design framework (SUPDF) with specific indicators, and variables of sustainability to offer a holistic planning approach. Third, case study and

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methodology is discoursed. Fourth, it discusses the findings from case studies and synthesizes existing theories and practices with an intention to let know the gaps and challenges of contextual urban park design policies in Bangladesh. Finally, from the top-down perspective, this study propose how this research on sustainable urban park design has contributed to the development of urban planning and practices.

2. Sustainability goals in urban Park: Threads and Gaps in worldwide policies and practices

Sustainability, a process to maximize economic and social development of cities through environmental protection and sustainable urbanism. The concept of sustainable development has ranging from land use plan to social justice, even it covers the socio-cultural issues. Though, there is no persistent agreed definition of sustainability or sustainable development (Shen et al.2011), it is often founded by three dimensions of sustainability: society, economics, and the environment. Yet, the universal or general sustainable frameworks rarely useable to measure all context like urban park since of dimensions of sustainability is varies according to the context and subject.

2.1. ECOLOGICAL SUSTAINABILITY OF URBAN PARK

Ecological sustainability at global scale refers the balance between natural and non-natural environment for long time. Yet, at local scale, to measure the urban park sustainability, this research assume the ecological sustainability as ecological benefits derive from ecosystem services based on many of theoretical and practical findings across the world.

Ecosystem services as ecological infrastructure is globally accepted and acknowledged by many peers reviewed journals for urban parks. Urban parks are one the —key providers of a diverse range of ecosystem services like provisioning, regulating and supporting cultural services (Costanza et al. 1997; Bolund and Hunhammer 1999) and more broadly biodiversity. Biodiversity of habitat specifically vegetation (urban green) can ensure ecosystem services.

MEA (2005) and Costanzo et al. (1997) stated that four categories of urban ecosystem services including 17 services like provision, regulating, supporting and cultural services, yet these merely are appropriate to analyze an urban park.

However, to mitigate this ambiguity on topographical intervention to ecosystem services, Bolund & Hunhammar (1999) taken five regulating and one cultural ecosystem services relevant for their research in the city of Stockholm: air filtering, microclimate regulation, noise reduction, rainwater drainage, sewage treatment, recreation/cultural values by using vegetation. To add to this, McDonald (2009) similarly stated that three main provisioning

ecosystem services can be measured at local scale specifically using vegetation and water (urban green and blue).

Although, the importance of vegetation or urban green in cities are widely acknowledged (Kaoma& Shackleton 2014), the role in providing such benefits in an urban park is still poorly been evaluated in both theories and practices (Botzat, Fischer, & Kowarik 2016) especially in urban planning discipline. However, despite the widespread agreement of its importance, the formal and systematic incorporation of ecosystem services into urban planning and practices is limited for a number of reasons that must be resolved before it can be effectively incorporated.

2.2. SOCIAL SUSTAINABILITY OF URBNA PARK

Social sustainability of urban parks in this research assume the wellbeing of people. Well-being refers the ultimate fulfillment of human needs in urban parks. The needs comprised of the recreational, physical, educational, cultural and psychological (Littig and Grieler 2007) aspects. It is already justified that an urban park is a key source for promoting social cohesion, reducing urban pollution and improving both physical and mental health. For instance, Nicol and Blake (2000) revealed that over 80% of the UK's population prefer urban green space for relaxation and health activities. Similarly, in Finland and Mexico City, the urban park is utilized as both social and economic hub for attracting visitors (M.Neuvonen, T. Sievanen, T. Susan and K. Terhi, 2007). More certainly, it is also found that urban park not only reduces the stress of older generation, it also works positively to the health condition of children. For instance, Fuller et al. (2007) in Sheffield, England, found positive relations between biodiversity and psychological well-being of children.

Despite a growing literature of health benefits of urban parks, many parks are still facing environmental injustice for not to permit all classes and age group in parks. Fewer facilities, less diversified land use planning and native landscapes are mostly ignored in the urban park policy and practice especially in developing countries.

2.3. ECONOMIC SUSTAINABILITY OF URBAN PARK

Economic sustainability of urban parks refers economic vitality of both urban park users and the host community. For instance, energy savings by using vegetation to cut the energy costs of cooling buildings and property value by increasing green space and tree planting is an

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emerging issue (Heidt and Neef 2008).Similarly, space like the park with enough vegetation is aesthetically pleasing and eye-catching to both host and investors to expand the property value in a community. The beautification of Singapore and Kuala Lumpur, Malaysia, for instance, is one of the factors that attracted significant foreign investments that supported fast economic growth (Sorensen et al. 1997).

While these findings largely cover the literature of sociology and urban planning, very few have been revealed in ecology based literature.

2.4. URBAN FORM SUSTAINABILITY

Urban form is nothing but physical entities that make up built-up areas, including the shape, size, density and configuration of settlements. It can be varied at different scales: regional, urban, neighborhood, block and street. In theory, the role of urban form like, building, shades, trees, roads, plaza around the parks is not only appropriate to promote dense settlements and active uses (i.e., land uses that generate foot traffic on the street, e.g., hotels, restaurants, and retail shops) even these are invigorate the inside of park spaces and expand park uses and benefits (Jacobs 1961). The main criteria of sustainable urban form is considered for producing low energy and pollution and also not hindered ecosystem for healthy living (Breheny 1992).

While such discourse has seen in the case of city scale, merely it has been seen in the case of urban park. But the lack of arrangement of the most desired urban form in the context of sustainability is the most crucial knowledge gap. Therefore, this research seeks to answer the following questions: What are the distinctive urban forms and how it relates with sustainability through ecosystem and how it will ensure socio-economic and cultural needs for people to live in a healthy living.

To summarise, within the ongoing debates and discourse about urban parks sustainability, three potential knowledge gaps have been come out in this article. First, knowledge of urban ecological infrastructure specifically ecosystem services through Biodiversity (specifically vegetation) is missing in urban design practice even not specific for urban park. Second, urban design policies mainly concerned with sioco-economic benefits and finally practices and benefits of urban forms has never been incorporated planning and practices

These gap in knowledge limit the capacity of ecosystem services research to inform policy and management to develop a sustainable urban park design framework. Therefore, the research aim to guide the field of ecology and urban planning in a policy context through balancing and linking the dimensions of sustainability.

3. Balancing and linking the dimensions of sustainability of urban parks: conceptual framework

However, to balance and link among these dimensions of sustainability, and contextualize the indicators and variables, it is needed to down the scale first. For instance, Forsyth and Musacchio (2005) also stated that the goal of balancing the social and ecological benefits of urban parks needs to improve the connectivity, diversity, and access for both human and non-human life at local scale. This balancing motivation helps to develop a conceptual framework for sustainable urban park.

This conceptual framework (figure1) is a representative of sustainable urban park design protocol is followed by an analytical framework to depict the indicators and variables of urban park sustainability. Three main domain are considered as sustainability of urban park at local level: ecological infrastructure, socio-economic benefits, and urban form through productivity, defensibility and livability. Ecological infrastructure (ecosystem services) and socio-economic infrastructure confirm productivity of urban park both in environmentally and socially. While urban environment and community will be sustainable if they remain defensive against climate hazard like urban heat island and savings energy by installing eco- sensitive urban form. Finally, park will be liveable if people get social, economic benefits by using urban forms like kiosk, shades, energy consuming built forms etc. However, overall, the park will cater the sustainability of urban neighborhood if leadership of policy makers and design excellence and people's perception of urban designers, architects incorporated with similar knowledge and values of sustainable urban park design.

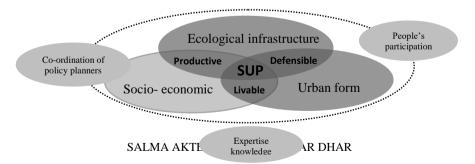


Figure 1, Conceptual framework of sustainable public park design through ecological infrastructure, socio-economic and urban form benefits, administered by leadership and the integration of design excellence. *Source (author, 2007)*

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Area	Domai n	Aspect	Indicators	Variables
Sustainable Urban park	Ecological infrastructure	Ecosystem services	Air purification	Vegetation & soil microorganisms
			Noise Reduction	Vegetation & Soft surface
			Rain Water drainage and waste management	Vegetation cover, sealed surface, soil
			Micro climate regulation	Vegetation
	Socio-economic	Socio- environmen tal	Educational benefits	Biodiversity(e.g. Vegetation)
			Psycho-physical and social health benefits	Natural landscape and biodiversity(e.g. Vegetation)
			Recreational opportunities	Diversity of facilities and services(shops, gymnasium, water body)
			Comfort and Image	Access to sunlight and shadow
				Safety and security Diverse activities
		Socio- economic	Economic valuation	Property Value
	Urban form	Socio- environmen tal	Natural and non- natural landscape elements	Energy savings Street and pedestrian
				Plaza, benches, playground etc.
				Water Building
				Dunung

Table 1: Analytical framework to depict the measurement tools of urban park sustainability.

(Source, The following analytical framework is based on many research, particularly, ecosystem services and vegetation akin the Bolund & Hunhammar (1999) and McDonald (2009), while others are adopted and contextualized from earlier mentioned literature by authors, 2017)

4. Methods

4.1 STUDY AREA

A brief overview of the two selected urban parks with cities, Hadis Park in Khulna and Biplob Uddan in Chittagong, is provided below.

Khulna, is the third largest city in Bangladesh is located is in south-western and pleasant in winter (https://en.wikipedia.org/wiki/Khulna). It is a less economy

and less bio diversified city. In Khulna many public places are an attraction to visitors. Hadis Park, is one of the largest public places in Khulna, is one of the main reason for selecting as case study.

Hadis Park is located at near of CBD (Central business district) at Dakbanglo, is about 7.5 acre in size. It is a renovated project by Khulna City Corporation. The park is surrounded by mixed land use, while inside of park has less diversified facilities. Entrance from three side make more welcoming attitudes of park. At west of park, Khulna City Corporation is located.

Chittagong, is a major coastal <u>seaport</u> city and <u>financial center</u> in <u>Bangladesh</u> is located coastal foothills of the Chittagong Hill Tracts in southeastern of Bangladesh. The Karnaphuli River runs along the southern banks of the city, including its central business district. Chittagong has a tropical monsoon climate and well- known for its rich biodiversity and public places (https://en.wikipedia.org/wiki/Chittagong). Biplob Uddan is one of the historical public park in Chittagong district. It is also located at near of CBD (central business of district), at 2 no gate Sholoshahar. It is almost 2 acre in size. It is a symbol of liberation war of Bangladesh is represented by its name.

4.2 METHODOLOGY

This qualitative approach consisted by three process. First, a critical literature review based on the domain of ecological infrastructure specifically eco-system services and biodiversity, benefits of socio-economic and urban form in urban park to find out research gaps and threads, is followed by a pilot study to justify the selection of case studies and by developing conceptual framework for sustainable urban park design. Second, sustainability of urban park has been measured across the aforementioned domains through semi-structured interview, Key informant interview, participant observation, policy documents, grey materials have also been conducted. Lastly, triangulate the collecting data in terms of data reliability has conducted.

Pilot study in this study has taken as a key method to get primary understanding of case study according to Patton (2002).Key informant has chosen through 'reputational snowball sampling technique' according to Farquharson (2005), for identifying micro-level network members, reduce the selection bias and meet the research aim. Ten interviewees between 31 and 40 years old have been selected as local public policy makers, NGO agencies, academics and professional practitioners. Thirty semi-structured interviews with open –ended questionnaire has been administered according to the following criteria's: (1) identify practices and means use of parks of in relation to ecosystem services within the park premises among different age groups and (2) identify where social, ecological, economic, educational and cultural activities that enables to sustain or unsustain the parks in relation to city image through field observation.

The analysis of the interview transcripts was manual according to content and findings somewhat analyzed by five-point Likert (highly dissatisfied to highly satisfied) scale to visualize the numeric number for all categories. Photographs in this study have been adopted by a wide range of approaches. Interpretations were based on the authors' contextual understanding. Finally, triangulation was conducted by reporting and discussing findings with KII, Participants interview and field observation were defined, investigated, and interpreted as experienced scholars suggest (Flick 2014)

5. Assessing sustainability of urban park design policies in Bangladesh : findings, synthesis and discussion

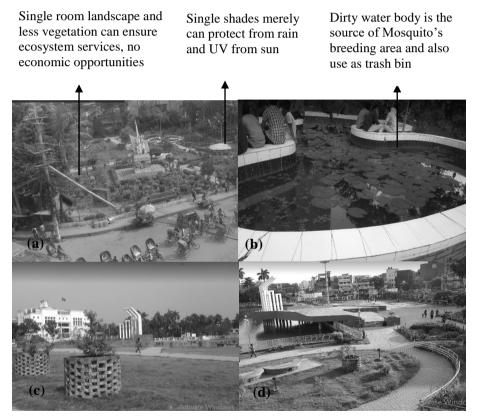
Overall, the result confirms that both parks are ecologically unsustainable, while socio –economic benefits ranked as moderately sustainable. Yet, the practice of urban form ranked unsustainable like the former one.

In both parks, air filtering, noise reduction, micro-climate regulation and Rain Water drainage system and Waste management under ecosystem services ranked 80% dissatisfied area. Due to lack of green belt, location of parks (Location of both parks is a great source of urban heat), flat landscape, lack of drainage system, both parks cannot filter pair, reduce noise and absorb extreme rain water is confirm the previous findings (Heidt and Neef, 2008).Biplob Uddan is a great example of water logging in summer, even become inundated in heavy pouring. Users often face awkward situation and sink in rain water (around 48 inch depth of water logging in raining season).Children merely visit the parks in the rainy season for fear of death, only adult and few older enjoy the park.

Socio-Economic Sustainability ranked as moderately sustainable. Though in Hadis Park offers very few food vendors only up to 10 pm (restricted time by management).In contrast, Biplob uddan (see figure 2)is not facilitated by economic opportunities. Both parks only use for recreational facilities like passing time and taking rest by mainly older and younger generation, while children are not enjoyed there due to less amenities and services like playground, trails and by cycle riding. For both parks, especially for Biplob Uddan, the property value is increasing day by day for recreational opportunities. Lack of biodiversity, native landscape, merely offer a place for cognitive development. Also, lack of diversified facilities and services like trails, playground and shops presented in both parks for attracting all aged

group also affirm the previous findings shown that presence of amenities and services is very important for livability of a park (Kaczynski et al. 2008).

Urban form sustainability is also ranked as negatively. Single landscape, absence of built forms, shades, very few sitting arrangement and polluted water body merely can sustain both of the parks. In Hadis Park (see figure 2)a large water body only use for recreational purposes, while in Biplob Uddan the small waterbody is use for dumping dirty water. Due to location, and neighborhood characteristics, the property value extreme of both parks park premises. Although park is very eye catching and 'eyes on street' according to (Jacob, 1961), but absence of green belt, vegetation and mixture of landscape patches merely vibrant and sustainable.



Figure, 2 (a), Three dimensional view of Biplob Uddan,(b) A single age group enjoy the Biplob Uddan , while older and children are not visit the park due to lack of playground, trails, bicycling area ©Single room landscape in Hadis Park merely can promote biodiversity and sense of urban form. Absence of green belt also cannot filter the air, reduce noise from roads (d) very few urban form like plaza, waterbody and few sitting arrangement has been visible, yet absence of shades and built form merely cannot protect from extreme sun light and rain in rainy season. (Source, author adopted from www.googlemap.com)

However, less sustainable urban park deign policies in Bangladesh mainly accused for three main reasons as follows:

5.1 LACK OF COORDINATION BY PLANNING AGENCIES

In urban planning, the lack of the coordination among public authorities is one of the crucial issue of Bangladesh. For instance, Islam (1992) mentioned that the governance at the city level is highly hindered by the lack of coordination among various authorities of governance. As result, they frequently overlap their responsibility and merely get single role to provide good planning and management.

The general procedure for establishing public parks and open green spaces is acquired by the key stake holders like CDA (Chittagong development authority), CCC (Chittagong City Corporation), KCC (Khulna City Corporation 2001) and higher authority. Due to decentralized process of planning policies in Bangladesh, urban parks face tremendous lack of management and ownership stability. In fact, the responsible authority largely failed their duties to protect and make sustainable open space and urban parks. It is the reason that none of the administrative authorizes in the city-region has merely follow a people oriented a strategic policy document or plan on public parks and green spaces.

5.2 LACK OF PARTICIPATION BY COMMUNITY

In Bangladesh, urban planning polices is undergoing expert -led process, and tokenism (Rahman 2016) which is highly outdated to true participation of people. Bari (2009) noted that, a true participation of community in urban planning, is more important than passing a plan through a short discussion, as it is only emphasize a top-down policy planning method and rarely able to perceive people's actual needs and contextual demand. In the course of planning the master plan, participation from all public agencies, elected political leaders, media and merely academics are asked to participate in the plan preparation stage to develop a progressive future. While this approach obviously open the scope to deliver the opinions by higher authorities, much less attention has been paid to general people's participation. Due to the lack of community participation in the grass root level, the local problem and people's needs are often overlooked and encounter with ill-being of people.

5.3 LACK OF EXPERTISE KNOWLEDGE

In Bangladesh, urban planning especially urban park design policies basically hindered by the lack of integration of various expertise knowledge. The integration of ecological benefits especially ecosystem services into planning and design in Bangladesh is limited. On the other hand, urban planners, architects play their role is limited to socio-cultural and socio-spatial benefits,

even they ignore the ecological benefits in urban design practices. They presume the urban park as a recreational space only, where vegetation (Urban green) plaza, path and benches (urban grey) are the main amenities. While these are really important for urban parks, but native landscape species are more important for sustainable urban park design is ignored by their educational and professional knowledge. Though, in planning sectors, like city corporations in Bangladesh recruit both planners and architects with the aim to sustainable urban development goals, they rarely hire or recruit any environmentalist to promote the planning and design phase.

Lack of proper planning polices by CCC or KCC merely can guided by national environmental protection laws, which is mostly concerned with protection of large, biodiverse forest wood land (http://www.moef.gov.bd/). In Bangladesh, another most rigorous initiative of environment protection has administered by BAPA (Bangladesh Paribesh Andolon) is still paid less attention to the protection of urban Public Park with ecosystem services and sustainability as a whole. Further, written column about urban park design guidelines merely evident in website and policies of City Corporation and public works related governance (http://www.mohpw.gov.bd/). Though, City Corporation is the key authority of park design and severely management, they merely alarmed about ecological sustainability in urban park.

6. Conclusion and way to future research

Urban park sustainability through the lens o urban planning in Bangladesh is merely satisfactory and vulnerable to ecological disaster. An urgent and holistic frameworks and coordination among stakeholders needs to be raised to mitigate the unsustainability.

To reiterate, although integrated ecosystem service framework into planning practice already is used by urban planners and developers, but context specific knowledge based holistic frameworks and findings from this study is very necessary in urban planning sectors, as the frameworks is based upon ecological, urban design and socio-economic elements.

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DISASTER RISK REDUCTION THROUGH THE LEARNING OF TRADITIONAL KNOWLEDGE OF BUILT HERITAGE: A CASE STUDY OF VILLAGE- BAGORI, UTTARKASHI, INDIA

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Abstract

The Sendai Framework for Disaster Risk Reduction 2015-2030 calls for a historic shift from an emphasis on disaster management to address disaster risk management. It also focused on to prevent new risk, reduce existing risk and strengthen societal and environmental resilience. United Nation also addressed disaster risks in the context of sustainable development and in building resilience through enhanced national and local capabilities to manage and reduce risk. In the light of these international forums, this paper is an attempt which tries to investigate the various physical aspects of traditional knowledge of the built heritage of the hills of Uttarakhand that contributed in surviving the impacts of disasters for long time and helped in mitigating and sustaining the disaster risk. The study gives an overview and explains the viewpoints of sophisticated built heritage with relation to the designs with traditional pattern, limited materials and technologies, which is a kind of survival design for mitigation of unavoidable disaster. It brings out the findings how and why the traditional wisdom is not effectively adapted in the contemporary built environment. The qualitative data collection and analysis is based on the intensive primary survey of the village Bagori in Uttarakhand state of India. The adaptation of this traditional wisdom dovetailed with modern practices will certainly contribute in the sustainable development of the disaster prone region.

Keywords:Disaster risk reduction, traditional knowledge, hill region, built environment.

1.Introduction

1.2 BACKGROUND

Traditional dwelling are the integral part of the local cultural heritage. These structures are the manifestation of architectural system developed over time through trial and error methods for a particular geographic and climatic contexts, that had enabled the communities to cope with the vulnerable threats including, harsh climate and to the natural disasters. In India, it is evident from a wide variety of traditional dwellings including Bhunga's in Gujarat, Bamboo

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houses in Bihar, and wooden houses in Kashmir are commonly built with locally available materials and have adopted traditional construction skills and techniques (Langenrbach, 2009). Thus, communities have developed survival strategies through their traditional knowledge skills for coping with the stresses from natural hazards.

It has been well noticed that Disaster Risk is increasing exponentially worldwide, due to increase in vulnerability as the poverty and environmental degradation is increasing very day; the climate changes have increased the frequency of natural hazard; and the exposure to poorly planned development. According to the Center for Research on the Epidemiology of Disasters (CRED) the number of reported disasters has significantly increased. In 2014, 48% of disasters occurred in Asia.Over 85% of those killed and 86% those affected globally were also in.Asia.

Secondly, United Nation focussed to build "Disaster Resilient Communities" by promoting increased awareness of the importance of disaster reduction as an integral component of sustainable development. Internationally, it is accepted to integrate multi-hazard, inclusive approach to address vulnerability, risk assessment and disaster management, an essential element of a safer world in the twenty -first century. The Sendai Framework for Disaster Risk Reduction 2015-2030 focused on to prevent new risk, reduce existing risk and strengthen societal and environmental resilience through the local knowledge. It is also encouraged to the dissemination and use of traditional and indigenous knowledge to mitigate the impact of disasters and promote community-based disaster management planning.

Uttarakhand, an Indian Himalayan state known for its rich spiritual and religious tourism, ecological richness and diversity, and cultural ethos rooted in tradition, but is also known for growing frequency and intensity of natural disaster (National Institute of Disaster Management, 2015). Inspite of that, various traditional dwelling remain intact and survived many earthquake (P. Rautela, 2007).

This paper aim to investigate various physical aspects of traditional knowledge of built environment and spatial development of rural area with the help of case study of Bagori and its role in reducing disaster risk.

1.2 SCOPE AND LIMITATION OF STUDY

Uttarakhand is source of origin of many rivers in India. Ganga and Yamuna rivers are main rivers, which are well associated in mythological and religious values. It has been also noted that the river valleys and the transverse spurs offer convenient sites for the settlement in rural areas. Various traditional

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construction techniques such as *Kath-Kuni* and *Koti*, *Dhajji-Dewari*, *Taaq* system, stone houses, mud houses, and wooden houses (Kumar & Pushplata, 2013) are well adopted in traditional dwellings according to their climatic, geographical and environmental requirement. Bagori, a small village of population 567 and 145 household, lies on bank of river Bhagirathi (*later Ganga*), near to Gangotri (*starting point of river Bhagirathi*) in Greater Himalaya, and an example of high altitude settlement in Indian Himalaya is taken for the case study. The traditional wisdom in tangible or intangible form is implicit and not available in written form, which has been translated based on the interviews and observations done by authors.

1.3.METHODOLOGY

This research is based on the qualitative approach, which has been carried out with the help of extensive studies of Bagori village, Uttarkashi, Uttarakhand. It is more explanatory and inductive in nature, so case study method is useful. The purposive sampling, mostly elderly is useful, as more information and experience they have than younger one. The data is collected through the following methods:

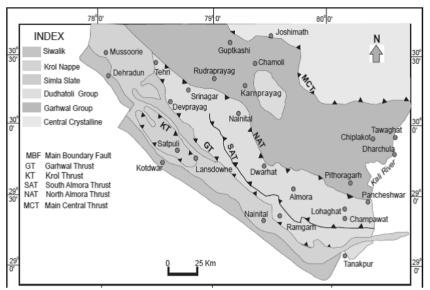
- Documentation the dwellings and their illustration
- Field study notes
- Direct and indirect observation
- Documentation of oral history and narratives through open ended and semi structured interviews
- Photographic and video recording
- Secondary sources

The verbal communications collected from the diverse responders were transcript and highlighted the major issues and coding was done. Content analysis was done by grouping and classifying the various codes evolves.

2. Field study and observation: Bagor

2.1. GEOGRAPHICAL LOCATION

Apart from Matri and Kailash mountains, on the right side there is the Shrikanth peak, behind which lies Kedarnath, and in the rear there is Banderpunch. Bagori is a small village of population 567 and 145 household, lies on Greater Himalaya, and an example of high altitude settlement in Indian Himalaya. The main tribe that settle here are *Bhutias*, the shepherd and follow Buddhism. Sheeps provide them wool, which is the main source of income. Bagori is known for its apple orchard, all around.



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Figure1: Geotectonic map of Uttarakhand

It is away from the geographical fault zone, known as the Main Boundary Thrust (MBT) and Main Central Thrust (MCT). Geographically, it strategic location reduces any type of regional hazard. (National Institute of Disaster Management, 2015)

2.2.HABITAT EVOLUTION

It is observed that Bagori flourished between the two folds formed in the terrain. The seasonal rain running water drainage will not be affected and will pass through without affected the built forms. It is very close to the Gangotri (origin of river Ganga) so the stream will be narrow and the flow of water is governed by the natural contour itself. River valley provides facilities of carving out terraces for agriculture, water sources and pasture land. The habitable residential area is on the foothill, whereas the agricultural farm lands are toward the river side. This keeps the local people away from the any possibilities of flood during heavy rainfall or cloud burst

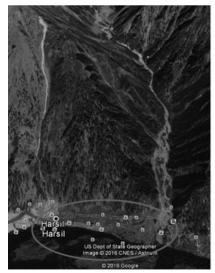


Figure2: location of village between the folds. Modified with Google image

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2.3.SETTLEMENT PATTERN

The main street laid is parallel with contour or river, while most of the residential units are placed perpendicular to street. The impact area of unit in case of flood from river side or landslide from the hill side is reduced. Each unit is isolated and separated by an accessible walkway of at least 1 meter in between. There is no built structure toward the river to safeguard them during the rise in the water level in the river.



Figure 3: Main street laid parallel with Contour



Figure 5: Each dwelling is detached

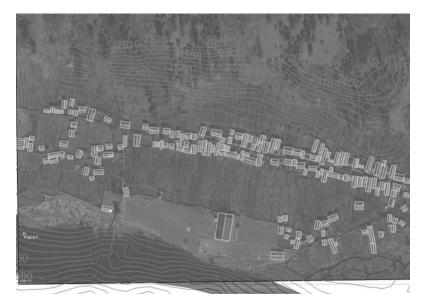


Figure 5: Layout of village

2.4. BUILT FORMS

Buildings with simple, regular and symmetry in both plan and elevation configured buildings produce less magnitude of twist during any hazardlandslide, flood, earthquake, velocity wind etc.. as considered to be very stable. Houses are usually in linear shape with verandah on the longer side with two or

more rooms opening in verandah. Semi covered verandah is usually used as multipurpose space sometime extended as temple, toilet or kitchen. Dwelling units are two storied building where ground floor is stilted and used for cattle and fodder and sometime as small shop in present time, while the upper floor acts as living spaces. Stilted structure help the people during the time of flood, landslides as well snow fall. Large projections are vulnerable in earthquake and undergo high deflections and reversible stress that lead to damage of the structure (Anand S. Arya, 2014). There are no projections used for this built form.

2.5.BUILDING MATERIAL AND STRUCTURE

The habitable composite structure is built of locally available timber and stone. The lower floor is stilted using the stone, whereas the walls are constructed by making the frame of timber and infill of stone in between the voids (Anand S. Arya, 2014). The walls consist of cribbage configuration wooden with orthogonally wooden arranged logs interconnected at the junctions by wooden pins/ tenons (Gujja Khoonta). The upper floor generally used as living area is constructed completely of timber.



Figure 6: Rectangular and simple plan

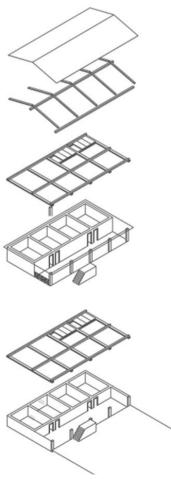


Figure 7: Exploded view of dwelling unit

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The floor and walls is constructed with the planks of timer. The stable frame structure is well constructed where it can bear the various external forces occurring in this region.

Wood has higher strength per unit weight than most other construction materials (Anand S. Arya, 2014). Timber is strong, elasto-plastic and fibrous material, form the basic framework of the structure. It has ability to absorb the various types of vibration and also climatic responsible material for this cold region. Both housing and nailing techniques are resorted for joining the wooden components in these structures which allows for minimal angular displacement. This kind of joint incorporates advantages of both pin joint and rigid joint and acts as a semi-rigid joint, which is an additional advantage for shock resistance. Stone is generally used as infill material in these structures, play vital role to resist various live forces.

3.Analysis

The intensive survey was conducted by the authors and information collected through various semi-structured interviews conducted during the field work and transcript. The following section discusses the analysis of finding based on the primary data

3.1. DEVELOPMENT AND CHANGE

With the time, the increase in the population and tourist in the region brought many developments in the area. The positive and negative realm of development and disaster has been put forward to local people during the interviews conducted by the author and key findings are as following:

3.1.1.Road widening increases vulnerability to landslide

It was found that local people are against road widening, even though it gives them better connectivity to other places. It was conveyed that the rock or debris occurred due to cutting of hill for widening the road, effect the vegetation at the lower portion which affect the intactness of the hillock (Fig.8). Deforestation lead to reduction in the compactness of soil and erosion of soil increases.



Figure 8: Widening of road lead to erosion of soil

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3.1.2. Changes in the land use and commercial approach lead to modern construction technology

With the increase in the tourism and hospitality attracted many nondomicile people for the commercial benefits. The change in land use from agriculture land to non-agriculture land gave the right to non-domicile people to acquire large parcel of land. For the fast construction, lack of time, availability ease of of modern



Figure 9: Contemporary construction material and techniques adopted

materials and labour, it is much easy to build new building and adopts modern construction technology (Fig 9).

3.1.3.. Planting foreign vegetation increases vulnerability

According to the local people *Chir* or pine (tall and straight tree of average height of 30mt) are not locally developed trees in this hill region. It's been brought by the British. Due to its foliage, it effects the growth of other vegetation and grass, leading to instability of the soil, thus increases vulnerability to landslides in the area. Tall tree stop the cloud, which lead to cloud burst.

3.2. SUPPORT SYSTEM

The traditional dwelling are the outcome of the understanding which people have developed, be it in the terms of choosing the building materials, its reusability and climatic responsive design. All this add to comfortable use and the sustainability of the structure.

3.2.1. Reuse of the construction materials

The traditional houses were made up of locally available materials as stone, wood etc. (Fig 3, 4, 6). At the time of any disaster, firstly these houses can sustain, due to its structural system and were not having any impact (Arya, 2001). But if any damage or collapse happens, stone and the timber can be reused to build the houses in future.

3.2.2. Climatic responsive structure help the cattle as well as human being

The habitable spaces are places above the cattle shelter area next to the kitchen, so that heat gets trapped between and make living spaces comfortable (Thankkar & Morrison, 2008). Moreover, the living spaces placed on the upper floor keeps the dwelling unit accessible during winter when it snow (Fig

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6, 7). The lower portion (cattle area) is trapped between the snows, so the heat due to cattle doesn't get insulted to the outer area and thus keep it warm.

3.3. COPING CAPACITIES

The local people have good coping capacity, be it choosing their site on the basis of location, vegetation, and potential knowledge about the available materials and natural warming system.

3.31.Geological and topographical understanding of site

Indigenous Techniques is used by the local people for selection of site. Local peoples have developd good understanding of the soil conditions and can identify the solid rock to choose the land and settle down or construct their houses. Natural setting and land form indicates the presence of water, which help the to choose appropriate location for the settlement. Considering the

geological and tographical aspect of site, they decide their settlement area and develop the required basic infrastructure.

3.3.2. Vegetation as indicator for identifying appropriate location

The existing and natural vegeataion help the local peolple to find out an appropirate leation to settle down. No vegetation indicates two things- firstly there is no sun, secondly there is a possibility of landslides that had occurred in past and affected the vegetations.



3.3.3.Knowledge on local building material and their potential for disaster resistance

Figure 10: Natural setting indicate life

With the passage of time and experience, the people had learned and understood the locallay availabale material and its potential use for disaster resistance. Timber is a very good absorbant of vibrations and used to form the base of the building. *Katli Chinai*, small pieces of stone – which help in absorbing the intensive vibrations developed during the earthquake.

3.4. LIMITATIONS TO ADAPT OLD TRADITIONAL BUILDING

Knowing the importance of the traditionally developed building in various factors such as climatic responsive, sustainable, distaster resilient etc people willingly or unwillingly are opting the contemporary practices. The various reasons were identified through the interviews conducted during the field visit are:

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3.4.1. Limited resources and access to locally available material

The traditional building material- stone and timber is been restricted by government Earlier, abundant numbers of trees available as the plantation of tree was associating with any ceremonial occasion in the family. Due to the development and cutting of hills, the availability of stone is also limited. Moreover the time constraints along with the busy schedule of life, people are now attracted towards the contemporary practices of using concrete and steel. Earlier people were very laborious and they get deodar timber from the forest located at Chakrata and Mussories. Wall and floors were constructed using timber as basic materials.

3.4.2. Lack of maintenance and unavailability of skill labour

In many cases, it was found that today, only elderly are basically residing in the traditional structure, while the younger generation people have migrated to the urban areas in search for employment. There is also unavailability of the skill labour either to do some repair or new construction work (Fig.11).

3.4.3. Benefits of new materials over traditional materials and techniques

In present davs. contemporary materials such as cement, brick and steel are much more easily avaiable and imported easily to their location. Due to economic stability and purchasing cabapilty, local people preferred to construct concrete houses (Fig.12). Secondly the time taken for constructing concrete hosue is less then the traditional houses.



Figure 11: buildings were left due to lack of maintenance



Figure 12: Contemporary materials are easily available

3.4.4.Community involvement has reduced

Earlier group of peoples, friends, and relatives helped each other to cut and bring the trees from forest and collecting stone for infill. But now, the construction of house is individual activity, so people choose to purchase the available materials and their labour as per their economic status and comfort.

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4. Discussion

Knowing the importance of the traditional building which contributed in surviving the impacts of disasters for long time and helped in mitigating and sustaining the disaster risk, the investigation came up with the various following result for the discussion.

- Development activity in the area, basically construction of new roads, widening of roads, amendments in the land-use, peoples own interest and profits, plantation of foreign vegetation leads to increase in the vulnerability to different type of disaster in the last few years.
- The support system of the traditional building which have developed with the wisdom and experience of their ancestors from a long time period in term of climatic and materials responsive lead to sustainable approach.
- Local people have inheritat knowledge from their ancestors, through socialization process and from their experience from the nature and natural settings to cope up the disaster. It is whether in the spatial feature, selection of site for habitable spaces and the seting lead to the sustainable built environment.
- Skill laborious people for new construction and maintenance, unavailability of local materials, ease of time and lack of community participation limit the people to adapt traditional building techniques and construction.
- Ease of availability of modern materials, adaptation to modern lifestyle make people to construct cemented houses.
- Traditional buildings are climatic responsive and effect of climate changes is negligible.

5. Recommendation and Conclusion

The study shows that local people are aware of the traditional wisdom is the outcome of holistic response to several tangible and intangible factors which form the contextual environment. Social, economic, geographical and climatic factor contributed to the accumulated wisdom for the continuous development of the area and safeguarded the habitats from ages. The zeal to protect the community by utilizing accumulated traditional knowledge and experimenting with local available building material, paved the way for the evolution of a unique dwelling constructed on stilts near to the river. The built form which are result of various planning and architectural practices have sustained multihazard. At present people are demolishing these old structures so as to use the building material for the construction of new and modern dwellings. The

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masses therefore need to be morally and economically supportive by the government in various aspects. It is required to attract the attention of the concerned authorities to promote these learning to frame the guidelines wisely. The government projects should consciously include the local materials, construction techniques, and encourage people participation in designing and execution phases. This will not only create employment opportunities but also can build a faith amongst the people and community regarding doing construction using the traditional knowledge.

The protection of these heritage buildings and construction techniques will instil a sense of pride for the traditional wisdom of their ancestors and will enable the coming generations to have a glimpse of the architectural tradition of the region. The insights have been reflected in wisdom of selecting safe places for residences, architecture to survive hazards, wise use of sloppy landscape for agriculture and other economic activities and in preserving ecosystems for survival and sustainability. This would also provide researchers with an opportunity to study this architectural style of Uttarakhand in detail.

6. Acknowledgment

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ARCHITECTURE OF THE BUILDING PROCESS: AN INQUIRY ON COMMUNITY BASED DESIGN

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Abstract

Community-based Architecture can generally be termed as a process of building production that relies on collective communal effort in order to build spaces for collective communal use. A process of such 'collective' building would naturally require the contribution of multiple actors, resulting in a dynamic decision-making environment during the design and construction phases of a building.

This study sets out to evaluate how such an atmosphere of multiple and dynamic decision-making impacts on the 'architectural' performance of the final product. The study argues that, in such context, architecture must embrace the input of a broader socio-cultural system, seek the benefit of the social capital, and more importantly, view building as a social process that accommodates a variety cultural demands, technical pressures, and on-site decision-making interventions. Subsequently, the study examines how the design of a building system changes during its production process, in what ways specific actors and situations contribute to this dynamic behavior of design and construction changes, and the subsequent qualitative impact on the building product.

The study concludes that, in Community-based Architecture, the building design is often in the mode of constant change, whereas the building project must be recognized as a socio-cultural system birthed by a specific socio-cultural process. Therefore, it is paramount that the building design and construction process must be organized with a latitude for changes and tolerances for variations. In doing so, it establishes a position - and a theoretical framework - on how the processes and principles of building can be altered, amended and re-defined during the on-site decision making process, thereby bringing up the intellectual need to acknowledge the way in which the 'process of building' generates, changes and re-defines the 'architecture of a product'.

Keywords: Community-based design, Architecture as a socio-cultural system, Social capital, Building process, On-site decision-making.

1. Introduction: Community as a Socio Cultural System

In fast-urbanizing and economically-developing countries such as Sri Lanka, a large number of building activities take place outside of professional frameworks, using informal knowledge bases and casual building supply networks. On the other hand, the professional involvement in community-

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specific architecture falls way below the necessary demand, which in turn is attributed to the complex socio-economic, socio-cultural and socio-technical conditions, limitations and challenges prevailing in such convoluted building interventions.

This study moves from the position that the act of building is a social process, which needs to accommodate a variety of social actors, cultural demands, technical pressures, production phases and on-site decision-making interventions. Hence, acknowledging and identifying a process of design that can anticipate and accommodate changes during this long-drawn building process is a critical requirement for the production of community architecture.

In general, the idea of 'community' refers to a category of group, whose members have common interests, interacting within an area of specific geographical location. As Mumford (1934) claims, a community evolves through human interaction, which gradually transforms into a generic way of life determined by common behavior patterns. Hence, a 'community' is enriched by existential meanings, cultural expectations and habitual duties between its members, in addition to the obvious functional relationships among each other. In short, the notion of community does not connote a mere conglomeration of human individuals, but "*a distinct socio-cultural system based on a socially-organized functional and cultural framework*" (Mumford,1934).

Communities in fact evolve and develop over time, both by design as well as by default. When it is done by design, we call it community development. In essence, community development is a process supported by promoting community participation, and encouraging community itself to fabricate their human and social spaces (Mumford,1934). This generally requires bringing together different factions within the community through social tolerance, cultural cooperation, and participatory-decision making. The goal is to use facilitators to formulate development strategies and trigger the system of change, and then pursue social actors to empower the community with knowledge, actions and ownership of development (Knevitt, 2013). Being a social craft and a spatial construction, the role architecture can play in such communal development is immense in many ways.

2. The practice of Architecture: Glorification of the singular author

Etymologically, the term 'architecture' is generated by the words 'archi' and 'tekton', meaning 'chief' and 'craftsman' respectively (Oxford Dictionary of English (3 ed.), 2010). Before industrial revolution and the division of labour, an architect was called a 'master builder': "*an all-rounder, responsible for*

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almost all facets of the design and construction phases" (Larson, 1993). These responsibilities included, among others, designing spatial and technical schemes for buildings, managing user expectations and aspirations, planning construction strategies and directing workers through the building phases, solving on-site construction problems and subsequent decision-making at building site, accommodating progressive changes and steering construction work till completion.

According to Larson (1993), the master builder was the thread that connected design with construction, product with process, and the client aspirations with on-site socio-technical possibilities. Being a part and parcel of the building team, the master builders led the construction process, responding to pragmatic building challenges and adjusting design tolerances to suite on-site technical, environmental and social changes. Yet, as Weston (2011) claims, the Renaissance conception of architecture as an art initiated a growing separation between design and the practical craft of building.

With the industrial revolution, the advancement of building craft fell into the prerogative of engineers, while other responsibilities of master-builder were gradually shared among a plethora of other professionals – such as quantity surveyors and project managers – thus escalating further divisions between the process of design and the process of construction (Larson, 1993). Yet, while the social process of building was fragmented into separate professions, the architects were still regarded as the singular authors of architectural creation.

"The romantic idea of the architect as an embattled artist-hero struggling to create civilization's greatest achievements originated with the writers such as Goethe, and was later adopted by architects such as Le Corbusier and Frank Lloyd Write. The latest reinvention of this role is the 'starchitect', an all-conquering, all-powerful designer able to put cities and clients on the map" (Weston, 2011)

This notion and practice of architect as the singular 'star' betrays the ground reality of building production, where a conglomeration of social actors – architects, engineers, surveyors, clients, builders, site-operatives, manufacturers, building system researchers, specialist sub-contractors, etc. – contribute to the successful completion of the final building artifact. The apparent singularity in the discursive acknowledgement of architect and the obvious plurality in social building production are contradicting with each other, resulting in a general lack of architectural intervention in community-focused, participatory work.

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In fact, Architectural historian Kenneth Frampton (1987) argues that architecture is increasingly made to be scenographic: an artistic practice of setting a stage of dramatic performance. Frampton claims that this product-focused obsession of artistic imagery has reduced architecture to "*a very gratuitous use of historicist motifs*" (Frampton, 1987).

In short, the fragmentation of design and construction advocated during the post 'master-builder' period must be overcome, by conceiving strategies to bridge the gap between the product of architecture and the process of building. Such move away from a scenographic adoration of architecture as an artistic product - and the subsequent glorification of architect as the singular creator of buildings - must be indeed welcomed, especially if participatory processes of community development are ought to be embraced by the profession of architecture.

3. Building as a Product

As mentioned above, the process of building can be seen as a convoluted, mutable - and at times turbulent – course of action, involving a diversity of actors, ideas and capacities, thus progressively changing the initial design proposal as the building is taken shape on site. Before critically establishing this position, it is required to evaluate the notion of "building product" beyond the scenographic ambitions as explained above. In short, buildings can be recognized as a byproduct of a series of thoughts, actions and a collection of systems, all leading to the articulation of a specific building output (Graok, 2000). These systems can be spatial systems as well as constructional systems, imparting a qualitative impact on the final product as it is shaped during the processes of design and building.

3.1. PRODUCT AS A SPATIAL SYSTEM

In general, a spatial system for a building is conceived according to the functional and phenomenological objectives of a particular building program, and is deliberated around an arrangement of spaces from entrance to the exit, and subsequent linkages of in-between spaces. According to Giedion (1971), spaces in a building are often arranged to a specified hierarchical order conferring to the requirements of a particular building program. This could impart upon a perceiver a feeling of direction and a sense of belonging to the spatial system. The spatial system thus has a strong impact on the formal aesthetic reading of the building. The massing of the individual spaces can be delineated by the visual weight, light and human scale; the diversity in use and character, on the other hand, can be generated by their association with the functional program (Giedion,1971). However, while this spatial system gives meaning and reason for a building product, there are all put together by a

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selective arrangement of a constructional system of building elements, components, and parts.

3.2. PRODUCT AS A CONSTRUCTION SYSTEM

Naturally, a building product is composed of a series of building systems, most prominent of them are the Foundation, Floor, External walls, Internal walls/partitions, Openings and Roof. A building process would assemble these construction systems in order to contribute to the formation a final product. The material selection, application and usage of each construction system will determine the quality to the building. In community-based design, the task of material selection become very important due to the limitations in the technological environment offered in such work. Generally, the material availability and costs are dependents on the socio-cultural systems are socially developed and the subsequent building product represents a particular socio-cultural facet of the community.

3.3. PRODUCT AS A QUALITATIVE IMPACT

In the grand scheme of building, however, the spatial systems and constructional systems are collectively meant to generate a qualitative impact on the performance and experience of a specific architectural product. The idea of what constitutes the 'quality' of an architectural product is a much discussed and debated position throughout the history of architectural discourse. The answer can be so diverse and so personal, depending on the intellectual positions, social objectives and professional alignments of the commentators. In general though, most of these varied interpretations focus on a set of common themes: Aesthetics, Ethics, Economy, Ecology, Energy, Context, Social awareness, Compatibility, and Transferability, etc.

4. Building as a process

Groak (2000) defines the building process as: a set of inputs (used in a given period of time and a specific site), which uses resource flows, to assemble and transform them into a specified building output. More specifically, a building process can be divided into two parts: design process and construction process. The design process will determine the location of the building in relative to spatial objectives, the protection of the financial resources, the terms of the members of the design and building teams, the object to be built and how to build it, and the eventual maintenance of the building, etc. Construction process, on the other hand, deals with the assembly of components, following approvals, controls and checks for general progression. In both phases, communication among the members of the design and building teams

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areimportant as the subsequent "decision-making can be triggered by various members – both internal and external to the project team - at different administrative, technical and financial capacities" (Groak, 2000). Essentially, building process is a social organization that accommodates input, knowledge and attitudes of a conglomeration of social actors.

4.1. PROCESS AS A SOCIAL ORGANIZATION

Any process of building triggers with a client who necessitates a building action and commissions a design team. The rest of the design and building team consists with: someone who designs the building, and specifies the building arrangements and constructions (architect); building consultants such as structural engineers, land and quantity surveyors and service engineers; someone responsible for purchasing material and manufacturing of components for the product in production line; and someone who constructs the building using these materials and components according to the consultants' specifications (usually, called contractors and sub-contractors). In addition, there can also be other actors, depending on the scope and composition of the building program: technical advisors, policy-makers, social agents, funding agencies, financial facilitators, planning authorities, research organizations, speculative users, etc.

4.2. PROCESS AS A DESIGN RESPONSE

One of the critical aspects of this social organization of actors during the building process is that, while they contribute to the gradual assembly of the building on site – either directly or indirectly - they also participate in various decision making tasks. All of them contribute to the development of the product, physically as well as intellectually. But some make critical decisions regarding the design of the building, even at the construction phase, and even by actors other than the architect and the specialist consultants. As Groak (2000) claims, "design" is a problem solving activity, and solving design-related problems during the construction phase can be the prerogative of many different social actors, who are involved either directly or indirectly with the project team. The origin and objectives for these on-site design decisions can be many, involving financial alterations, technical possibilities, fluctuations in on-site labour skills, needs to respond to changing cultural conditions or unanticipated environmental parameters.

5. Process vs. Architecture

The specific position taken by this research argues that architectural thinking is applied in all these different *stages* of building production, by the contribution and involvement of many different *actors*, and with the resolution and application of a diverse range of building *systems*. In other words, architecture

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is not the result of a determined decision-making by a singular author, but a collective intellectual input by a variety of actors, in a variety of stages, in order to design and assemble a variety of building systems.

This research sets out to identify general behavior, association and relationship between these three important components of building production: *Stages* (Concept, Schematic design, Design development, Detail design, Tendering, Construction, etc.), *Actors* (User, Client, Social agent, Funding agent, Architect, Engineers, Contractor, Manufacturer, etc.) and *Systems* (Floor, Wall, Roof, Partitions, Foundations, etc.). It also investigates the qualitative changes enforced on the final product due to the dynamic behavior of these elements, by examining the subsequent design changes in the light of ethical standards and social equity, the degree of change and transferability, ecological quality and energy conservation, economic performance and compatibility, and contextual response and aesthetic impact.

In order to maintain consistency, the case study investigation is organized under the aforementioned three rubrics of Stages, System and Actors. Consequently the analysis centers on examining how design is developed, applied and changed during different design and production stages, by which contribution and involvement of the participatory actors, and with which transformation of building systems and principles.

5.1. STAGES VS SYSTEMS

The different roles and objectives of project stages - from Conception to Completion – would generally determine how building systems are conceptualized, developed and implemented throughout any given building project. Even though it can be theoretically argued that most building systems must be conceptualized and developed during the detail design stage, and assembled during the construction phase, the reality is far from such a linear process of activities. In fact, the development of a building system can go through a turbulent path, depending on the technical pressures and cultural interventions that may take place during different stages of the building process (Hudson, 2006). Staging of building process is determined by a set of sociotechnical, socio-cultural and socio-economic conditions, which the actors must respond to through specific building solutions; changes that occur during these different stages may change the composition, ethos and performance of a building system. In practical terms, the objective of this *first analysis* is to identify the formation of 'drastic changes' and/or 'gradual developments' of building systems as the building is progressed through various stages of design and construction.

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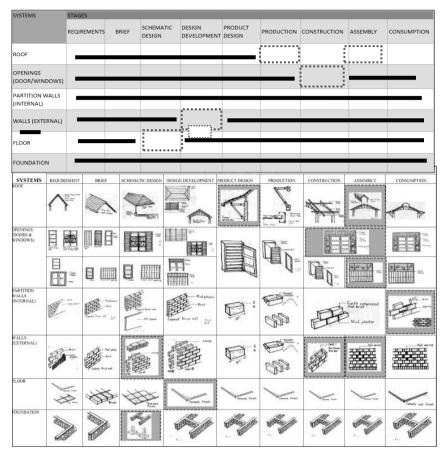


Table 1: Introduction to Stages vs. Systems

Figure 1, Identical changes – Systems vs. Stages: Yodakandiya Community Complex (*Source: by author*)

5.2. STAGES VS ACTORS

In architectural production, the staging of activities is both a necessity and a choice determined by the roles and capacities of different actors involved. However, with these different actors imposing diverse roles and aspirations in different project stages, the process of building may invariably generate a turbulent technological and social environment. This will result in a dynamic design and construction milieu, which can be subjected to disputes of ideas, development of diverse solutions, and situations of unforeseen changes. This forms the theoretical background for the *second analysis*, which evaluates the involvement, behavior and relationships of different actors as

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they are directly or indirectly participated in different stages of the design and construction processes. In particular, the analysis will follow the path of design development, identifying the roles played by main and sub contributors at each of the project development stages.

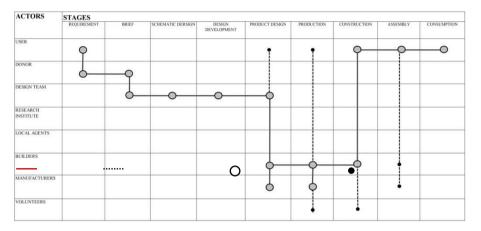


Table 2: Data Collection - Stages vs. Actors: Yodakandiya Community Complex

5.3. SYSTEMS VS ACTORS

It can be argued that the design and assembly of any building system is determined and conditioned by the building actors involved in the subsequent design and assembly processes of the particular building system. It can further be claimed that a range of social actors - who come into the production process at different stages of building procurement - conceptualizes, develops and assembles a building system in its process of assimilating into the building whole. Invariably, their decision making lead to building system changes the building process, resulting in many different technical. during environmental, economic and aesthetic repercussions. The third analysis moves from this argument and investigates the context of actor participation at the critical junctures where significant design changes occur during building production process, and inquires on the subsequent technical, environmental, economic and aesthetic impact that these changes generate on the building output.

Table 2: Data Collection - Systems vs. Actors: Yodakandiya Community Complex

ACTORS	SYSTEMS					
	ROOF	OPENINGS (DOORS & WINDOWS)	PARTITION WALLS (INTERNAL)	WALLS (EXTERNAL)	FLOOR	FOUNDATION
USER		XI			X2	
DONOR						
DESIGN TEAM	(X3)	(X4)		(X5)		X6
RESEARCH INSTITU	UTE					
LOCAL AGENTS						
BUILDERS			X 7			
MANUFACTURERS		X8				
VOLUNTEERS						

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In order to evaluate the afore mentioned research positions and the ensuing analytical framework, two community-focused building projects built in Sri Lanka within the space of last 10 years have been analyzed: Yodakandiya Community Complex and Lunawa Livelihood Development and Community Center, both designed by the architect Susi Jane Platt in collaboration with Architecture for Humanity. According to the research findings, almost every building system goes through a gradual development but some are subjected to drastic changes, even leading into significant transformation of their technical composition and performative principles. These so-called 'drastic changes' may occur due to different social, economical, and technical reasons, via decisions taken by different actors in different procurement stages.

A critical observation of the two case-study projects, however, is how they differ in terms of when and who triggered these so-called 'drastic changes' during their respective building production processes.

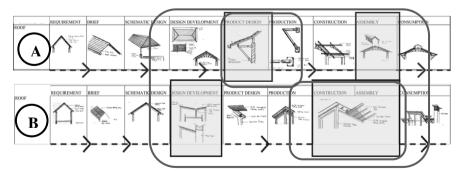


Figure 1, Cross Projects Analysis: Identifying System changes in which stage by which actor to maintain which product quality (*Source: by author*)

For example, in the Yodakandiya project, most 'drastic design changes' have happened during assembly and construction phase. The architect's involvement

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in these changes have been significant, although they were mostly influenced by other actors. In the Lunawa project, on the other hand, most design changes have happened during the design development stage via the contribution by many. It is evident that, when moving from one project to the other, the design and building team has deliberately been more flexible in order to accommodate input by other actors during the design phase. Bringing in many actors to the design process as early as possible has allowed a less-turbulent building process where the need for drastic changes later on has been reduced. The ability of the design team to embrace 'collectivity' of actors and inputs – as opposed to the 'singularity' of a deterministic author – can be attributed as a critical factor in contributing to the success of these projects.

6. Conclusion: Designing for change

It is evident that, in community architecture, where a community of actors participates in the building process, the prevalence of a singular decision-maker may result in a turbulent construction environment, which can eventually lead to building failure. This may be one of the reasons why reputed architects have failed to deliver community buildings of great eminence and success. The comparatively successful projects such as Yodakandiya reveals that, for community-involved architectural interventions, both the product and the process of building must be 'designed' with a fair degree of tolerance so as to accommodate inputs by diverse actors at different stages of building procurement. Within such a flexible design approach, the architect needs to embrace the dual role of being both a definer as well as an accommodator of the dynamic decision-making that takes place during the entirety of the building process.

The specific findings of this study showed how 'drastic changes' and 'gradual developments' to building systems occur during the building process with active participation of many different social actors. It also showed how such changes impact on the quality of the final product, with some changes even compromising the intended cultural aspirations and performative attributers of the building. If such adverse performative impacts need to be overcome, then such buildings – as well as their procurement processes - need to be designed with a capacity to tolerate future changes.

While the spatial and technical resolution of the final 'product' must still be a key prerogative of community architecture, it is the 'process' itself that must be brought into a more rigorous attention. Exploring what this study calls '*an architecture of the building process*', some key recommendations on this regard can be formulated as follows. Firstly, community-specific buildings that

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rely on social capital for its production need to be designed with an appropriate level of technical and formal flexibility to accommodate unforeseen changes that may arise during the construction phases. Secondly, building production must be understood as a social process involving many beneficiary parties who involves with varying scopes and skills during the design and construction processes. Thirdly, most of the actors of the building process must be brought into the design phase as early as possible, to mitigate the possibility of changes that may occur later during the assembly stages. Fourthly, the building process should be planned – and designed - to identify and accommodate contributions by a diversity of social actors; the planning of the process must be given an equal space, value and attention as it would be for the planning of the final product. Fifthly, community architecture must be embraced as one that accommodates a whole socio-cultural system, certainly not an outcome of a singular author.

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CHANGING ROLE OF INSTITUTIONAL OPEN SPACE IN THE MODERN EDUCATIONAL SYSTEM.

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Abstract

In the recent technological advancement, role of institution becomes facilitator in the learning process, where knowledge and skills are acquired through guidance and self indulgence. In that process the space confined (class room) learning transforming to space unconfined learning process (outside class room) is gaining its momentum. In that context space between and within buildings in the institute is emerging as an active spot for individual or group to engage in self-learning. There is a need to understand the impact and diverse effects of open spaces in campus, in order to meet the expectation of the user. Apart from imparting learning, institutions encourage extracurricular activities to maintain quality of learning which are catered by landscaped spaces in a campus. Are the spaces between the buildings meeting the expectations of the users? What are the aspects to be considered to create these spaces in the changing learning environment? What is the impact and perception of these spaces? The main objective of the research is based on finding answers for these questions. The present study involves local case studies to find out how the open spaces are perceived and how spaces are evolving. To meet this objective a multi layered methodology is indulged in this research in order to develop reliable results which includes direct Impressionistic observation -where the users are identified, observation of the spaces is done and verification of the findings is done through evaluation and survey questionnaire and behavioural mapping- a systematic way of recording the observation which includes place centred and individual centred mapping. The outcome helps in creating flexible and user centric open spaces in campus design.

Keywords: Open spaces, direct impressionistic observation, behavioural mapping.

1. Introduction

Institutions are playing a major role in our lives. It provides opportunity for social economic & cultural activities that are diverse, but unified. The changing trends in education system have influenced the users to seek knowledge outside the classroom. An institution is a setting which has users from various demographics that contributes to its rich culture of diversity. Providing unconfined spaces for such users involves a lot of research. The users can be marginalised to students, faculty and staff and community members who use the space. In the initial stages, Institutions focus is primarily on built structures

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and infrastructures rather than open spaces. Open spaces were mere spaces confined for future development. In the recent years recognized universities are redesigning the campus in order to reflect the identity of the university and provide space for user activity. Christopher Tunnard predicted the futuristic approach to design of open spaces, designers in the future; "will not be concerned with outworn formulae or manmade theories Useful for other times and no longer applicable for our own. They will demand the freedom to draw on any art in any age for inspiration, adapting it for use in accordance with individual needs for expression." * Literature on how to design campus open spaces is limited to few when compared to other streams of design, especially the ones which links design of open spaces and user needs. To design such a space one should do considerable research on how the space as a setting is understood? How a user behaves in a particular setting. Once the issues are found out user expectations charted out we can easily identify whether the said designed space caters to the activities or not.

2. Objective.

To find the expectation of a user from an institutional open space. To identify the design aspects that influences the institutional open space. To understand the role of the institutional open space in the modern educational system

3. Literature Review

The researcher needs to have a clear understanding of the requirements of an institution, the spatial recognition, user needs and methodology which has to be applied in order to get reliable results. The literature gathered around such aspects is mentioned below;

3.1. OPEN SPACES

There are lot of definitions for open spaces based on open space plan, ecology, urban setting etc. (Richard Forman 1995, Lewis 1996) The definition which can be closely related to a campus is given by Ashihara (1981) external space is 'a space that is configured by a framework for identifying or removing part of the extended and infinite nature, which is a building without a roof, and is formed primarily by the correlation between man and the things he perceives.'* Two things must be understood regarding a setting, one the nature of the setting other how its user will act in it. Robert Fenton (1968) while explaining his "landscape effect" "the total emotional reaction to the form, size, quality & character of the greenery in this Urban campus setting" * has mentioned that the design determinants should include four spatial types; entry spaces, district spaces, major open spaces, architectural spaces and the incomplete linkage of

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these areas functionally and visually will create fundamental flaw in the existing setting.

3.2. BEHAVIOR SETTING

A user is a person who lives in it, work in it, pass through it, repair it, control it, profit from it, suffer from it, and even dream about it. Basic information about the user predicts certain behavioral pattern in general. The space should have cognitive impact on the user (Amos1977). According to Roger barker (1968) "A central tenet of behavior-setting theory is that consistent prescribed patterns of behavior, called programs, are found in many places."* "A good setting supports purposeful behavior; it makes a good fit with user actions" * Variation in diversity of user will change the patterns of behavior and in certain cases it becomes difficult to control the environment. (Amos1977)

3.3. DESIGN DETERMINANTS

The design considerations should take the following into consideration; physical & ecological quality, behavioral & functional quality and aesthetic & visual quality. Abu Ghazzeh (1999) Site furniture are elements that inhibits comfort, convenience, information, circulation control, protection and user enjoyment. Benches, bollards, signage, lighting, tree grates and utility boxes are a few examples. Design of these elements are influenced by cultural (Social and Political), Physical (climate, physiographic and built environment), Environmental (Temperature, precipitation, wind, light and noise) and Operational (Regulatory standards and Human body dimensions & movement).*(Cerver 1995) Yet significance is given to "availability of each Unit, Maintenance requirements, Initial and lifetime costs, and Whether the solution will be consistent with the overall design of the project" (Serra 1996). The study of design elements (color, lighting, technology, landscape and spatial arrangement) and behavioral psychology based on public space environment shows strong connections. (Ding, Guaralda 2011)

4. Research Methodology

"Research designs are plans and procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis". John.W.Creswell (2009) Revisits to the research methodology on studies related to open spaces and behavioral psychology links us with mixed methods (qualitative and quantitative) that involves a variety of study & verification methods (Abu Ghazzeh 1999, Ashraf.M.Salama 2008, Ding, Guaralda 2011, Tien-ling yeh, chieh-ju Huang, 2015). Based on these studies a multi layered methodology is being formulated which encompasses direct observation method, behavioral mapping and survey questionnaire. It is

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recognized that the value obtained from such a method can be reliable and error in the results would be negligible. (Ashraf.M.Salama 2008)

4.1. DIRECT OBSERVATION METHOD

Direct Observation records what people actually do in a place, how they behave and how they react to a particular place? This method provides a great deal of objective data; every setting is a place for gathering it (Lynch 1984). Direct Observation is undertaken for two reasons: the first is to identify key issues to be explored, while the second is to verify the responses received. The method involved in touring the outdoor spaces several times within the campus while documenting the tour by photographing key spaces, key positive aspects & demerits found in the spaces. Verification of the key issues can be done by the analysis of survey questionnaire.

4.2. BEHAVIOR MAPPING

Behavioral mapping is a technique used to study people"s locations and actions in a particular setting (Sommer and Sommer, 1997). Data pertaining to the movement patterns is obtained by observing people in person or through recordings and its analysis (Madden and Love, 1982). The particular research a combines a mapping technique which integrates "place-centered" mapping & "individual-centered" mapping. Place centered mapping aims at observing actions in a particular setting which are recorded on plans and diagrams. Individual centered mapping aims at recording the tasks, activities & movements of people throughout the space. (Ashraf.M.Salama 2008)

4.3. SURVEY QUESTIONNAIRE ANALYSIS

A questionnaire survey is conducted to find what expectations a user has regarding a courtyard and garden space. Survey Questionnaire analysis is used to identify the expectations of the user and whether the observed actions are actually intended by the user or not and whether they are met.

5. Findings & Analysis

5.1. CASE STUDY: SRM UNIVERSITY (KATTANKULATHUR), INDIA.

As a primary area of observation the campus of SRM University, Kattankulathur campus has been chosen. The campus caters to the needs of around 38,000 students and 2600 faculty across all the campus, offering a wide range of undergraduate, post graduate and doctoral programs in various streams of education. The campus spreads across 600 acres with a variety of facilities like state –of-the-art-labs, libraries, Wi-Fi, Auditorium, 100 online smart classrooms, gym, book stores, dining hall, prayer hall and more. The ground coverage and amenities cover up to 54% of the whole area, courtyard around 0.5%, landscape area (park, play ground, pond, lawn etc) occupies 30%. Area

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selected 1 - courtyard formed in between architecture department and MBA block and 2- Garden in front of the tech park. (Figure-1)

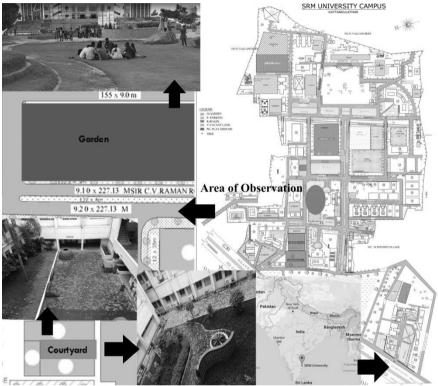


Figure-1, Area of observation (source :Author)

These spaces accommodate users from various spaces in the campus for example Management, Engineering, Architecture & Interior Design Using mixed methods strategy, the qualitative and quantitative data related to the space is being collected, where quantitative data is collected with the help of observational methods and qualitative analysis is done through behavioral mapping and survey analysis.

5.1.1. Direct observation method

The observation study was conducted by touring the spaces of interest, recorded using CCTV in courtyard and digital camera in the garden for certain interval of time. Initially the time of observation was with an interval of 2hrs from 8:00 am to 6:00 pm (8:00-8:30 am, 10:00-10:30am, 12:00-12:30pm, 2:00-2:30pm, 4:00-4:30pm & 6:00-6:30pm). Later on based on the activities observed the time intervals were changed to (8:45-9:00am, 10:25-10:35am, 12:15-12:30pm, 1:25-1:30pm, 4:00-4:30pm & 5:30-5:45pm). The findings

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being charted out in Table-1 shown , , below are based on the observation of activities in the space, behavior patterns of the users, and design elements that are present & that are needed.

Courtyard	Garden				
Activities					
Academic- sketching, workshops, thesis	Academic-group discussions, combined studies,				
discussions, interactions- intended, impromptu,	browsing, using laptops, sketching				
combines studies, browsing, using mobiles	Extracurricular- shooting short films and movies, club				
Extracurricular- Playing badminton, playing	gatherings, playing instruments,				
instruments, club gatherings	Maintenance-watering, mowing, sweeping, cleaning,				
Maintenance- sweeping, repairs, cleaning,	parking				
dumping of waste, carpentry, clay molding	Others- photography, relaxing, sleeping, storage,				
Others- photography, celebrations	parking, eating & intimate interaction, celebrations				
Behavior pattern					
Time influences activities and volume	Climate (shade) & design elements influence the				
subsequently the behavioral pattern	activities, volume and behavioral pattern.				
Peak time-8:30am, 12:15pm, 4:00pm - clash	Peak time- 4:00pm to 6:00pm,				
of activities happen, volume of users supersede	Size of a group- accommodates larger gatherings				
the activities	around 30 -40 members without any difficulties				
Size of a group- 3 to 5, beyond 5 members it	Drawbacks-without visual barriers or focal point it				
creates discomfort and splitting of group.	becomes monotonous, using recycled water for				
Drawbacks-Peak time the size of courtyard is	maintenance of landscape creates discomfort.				
inadequate, seating not provided					
Design elements					
Design aspects provided- Pathway, water body,	Design aspects provided- Pathway, water body,				
flexibility, turf.	flexibility, turf, trees, parking lot				
Design aspects needed- seating, sculpture, and	Design aspects needed- shaded seating, sculptures,				
availability of technology (Wi-Fi).	availability of technology (Wi-Fi).				
Nature of education of users					
Course facilitation- Courses are fixed, users	Course facilitation- courses are flexible, users can				
doesn't have much choice in attending the	chose the classes based on their interest. This induces				
classes based on their interest. Max users-	movement in the entire campus. Max users-				
Architectural background	Engineering background.				

Table -1 Comparative analysis of Observational data recorded in courtyard & Garden.

The findings clearly indicate the various aspects of design and variables that link the quality of the space and quantity of time spent in the space. Adhering to the courtyard apart from the design aspects, the changes in the educational system of the users will drastically change the amount of quality time spent and

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volume of the users. In the scenario of the garden, the education system is already flexible, so the quality of the space with respect to design aspects (shading, seating, technology etc) will induce the change.

5.1.2. Behavior Mapping

The movement of all the users and activity zones of the courtyard is being charted out in Figure-2.

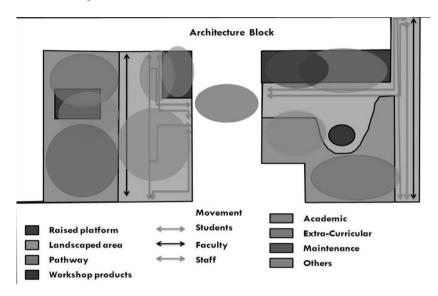


Figure-2, Mapping of Activity zones & Movement Pattern - Courtyard (Source: Author)

The movement of all the users and activity zones of the garden is being charted out in Figure-3.

Most of the activities in the courtyard are time constrained; lack of seating limits the quantitative usage of the space. Movement pattern in the courtyard is clear; pathways are used for traversing irrespective of the user. The space supports academic activities like workshops, which tends to change the outlook of the space every year. Most of the activities in the garden happen under the shade of the trees, lawn area is used mainly for huge gatherings or discussions, places like amphitheatre where seating is provided is the preferable hangout space in the evenings. Movement of the students tend to change with respect to convenience and shading, this is irrespective of the pathway provided, whereas the maintenance staff tend to move around the whole garden for maintenance activities, faculty movement is subjective to shade and pathway.

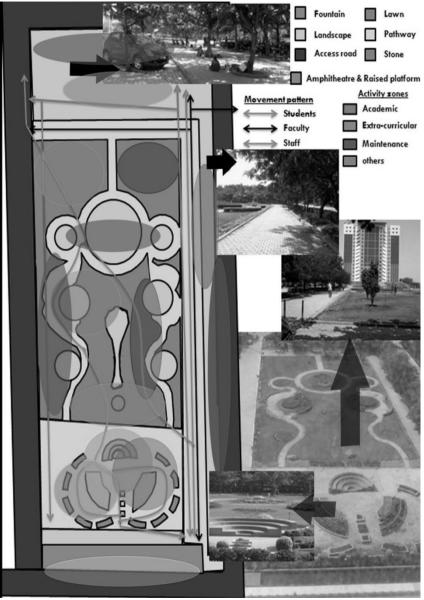


Figure-3, Mapping of Activity zones & Movement Pattern - Garden (Source: Author)

5.1.3. Survey Questionnaire Analysis

The analysis reflects the result from 3 Questionnaires, the first questionnaire was relating to the expectations of the user from an institutional setting which comprised of content related to frequency of visit of the particular space, activities that make the space lively, and preferred design features. The preferred features from both the spaces are charted out in the figure-4.



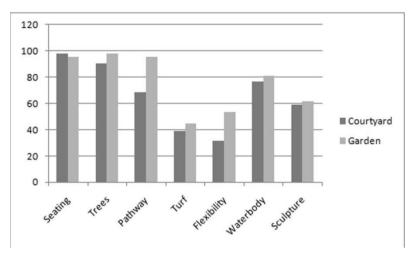


Figure 4, Comparison of expected (user) design features-courtyard & garden (Source: Author)

The data was taken from 50 users who on a daily basis are a significant part of institution. The 2^{nd} and 3^{rd} questionnaires were prepared based on the output from questionnaire-1 and circulated among users of SRM University. The response rate for Courtyard (31/60) and garden (47/60) is 51.6% and 78.3% respectively. Around 50% of the responses were from students, who are associated with the campus to a span of 5 years. The quality of the courtyard and garden space in SRM University based on observation and design elements was rated on 5 point likert scale shown in figure-5 & 6.

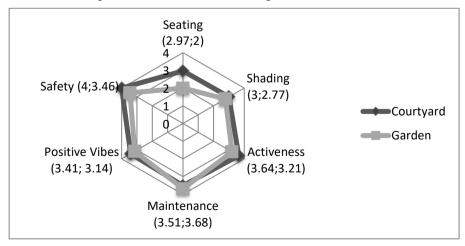


Figure 5, rating of observed criteria -courtyard & garden (Source: Author)

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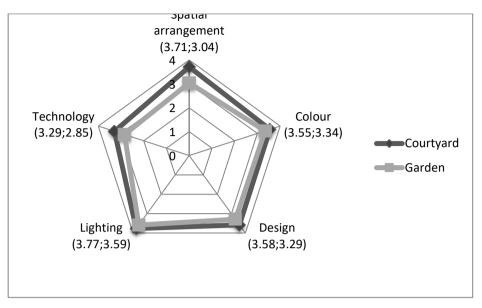


Figure 6, rating of design elements -courtyard & garden (Source: Author)

Most of the expectations were provided in the garden except for seating and shaded area where it has only 2 and 2.77 points respectively. The other responses related to activities, optimum time to visit and favorite spot of the users are being charted in table-2.

Table -2 Comparative analysis of Survey Questionnaire recorded in courtyard &
Garden

Courtyard	Garden				
Activities					
Academic-Studying, workshop, interaction	Academic-Studying, Work-laptop				
Extracurricular- Dancing, playing badminton	Extracurricular- Celebrations				
Others- relaxing, waiting, pass by sitting, and	Others- Lunch, relaxing, sitting, and				
talking/chatting.	talking/chatting.				
Optimum time to visit					
Optimum time to visit-Evening 5:00 pm to	Optimum time to visit-Evening 5:00 pm to 6:00pm				
6:00pm (47.4 % of the users suggestion)	(53 % of the users suggestion)				
Design Feature					
Design feature- Fish pond, steps & seating	Design feature- Centre of the garden, seating				
are the favorite spots.	space and amphitheatre are the favorite spots.				

Most of the users feel happy visiting the space (courtyard-61.3%, garden-38.3%), the emotions felt in courtyard and garden are shown in the figure-7

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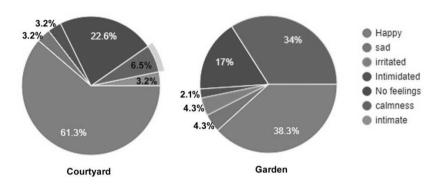


Figure 7, Feel of the space -courtyard & garden (Source: Author)

6. Conclusion

The objectives of the study are achieved in this paper. The expectations of the users were gathered through survey questionnaire and understood. The design aspects were identified through literature study and direct observation study and through survey the quality of the spaces were rated. The findings from the direct observation study, behavioral mapping and survey clearly indicate influence of institutional open space and its needs in modern educational system. The flexibility in curriculum, the academic activities carried out in the open spaces and incorporation of design aspects based on the expectations indicates the impact of the space on the user. Certain aspects like fish pond, low seating in courtyard and amphitheatre, lawn space in the garden attract the user and provides a sense of ownership towards the space. Provision of seating & shaded seating in courtyard and garden space respectively can create a great impact on the quantum of activities observed in the spaces. The findings provide a quantum amount of information, research in depth could result in new insights towards the institutional open spaces. Since the scope of research is limited the present paper is concentrating in just finding the answers.

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CHILD AS THE STORYTELLER OF URBANITY

- A Case of Gurugram, Haryana

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Abstract

Gurugram, Haryana, is the melting pot of different social and cultural stratas of the Indian population. The instant urbanization phenomenon of Gurugram, post the IT boom has resulted in a global, shimmering city with no heart. As the city endeavours to tackle the pressing 'adult' concerns such as transport, infrastructure, economic sustainability and development boasting of global standards, 'the child in the city' becomes minor issue. The effect of the environment on the development of children has been well documented but the voice of the child as a stakeholder of the city is absent from the dialogue of planning process in Indian urban settlements. As the city matches the aspirations of the parents, the association of the children with the city is under duress. Urban space envisaged by adults varies tremendously from what the perceive. The paper attempts explore possibilities children to of experiencing/envisaging the cityscapes through the eyes of the child and providing some broad guidelines for integrating child-friendly spaces within the gargantuan sprawl. The author follows and tries to comprehend the said cityscapes through the experiences of the children from the slums of Ghatagaon and the upscale Malibu Township, Gurugram, Haryana. The paper concludes on the possibility of the approach resulting in safe and interactive urban spaces for not just the child but all inhabitants of the city. This could further translate into a socially and economically sustainable city form which is the utmost need for today. While the importance of sustainable development is an important topic in academic and political discourse, the social impact of rapid urbanization on our future generation is an even more critical subject that requires immediate attention.

Keywords: Child, Stakeholder, Child-friendly spaces, Urban Planning Process, Sustainable.

1. Introduction

"But I think there is deeper philosophical point here we have failed comprehensively to address in Indian cities. And that is: how to make children grow into adults who feel a sense of obligation to observe the rules and regulation of society. This is often not the

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case. Our cities seem to produce young people who are alienated and develop a sense of hostility and have difficulty with civic behaviour." (Shah)

The dawn of 21st century has brought in great changes in the lives and lifestyles of the people. This is the period, where, social interaction moved from playgrounds, parks, sidewalks, staircases, gullies, mohallas, public libraries, shade of a tree, etc. to digital platforms. An adult, born in the 1970s or 1980s, will associate to memories of a city through various spatial characteristics, playgrounds, clubs, homes of friends and families, etc. This is in complete contrast to the children in city today. Rarely does one come across neighbourhoods filled with laughter of children playing in the parks, or walking to and from schools to home, bicycling on sidewalks, etc. The association of the child to the city is found to be limited to her textbook knowledge.

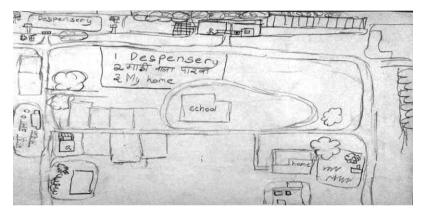


Figure 1: 8 year old's perception of his neighborhood in Gurugram

When asked to draw their perception of the city, the children only drew their home, school and dispensary connected by a road (Refer Figure 1). The social interactive spaces were found to be missing in almost all the drawings. Experiences were found to be bound inside of the gated colonies, with structured manicured lawns and formal interactions with the neighbours. The physical environment a child grows in is crucial for her development into a confident, responsible and intelligent human. And hence, it is critical that urban spaces in the city be inclusive and respectful towards their needs.

Various researches, institutes and conferences across the world have detailed the need to value child's opinion and integrating child-friendly spaces in design for a sustainable development.¹ The importance of equity to extend to the

¹ UNICEF; National Institute of Urban Affairs, India; Child in the City, London; Bernard van Leer Foundation, Hague; et al.

youngest stakeholder in the city has been emphasized. But to advocate childfriendly practices, issues such as appropriate safety standards, guidelines on the quality of the built and spatial environment, equal opportunities of the differently-abled, children's participation in decision-making and convergence of actions of various city agencies must be dealt with.

"Children are an indicator species for cities. The visible presence of children and youth of different ages and backgrounds, with and without their parents, in numbers, is a sign of the health of human habitats."²

1.1.AIM & OBJECTIVES

The paper aims to establish the child as a competent stake holder of the city and the need to involve and formalise her perspective in the urban planning process.

The objective of the study is to understand the issues faced by the child in the city. The study would further research into the reasons behind these issues and establish markers for including them as potential stakeholders that inform the design of not only their immediate neighbourhood but to an extent the city space.

1.2.SCOPE OF STUDY AND RESEARCH METHODOLOGY

Gurugram, offers a dichotomy of living standards. On one edge are the highrise condominiums of glass and steel and the other edge houses illegal settlements (slums) and villages. The city presents two contrasting scenarios for study and helps in establishing, that, the needs of children are not just basic, simplistic but also same despite the class barriers. This paper, elaborates on the above factors through the experiences of children from the slums of Ghatagaon and draws parallels with those from the upscale Malibu Township. It attempts to explore, a child's vision of her space in the city to establish how it can be included in the urban context.

Primary surveys of 40 children, 20 from each settlement, Malibu Towne and Ghatagaon, along with their parents was conducted to understand their daily schedules and experiences of the cityscape. Drawing workshops and walks were conducted with the children to engage them in the process. Further, through reviewing and understanding the recommendations, laid out by various researches & recommendations, both national and international, the paper

² Tim Gill; 'The child as an indicator species for cities: reflections on Philadelphia'; www.childinthecity.org; published on 24-07-2017.

endeavours to list out physical indicators to adopt in the urban planning process.

2. Gurugram – Exploding Boundaries, Shrinking Playgrounds

Liberalisation and the IT boom, in the Indian context, has been a huge stimuli for rapid urbanisation of Metros, suburban areas, B-towns and C-towns in the country. Gurugram, on the suburbs of Delhi, is one such city. Post 1980s, the city saw a fast paced growth in terms of its size, population, development etc. Further in the millennium, as India opened its doors to the foreign players of the world, Gurugram became one of the most lucrative grounds for setting up the IT Industry due to land availability, connectivity and closeness to the seat of power. As the metropolis grew exponentially, laying stress on its resources, the infrastructure, both physical and social, struggled to match the pace of development. In such a scenario, the child became a very vulnerable and meek spectator of this growth.

In the Indian context, and especially Gurugram, the cities are planned from the vision of an adult working individual. The child as an important inhabitant and stakeholder of the city is completely neglected. This is clearly visible from the lack of playgrounds, recreational spaces and an integrated networks of streets. The so-called Cyber-hubs or Entertainment Zones in the city, too, are planned to cater to a young individual in the age group of 12-18 years. Integrated parks, play areas, bicycle tracks are found lacking in the neighbourhoods. The child is at the receiving end of this distorted understanding of child-friendly design. The needs of 13% population in the age group of 0-6 years (*District Census Handbook Gurgaon, Census of India 2011*), cannot be ignored. Moreover, it is imperative for a sustainable development plan, to make equitable provisions for all inhabitants, including the children.

"For a city to be inclusive, it must provide a physical environment that ensures children's health, develops their faculties, and fosters their love for community and nature. Urban design, architecture, landscape architecture, planning and land development play essential roles in ensuring a sustainable physical and built environment."³

3. Child-friendly Initiatives

In 2016, United Nations (UN), stated that an estimated 54.5% of world's population lived in Urban Settlements and the figure will rise to by 2030, it will rise to 60% in 2030, and further estimated to go up to 66% by 2050.

³ City4Kids, "Small Children, Big Cities: Building Smart Child-friendly Cities for 21st-century India", NIUA Conference, New Delhi; November 2014

At present, 26.1% of urban population, is of children in the age group of 0-14 years (World Bank Urban Population Statistics, 2016) and for the Indian cities the figure is a whopping 28.2% (Refer Figure 2).

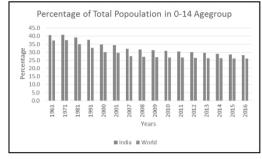


Figure 4: Percentage of Urban Child Population in 0-14 Age Group Source: World Bank Development Indicators

India does not have an established model of Child-friendly Cities (CFC) that relates urban planning and development to outcomes in children's development. The National Policy for Children (NPC), formulated in 2013, was the first step towards asserting the Government's commitment to addressing the challenges faced by children. The NPC recognises that childhood is an integral part of life with a value of its own and that children are not a homogenous group and their prerequisites need different responses. NPC also acknowledges the need for a long term, sustainable, multi-sectoral, integrated and inclusive approach for the overall and harmonious development, responsible for executing the NPC, has drafted the National Plan of Action for Children 2016 to provide a roadmap, linking the policy objectives to actionable strategies under the key priority areas. The action plan aims to establish effective coordination and convergence among all stakeholders, including government ministries and departments as well as civil society organisations.

Further, the Indian government has emphasized the need for urban planning practices to work towards enhancing talent, creativity and aspirations of children. Children's needs to be made the focus and open spaces, play centres must proliferate in city master-plans. The gaps in urban planning have resulted in adverse impacts on children in terms of poor behavioural and academic outcomes, high risk of diseases, inadequate brain development and impaired physical development and skills.⁴

⁴Shri Venkaih Naidu, Vice President of India, "Small Children, Big Cities: Building Smart Child-friendly Cities for 21st-century India", NIUA Conference, New Delhi; November 2014

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3.1.APPROACHES TO CHILD FRIENDLY CITIES (CFC)

Urban Planners and Designers, tend to have distorted vision when it comes to CFC because the approach is from the adult's viewpoint. For child-centric approach, planners need to adopt the concept of co-design, grounded in evidence, valuing children's insights and their contribution to the planning process. Participatory Planning approach should also involve children spaces such as parks, playgrounds, schools, nurseries. A child's mind has vivid imagination and thus it would need a guided effort and training to be able to inform the design practically and comprehensively. The strengths of the child is his approach towards a space being beyond typologies defined by the adult minds. His imagination may be explored to investigate new avenues to planning.

Children's participation in urban planning received ample attention during the international seminar on Urban Planning and Children, organised by The Child in the City Foundation, The European Network for Child Friendly Cities and the Municipality of Rotterdam in June 2017. They emphasized that important factors to achieve these would be:

- 1. *Training:* The Government and Institutions involved, should encourage and endorse specific children's rights training for planners at both degree and professional practice level.
- 2. *Guidance:* Guidelines should be laid out to explore the different methods and approaches required for children of different ages and abilities, but must not prioritise older children over younger children.
- 3. *Feedback:* A robust and routine feedback mechanism between planners and child participants should be imperative to the Action Plan. Open and honest dialogue opens up opportunities for critical thinking about the methods employed, and how to communicate with children about what is and is not possible.
- 4. *Networking:* The government should encourage networking, collaboration, and skills exchange between planners, teachers, and youth workers.
- 5. *Evidence:* The government should collate an accessible evidence base on children, young people and their relationship to, and use of, the built environment.

There is a long way to go in making children's rights a reality but these proposals offer a clear way of moving closer to that ambition in the field of planning. Embedding children's rights in the everyday work of planners and other practitioners will have great value in improving how public services run and react to the diverse needs of our varied population.

3.2.INDICATORS FOR CHILD-FRIENDLY CITIES

An exhaustive list has been conceived by NIUA in association with the Bernard Van Leer Foundation and ECORYS, as a starting point to develop indicators that can be used to assess the impact of urban development on children. The indicators developed by NIUA ((Refer Fig. 3), are categorized mainly in four key areas, namely,

- The Built Environment
- Services & Facilities
- Safety and Mobility
- Ambient Environment and Disaster Management

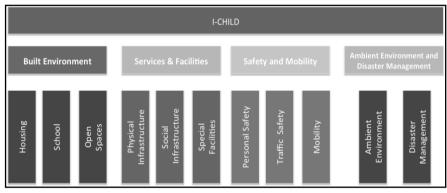


Figure 5: Typology for I-Child

A sustainable city design must incorporate all four key parameters holistically to establish a potential child-friendly city model for development. The successful built environment is not isolated from its services & facilities and mobility or ease of transport is key factor to connecting them efficiently. And all of these, Built Environment, Services & infrastructure and modes of transport, have to be secure for the child to be able to experience them wholly. Together, all with effective measures and policies, stringent implementation and monitoring systems, will form an Ambient Environment for the child to grow in.

4. Gurugram – Case Studies

Malibu Towne and Ghatagaon (Town area) were selected for study area as they offer a very diverse structure in their typology. For observing the relationship of the children, mid to high income groups, with their neighborhood, Malibu Towne, a private development, was preferred, appropriate, due to its size and integration with the city. Ghatagaon (town

Source: Indicators for Child friendly Local Development, 2016, NIUA

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area), on the other hand offers a contrasting typology, due to its organic layout and lower-income group residents. Certain parameters were kept constant in the study, such as, age bracket (5-8years) and literacy levels (primary school), while the family incomes, type of settlement etc. varied.

The approach required approx. 20 children, from each settlement, to draw their experiences & perceptions of the city. The drawings were vital proof in understanding the child psychology and their experiences of the city. They provided evidence of lack of certain amenities and need for others. Simultaneously, a walk in their neighborhood with them allowed to understand the environ they engage in on daily basis. Open ended discussions too, allowed to understand their needs and what they feel is lacking in their environments.

MALIBU TOWNE

Malibu town is a "gated" integrated township situated on Sohna Road, Gurugram (Haryana), spread over 200 acres of land. Being one of the oldest townships of the city, it currently has over 800 families residing within it. The society has approximately six affluent schools and a few shopping malls in its vicinity. It has been designed along the lines of a typical American gated community; with several cul-de-sacs ensuring no traffic flow through & planned greens.

GHATAGAON

Ghatagaon, in south-west of Gurugram, is one among the 3 town areas of Gurgaon Block of Gurgaon district of Haryana. Of the total population of 2,128 persons (*Census of India 2011*), 17% is of children in the age bracket of 0-6 years. The settlement is originally a village around a natural waterbody with a temple on its periphery. A number of small grocery shops have come up around this area. The 3 to 6 meter wide inter-twining streets has two to three-storey houses without setbacks and act as social interactive spaces for the residents.

4.1.ACTIVITY 1 – DRAWING WORKSHOP

Yuvraj, 8, drew his house in a beautiful landscape with his two friends playing near a tree close to his house. When asked if his house is painted orange and green he said "No, but I like these colors". Devansh, 9, drew his friend, park & his house along a busy road which he dislikes saying, "It makes a lot of noise". The national flag is just something he saw in his textbook that day. Kashvi, 7, drew her house, a park and her school bus, and her friends playing on the swing. She did not remember a clear path connecting the two.

CHILD AS THE STORYTELLER OF URBANITY

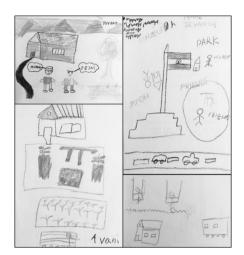


Figure 6: Malibu Towne - Children's Dwg

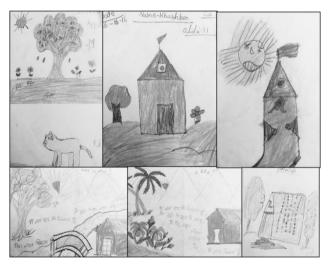


Figure 7: Ghtagaon - Children's Drawings

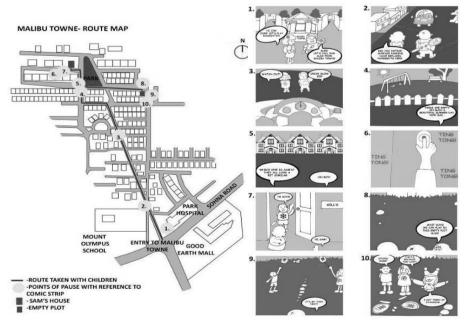
Tinku, 7, likes trees but dislikes potholes, especially during rainy season. Vikram, 11, complained about the stinking open drains near his house. He likes trees & flowers that he sees in his neighborhood. Shivam, 9, likes the temple as it is very quiet and pleasant. Shubham, 11, likes trees and flowers in his area but dislikes the animals (pigs) that roam on the roads.

Almost every child, from Malibu Towne, associated with three things i.e. house, park and school. The house is their sanctuary, a secure place and a constant in the drawings and the school is where they spend a large part of

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their active day. Most of the children drew their neighborhood park as their favorite place. The importance of open greens and the joy in indulging in physical activity is reflected in these pictures. The streets are absent from their imagination, as are any landmarks, which might help in mapping their neighborhood let alone the city.

In contrast, the children from Ghatagaon, do not associate play with parks. Their familiarity with their neighborhood is expressed through prominent landmarks, i.e. the temple, a large tree or brightly lit houses. Their drawings reflect a regular interaction with their immediate built and natural environment. However, it is coupled with broken paths, open sewers, garbage dumps and harsh weather conditions. They are able to identify the need for shaded and leveled walkways and are acutely aware of the poor conditions of the streets.



4.2. ACTIVITY 2 – WALK WITH THE CHILDREN

Figure 8: Route Map & Experiences of Children - Malibu Towne

A walk around the respective neighborhoods of the children was a revealing experience to their likes and dislikes and their needs for a safe secure play environment. At Malibu Towne, deserted streets and absence of designated sidewalks, allowed the children to take short-cuts and walk on the roads. A playground, on the way, that had swings, was an attraction for the children but due to security concern they did not venture towards it. Parks closer to homes were preferred due to safety concerns, despite being within the perimeters of a gated community.

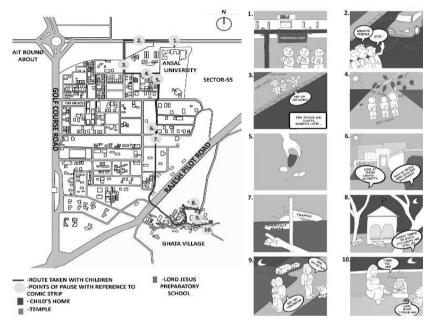


Figure 9: Route Map & Experiences of children - Ghatagaon

Contrary to that, the children form Ghatagaon, preferred longer routes to their destination as it encountered less vehicular traffic and avoid the unsafe open areas. At every bend there was a landmark such as a shop, a school, a temple etc. The children were familiar with the locals in the areas which gave a certain sense of security to them. The park next to them temple was devoid of landscaping and the roads broken and muddy, posing a risk to their safety. During rainy season, the potholes get filled with water making it difficult to walk in these streets.

4.3.SURVEY WORKSHOPS

Engaging Discussions and primary questionnaire survey with the parents of the survey group had interesting revelations. Almost all parents, expressed security concerns for their children. Despite high security and landscaped features of Malibu Towne, the deserted streets were a hindrance to parents allowing their children from venturing out alone. In Ghatagaon, though, lack of vigilance measures, dark narrow streets, or wider streets with too much traffic raised a

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similar concern. But due to poor economic backgrounds and lack of choice, 90% of parents still allowed their children to venture out alone despite apprehensions. The poor quality of roads and health concerns were also raised by Ghatagaon inhabitants. The lack of bicycle tracks or pedestrian pathways was also highlighted by both sets of parents.

The contrasting element was presented in the social interaction of both peer groups. The lack of community structure of Malibu Towne and concepts of privacy seemed to be breaking a strong community network vital for a secure child-friendly environment. Ghatagaon, being an old settlement, has strong social networks extended to families. These also helped in creating support systems for working parents during their time at work. The opinion was mostly divided among formal and informal local shopping. But most agreed on the strategic location of the existing shops being helpful as 'eyes on streets' for the children.

Another interesting feature highlighted through children's drawings, is use of color and other attractive features, lights, trees, etc. in them. Most children expressed their liking towards vibrancy of colorful spaces.

4. Conclusions

The study arrives at a conclusion that the Child is an intelligent stakeholder of the city, who perceives and has an opinion about his spaces, but voice needs to be strengthened. This research asserts that it is possible for the children to elucidate their needs and even suggest strategy for planning their surroundings. The spaces in the city should not just cater to the young working class, collegegoers, teenagers only, but also to the children of these urban families. To achieve this, we need to change our approach to planning the city with its focus on adult culture and activities, into a more inclusive and more differentiated city of today.

However, the capacity of the urban planners needs to be strengthened to understand and exploit the potential of the 'child as a planner'. Thus, the systems need to adopt a policy and train budding planners, designers towards child rights. Simultaneously, child psychologists, sociologists, child-welfare workers, schools, directly engaging, with the children can become a strong communicating link between the children and the City Planners. A <u>strong</u> <u>Participatory Network community for children</u> can be achieved if policies and guidelines allow for children workshops to be conducted, where they are allowed to talk and discuss city-based developments through drawing debates, essays, etc.

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The security of the children of all age bracket, came out as main concern in both settings. Security emerges one of the biggest challenge and indicator of child friendly spaces. This may further be defined as both physical and social security. Where physical security concerns, need strict guidelines and policies to be implemented. The Social security is an achievement of strong community networks.

Physical features of security in cityscape design may be broadly outlined in terms of optimum pedestrian walkways, well-lit street design, presence of landmarks of social interaction, <u>clearly demarcated children zones</u> and zebra crossings on roads, etc. Pedestrianisation, open spaces, connectivity, when seen from the perspective of the young, would not just result in a more sustainable design but would also address concerns of the parents in terms of security of their children. Children, from all age groups, clearly identified the need of easily accessible parks for playing. <u>Guidelines, at the city level</u> need to be laid out to clearly demarcate children parks and sports grounds. These should be connected through an internal vehicle free road networks for ease of access to children. The development of streetscapes of the city, has to keep in mind the security and ease of access to the child.

The <u>built environment is a huge catalyst to strong community networks</u>. Highrise apartments, with individual privacy, restrict user interaction, whereas closer, or on narrow streets allow for more regular interaction. These may be difficult to achieve but design interventions <u>exploring with traditional systems</u> of courtyards, might be a step further towards a happier environment. Similarly, in a setting like that of Ghatagaon, in-situ renewal schemes may be adopted to intersperse a hierarchy of open space networks into the existing fabric. Projects reclaiming grounds and public parks have shown positive results leading to reduction of use of motorised vehicles, increased the happiness factor and reduced stress levels and increased community feeling among inhabitants (Gill).

A child, growing in a city, totally detached to its surroundings, or restricted to certain kinds of environments, may not able to appreciate or contribute responsibly to it. A city does not solely belong to those involved in the Planning or Designing of it, but is the actual living entity for its inhabitants. It needs socially responsible and aware inhabitants to SUSTAIN it. Hence, the child is the **most crucial stakeholder** of the city. Her/his experiences and vision of the city cannot be overlooked in the Planning Process.

A Sustainable City is a resultant of happy childhood.

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PRODUCT DESIGN INTERVENTION TO IMPROVE HAND SKILLS OF CHILDREN WITH HEMIPLEGIC CEREBRAL PALSY

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Abstract

Hemiplegic Cerebral Palsy is a form of physical disability in childhood that cause disorders of posture and movements. Physiotherapy play an important role in rehabilitation of children with this condition. Studies revealed of reluctance among children to engage in therapy activities as the process is time consuming and intensive and as therapy assistive devices were less engaging and appealing. Thus, the need of therapy assistive devices that were engaging and effective was recognized as one of the main aspect that needed intervention in terms of product design. This was more apparent in therapy activities of upper limbs, as they involve high level of control and coordination. Accordingly, research was based on to develop designs to improve the hand skills of children. Methodology of this research was iterative with a participatory design approach. Designs were developed with the active participation of multidisciplinary key stakeholders. Form, tactile preference, colour and movement patterns were recognized as main factors for consideration in developing therapy assistive devices. Designs were developed through prototyping, testing and development based on the feedback and observations. Design outcomes encourage gradual improvement of posture and hand skills, including, gross motor functions, fine motor functions and grip, as therapy assistive products.

Keywords: Co-design, Rehabilitation, Design Intervention, Cerebral Palsy, *Physiotherapy*.

1. Introduction

Cerebral Palsy (CP) is one of the most common forms of physical disability in children. Occurrence of CP in children ranges from 1.5 to 2.5 per every 1000 live births (Gupta & Appleton, 2001). CP is a group of motor-neurone diseases that occur due to damages to the brain during early stages of birth, which limit the postural and movement abilities of children. (Mundkur & Sankar, 2005). CP can be classified topographically as hemiplegia, diplegia and quadriplegia. Hemiplegia and quadriplegia are the most common forms of CP in children. In Hemiplegic CP both upper limbs and lower limbs of one side of the body, either left or right, are affected due to damages to one hemisphere of the brain. Even though both upper limbs and lower limbs are affected by hemiplegic CP, degree of impairment is higher in the upper limb controls (Mundkur & Sankar, 2005). Compared to the functions of the lower limbs, upper limb activities

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require more sophistication and a high degree of coordination. This research would focus only on the hand skills of children as hand skills are recognized as one of the main areas where design intervention is required (Gunatillaka, 2004) (Gupta & Appleton, 2001). This research would also focus only on hemiplegic CP, where only functions of the one hand is affected, as each type of CP require different therapy techniques as treatments. (Mundkur & Sankar, 2005).

Two main motor functions could be identified as gross motor functions and fine motor functions. Gross motor functions include larger muscle movements of arm, shoulder and elbow. Fine motor functions are movements of small muscles of wrist and the fingers with eye-hand coordination. Children with hemiplegic CP lack both gross motor and fine motor abilities of the hand due to impairment in the motor neurones. Stiffness and weakness in muscles caused due to hemiplegic CP limit the range of motion and dexterity of the hand. Usually the posture of the hands of children with hemiplegic CP deformed due to the muscle spasticity. Even though the degree of deformity may differ from patient to patient, a typical postural deformity could be identified of the hand as "pincer grasp of the thumb, extension of the wrist, and supination of the forearm...,..there is increased flexor tone with the elbow and wrist. Palmer grasp may persist for many years..." (Mundkur & Sankar, 2005)(Figure 1).

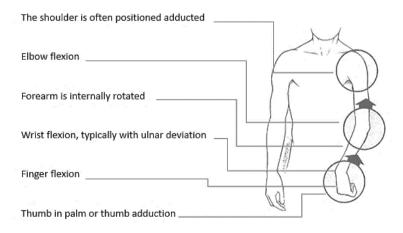


Figure 1 Typical posture of hands of children with hemiplegic cerebral palsy (Source: Author's Creation)

Physiotherapy play an important role in rehabilitating children with hemiplegic CP, especially in improving posture and movements of hands. Sensory and motor functions are the primary functions of the hand and support the subordinate functions such as reach, grasp, release and in-hand manipulations. If not rehabilitated through physiotherapy, deformed postures and movements

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could have negative impacts on these functions. Typical deformed posture of hands with hemiplegic CP limit the range of motion and strength of the hand, making it impossible to carry out day-today activities. Prolonged continuation of the deformed postures of the hand cause muscle wastage and permanent deformity. Deformities limit the dexterity of hands, abilities of gripping and eye-hand coordination, which are essential skills in manipulating objects.

Physiotherapy for rehabilitation of children with hemiplegic CP is a carefully planned process that implicate commitment on all parties involved; especially physiotherapists, patients and parents/caregivers. Interaction sessions during therapy activities with children revealed that there is a certain reluctance among children to use therapy assistive products as they were less appealing visually and functionally. Most of the products used for physiotherapy at government operated hospitals were adaptations from either items of day-today use or toys in the general market. In some cases specifically designed therapy assistive products were not readily available in the local market. Thus, there is lack of products specifically designed to meet the needs of the Sri Lankan context to improve hand skills of children with hemiplegic CP. Studies have also revealed of reluctance among children with hemiplegic CP to engage in therapy activities as the process is time consuming and intensive. "Motivating a child to perform uninteresting, frustrating and repetitive movements by themselves is challenging" (Weightman, et al., 2010). Hence, the need of therapy assistive devices that were engaging and effective was recognized as one of the main aspect that needed intervention in terms of product design.

2. Research Methodology

Studies for this research were conducted at Lady Ridgeway Hospital for Children Lady Ridgeway Hospital for Children (LRH), Colombo, Colombo, which is the only government operated childrens' hospital in Sri Lanka. Lady Ridgeway Hospital for Children consists of a separate physiotherapy unit, where a large number of children with hemiplegic CP are being treated (Gunatillaka, 2004). LRH also consists of facilities to develop products at the workshop at the hospitals premises, where most of the products necessary for therapy are manufactured and adapted. Age limitation of the children for the research is beween age 4 years to 12 years as LRH treat children under age 12 and as the typical impairements of the handskills are more recognizable at age 4 years upwards. Research was conducted with the participation of 10 children diagnosed with hemiplegic CP. Tharapy review session were conducted under the supervision of chief physiotherapist at LRH.

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Multi disciplinary approach is essential in developing medical devices for therapeutic purposes to achieve effective results. Commenting on the current procedure of rehabilitation of children with cerebral palsy, Gunatillaka (2004) has noted that "multi disciplinary approach is limited to mere words in the Sri Lankan setup". This research was conducted through active participation of the key stakeholdres such as medical professionals, patients, parents/caregivers, designers and manufacturers throughout the process. Data were collected through literature reviews, questionnaire surveys, interviews, group discussions and group interaction sessions. Interviews and group discussions with the medical professionals were used to understand concepts of therapy, in-depth analysis of the design requiremnts and develop guidelines for the therapy assistive devices.

It is important to involve the end-user in developing medical devices as it "…increases the likelihood of producing devices that are safe, usable, clinically effective and appropriate to cultural context" (Bridgelal, et al., 2008). Given the context of this research, end-user is not necessirily just the person suffering from the impairement, but also include the therapists and parents/caregivers that interact with the end-products. "Although expensive and time consuming, the optimum method of applying usability tests is to perform a number of throughout an iterative design procedure" (Martin, et al., 2008). Thus, an iterative design prototyping, testing and development based on the feedback and observations. Field investigations were carried out at interactive sessions with the children with hemiplegic CP. Therapy sessions and questionnaire surveys were carried out to obtain feedback on improved products.

1. 3. Discussion

Research outcomes consists of three main designs developed as therapy assistive products to improve posture of hand and hanskills that involve gross motor functions, fine motor functions and grip of children with hemiplegic CP. Design outcomes encourage gradual improvement of the above through design one to design three. Design outcomes were developed through prototyping, testing and development based on the feedback and observations.

Developing therapy assistive products that were effective, engaging and appealing were main objectives of the research. To achieve these factors, it is important to consider and understand both therapeutic aspects and preferences of the children. Weightman, et al. (2010) has empahasised on five design requirements, namely, therapeutic benefits, mechanical functionality, safety, social acceptability and motivational factors, that are fundamental in developing therapeutic devices for children with cerebral palsy. These parameters were taken into consideration when evaluating prototypes througout

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the iterative design process of this research.Form, tactile preference, colour and movement patterns were recognized as main design consideration in developing therapy assistive devices to improve handskills of children with hemiplegic CP.

Form development plays an important role in making therapy assistive devices more effective, engaging and appealing. Therapy balls are devices that are already being used to improve hand functions in physiotherapy (Charles, et al., 2007). Thumb in palm is a typical postural defect in children eith hemiplegic cerebral palsy. Holding a spherical form in the palm automatically move the thumb away from palm and encourage the correct posture. Spherical forms also provide better grip and varying the dimensions of the spheres from large to small changes the grip type from power grip to precision grip. Thus, spherical forms were utilized in different components of design outcomes. Forms were developed mainly considering the therapeutic benefits and mechanical functionality of the outcomes.

Research indicate that children with cerebral palsy chose hard objects significantly more often than they chose soft objects as they may have decreased tactile awareness and need greater proprioceptive input that hard objects provide. This was also observed during the interactive sessions with children. The concious perception of an object was high when the objects were hard and had considerable weight to it. Studies further suggest wood and thermo-plastic as suitable materials to be used in product for children with cerebral palsy according to their tactile preferences and somatosensory requirements (Curry & Exner, 1988). Utilization of tactile preferences of children with hemilegic CP in therapy assistive devices was considered as a motivational factor to make them more appealing and engaging. Wood is a readily available material in Sri Lanka and manufacturing technology necessary making wooden devices was available at the workshop in LRH. Hence, wood was used as the main material in all three design outcomes.

According to the research done on colour psychology of children, it has been revealed that colours have relationship with emotional and sensory reactions of children. It's been found that children had positive reactions to bright colors (e.g., pink, blue, red) and negative emotions for dark colors (e.g., brown, black, gray) (Boyatzis & Varghese, 1994). Interactive session with children and discussions with physiotherapists and parents revealed that children with CP have difficulty recognizing colours and knowledge of colours were limited to the basic colours. Red,green, blue and yellow were used in design outcomes to evoke positive reactions from children , as well as to differentiate forms, spaces, sizes and functions of components of therapy assistive devices.

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One of the basic concepts of physiotherapy is the use of repetitive motions under the direction of the therapits for a recommended period of time with recommended periods of intervals with gradual improvement of proximal movements to distal movements (Bobath & Bobath, 1984). Thus, movement patterns and range of motion were recognized as main considerations in this research to make therapy assistive products more effective.

As movement and eye-hand coordination of children with CP is poor, special attention was given to the safety factors of products. Surfaces were smoothened and rough, sharp edges were avoided. As the children with hemilegic CP may sometimes have tremblings in the hand, components that must be grasped in hand were comparabily light weight and components that need to be stable were manufactured with a considerable weight to avoid being moved unintentionally.

3.1. DESIGN ONE

Design one (figure 2) aim to improve gross motor functions and range of motion of shoulder and elbow and power grip and posture of the whole hand. The wheels support and encourage the movements. Sperical grip correct the posture of the hand and the grip top is changeable to three sizes to encourage grip from power grip to precision grip (Bullock, et al., 2013).



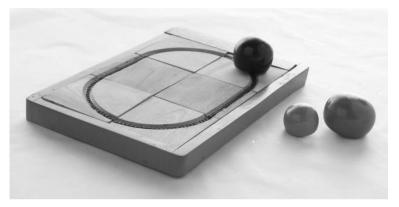
Figure 2 Design one (Source: Author's Creation)

3.2. DESIGN TWO

Design two (figure 3) was developed aiming to improve fine movements of the shoulder, elbow and wrist gradually with simple movements to complex movements (Bobath & Bobth, 1984). It consists of spherical gripping forms with wheels that could be moved on a path. The path is rearrangeable according to movement patterns by moving the wooden tiles. It also assist gradually improve grip abilities from power grip to precision grip (Bullock, et al., 2013). Degree of eye-hand coordination required to perfom tasks of design two is

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higher than of the design one. It be used to improve the colour recognition of children as a secondary use through interactions and conversations between the therapists/parents.



3.3. Design Figure 3 Design two (Source: Author's Creation)

3.2 DESIGN THREE

Design Three (figure 4) aim to improve fine motor skills of the wrist and fingers. It consists of a ball that needed to be hit with fingers along a directed path to hit a target that provide a audio feedback. The distance between the target and the staring point is changeable to set achievable goals (Weightman, et al., 2010). Therapists could direct the child to use each finger for this task. It strengthen the finger muscles, reduce muscle tone and help improve eye hand coordination.

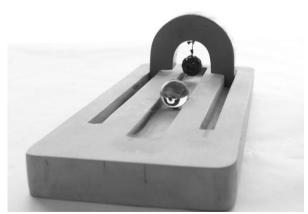


Figure 4 Design three (Source: Author's Creation)

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Movement patterns encouraged through design one to design three gradually focus on to fine muscle movements(fine motor functions) from large muscle movements (gross motor functions). The degree of dexterity of hand and degree of eye-hand coordination also increases with the increase of complexity of movements patterns (Bobath & Bobath, 1984). Recommended time period for each design outcome by the physiotherapists is 10 minutes minimum and 20 minutes maximum, with intervals of 5-10 seconds for effective outcomes. Correct posture is encouraged through all three design outcomes.

Interactive sessions with children and group discussions with parents and therapists indicated that there was a significant improvement of likeness of children to engage in therapy activities using the developed therapy assistive products than engaging in similar tharpy activities without the therapy assistive products. To determine the improvement of the hand skills, it is important to consider both the efficiency and quality of performance. Efficiency of the above mentioned actions depend on different parameters of the task like objects' locations, their weights, sizes and textures. Quality of the perfomance is determined by complexity of the movements, accuracy of control and timing. These parameters were reviewed by the tharapists for the use of developed products by children with hemiplegic CP. Reviews indicated with the gradual improvement of complexity of movements and range of motion had positive effect on the parameters like reach, control of movements and timing. Compared to the efficiency of the actions, there was a visible improvent of the quality of the actions over time when the developed products were used for therapy activities.

Gunatillaka (2004) has highlighted that for rehabilitation of children with CP, setting achievable and meaningful relevant functionl goals as an important concept of therapy intervention. Setting achievable goals generate confidence and satisfaction in children and act as a motivational stimulant. It was also observed during interactive sessions for testing. prototype that acknowledgement of accomplishing a simple task by the therapists or caregiver through visual, gestural and sound cues such as smiling, clapping and thumbs up had an positive impact on the children. Hence, all three design outcomes consisted of different stages of accoplishments in terms of extension/retention of posture, range of motion and movement patterns as set goals.

4. Conclusion

Design intervention could be identified as an effective approach that could be applied to develop medical products that are more effective, engaging and safe. Even though often considered complex and neglected, especially in the Sri Lankan context, the need of product design intervention in terms of developing therapy assistive products is in demand. Multidisciplinary and user-centred

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design approaches to product development are challenging and time consuming, yet viable practices, especially in terms of developing therapy assistive products for children with postural and movement disabilities. Therapy assistive products for hemiplegic CP should present opportunities for gradual improvement, focusing from proximal to distal movements and gross motor to fine motor functions as per therapy requirements and to set achievable goals for patients. Due to the heuristic nature of the process, executing both clinical and design requirements in products is challenging, but could be achieved through careful understanding and planning of the process and usability testing to design more effective, engaging and safe therapy assistive products.

5. Acknowledgement

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AN INVESTIGATION INTO DISASTER MANAGEMENT PRACTICES IN RELATION TO RECENT DISASTER EVENTS IN SRI LANKA

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Abstract

Disasters have become frequent phenomena in Sri Lanka over the past few years. The latest incidents were experienced in May 2017. Although a frequent occurrence, the preparedness of government authorities and communities, was found to be experiencing significant hurdles. Hence, this study aimed to identify the opportunities and challenges in the disaster management process and explore future strategies. In order to achieve this aim, firstly a newspaper article review was conducted, which was followed by interviewing experts in various branches of disaster management in Sri Lanka. The collected data were analysed through manual content analysis, and several key findings were established. It was found that the communication of early warning from state agencies to communities were ineffective to a large extent. Thus, developing extensive hazard maps to identify and react to early signs of disasters by themselves was identified as a key strategy that should be implemented in the future. The study further emphasised the importance of complying with building codes and land use practices that are already existing.

Keywords: Disaster Management; Floods; Landslides; Sri Lanka.

1. Introduction

Disasters undermine decades of development gains and affect the social, economic and political achievements of a country (Wickramaratne, 2012). Sri Lanka is exposed to several types of severe natural hazards including floods, landslides, cyclones, drought, tsunamis, coastal erosion and sea level rise (Malalgoda & Amaratunga, 2015). The frequency of occurrence of floods and landslides has increased in the country, resulting in deaths and destruction of properties, which is evident in catastrophes in 2016 and 2017 (South Asian Disaster Knowledge Network, 2017).

Massive floods and landslides in May 2016 were considered to be the worst in 25 years, but the impacts of floods that occurred in 2017 were much greater than that of 2016. This year 2017, the floods and landslides occurred due to

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heavy southwest monsoon rain, which continued for two days (25-26 May), affecting 15 of the 25 districts in Sri Lanka. The reason for this heavy rainfall was identified to be the tropical cyclone 'Mora' that hit the coastal regions in the Bay of Bengal (Sharma, 2017). The Disaster Management Centre (DMC) in Sri Lanka confirmed 213 deaths and approximately 230,000 affected families. Hence the focus of this study was to review disaster management practices in the country in relation to recent disaster events to be able to inform policy and practice with the objective of building community capacity and resilience. As an initial review, this paper presents findings on communication between agencies and communities in disaster events, challenges in management and successful strategies implemented in disaster events. It further suggests steps to be taken for future disaster risk reduction based on the lessons learned from the analysis of media reports and expert interviews.



Figure 1: Recent floods and landslides in Ratnapura District, Sri Lanka

2. Methodology

The review was conducted on floods and landslides that occurred on 25-26 May 2017. A qualitative research method was used for this study, where a review of newspaper articles was conducted initially. Six national newspapers were selected in three languages Sinhalese, English and Tamil. Relevant articles during the period from 18 May 2017 (one week before the disaster events) to 01 August 2017 were referred in all six newspapers. Table 1 indicates the details of newspapers reviewed in the study.

Newspaper Code	Language	Frequency
N1	English	Daily
N2	English	Weekly
N3	English	Weekly
N4	English	Weekly
N5	Sinhala	Daily
N6	Tamil	Daily

Table 1:1	Details	of newspaper	articles
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The data collection was further extended to interviews of various experts in the field of disaster management in Sri Lanka. Accordingly, seventeen interviews were conducted among experts in the field of disaster management in Sri Lanka. Table 2 provides the profiles of the interview respondents; this paper presents preliminary findings of the research and draws on interviews conducted at the initial stage.

Respondent	Years of	Organisation Type	Designation
Code	experience		
P1	25	Private Entity	Technical Advisor
P2	25	Individual	Consultant
P3	12	Local Government	CEO
P4	10	State Government	Assistant Director
P5	14	Private Entity	Consultant
P6	20	Private Entity	Consultant
P7	1.5	State Government	Assistant Director
P8	5	Semi Government	Head of the Department
P9	25	Private Entity	Assistant Country Director
P10	22	Individual	Consultant
P11	13	State Government	Senior Professor
P12	5	State Government	Scientist
P13	25	State Government	Director
P14	5	Local Government	Development Officer
P15	18	State Government	Deputy Director
P16	10	State Government	District Engineer
P17	22	State Government	Deputy Director

Table 2:	Interview	Respond	lent's	Profiles
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Data collected through newspaper articles and interviews were analysed using content analysis. An inductive approach was used to analyse newspaper articles. According to Bengtsson (2016), in inductive approach, the researcher analyses the text with an open mind. However, for interviews, a deductive approach was used. In deductive approach, prior studies are available on a particular subject and are supplemented with further description (Heish & Shannon, 2005). Hence, the findings of the newspaper review were used for the deductive content analysis of interview findings. Kondracki et al. (2002) have explained that it is useful to take an inductive approach initially followed by a deductive approach, and this concept was followed

3. Research findings and discussion

Research findings are discussed under five aspects including response to disaster events, communication between agencies and communities, challenges

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in management, examples of successful strategies and steps to be taken for future disaster risk reduction.

3.1. RESPONSE TO DISASTER EVENTS

Early warnings

In Sri Lanka, the lead organisation for issuing early warnings on disaster situations is the Disaster Management Centre (DMC), which is the main government agency responsible for coordinating disaster management activities (Malalgoda et al., 2016). According to Respondent P4, wireless 'walkie-talkie' (high frequency/HF, very high frequency/VHF), satellite, SMS, email, fax and social media are various systems established to communicate early warnings from DMC to DDMCUs (District Disaster Management and Coordination Unit), which are established under the District Secretariat divisions. Thereafter, DDMCUs use their own mechanisms to pass the messages to the community. In addition, the respondent mentioned that DMC also seeks the assistance of communication units of the police and armed forces to transmit the messages. According to P4, these units use a public address (PA) system or loudspeakers to inform the community.

Rescue, relief and temporary settlement

According to P4, the involvement of the police and armed forces is not limited to pass the early warning messages to community, but also, they have a significant involvement in rescue and relief work. All six newspapers reviewed in the study provided substantial prominence to this involvement. Newspaper N4 reported this stating, "Government agencies, the armed forces and police along with volunteers have now launched an extensive rescue and relief operation." Furthermore, N4 reported the significance of this involvement in reaching inaccessible places for rescue and relief work.

After the immediate rescue and relief work, all the selected newspapers reported the establishment of temporary camps, highlighting the fact that these temporary camps were established in public places like temples, schools, mosques and community halls rather than in designated places managed by the Ministry of Disaster Management. National Disaster Relief Services Centre (NDRSC) is the main government agency responsible for planning and implementing relief, rehabilitation and reconstruction activities. According, to P7, NDRSC provides immediate action for emergency relief in accordance with the 03/2016 government circular and the national insurance policy while the expenses are provided by the government through the National Insurance Trust Fund (NITF) and treasury funds. Further to P7, NDRSC was also

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involved in managing temporary camps through their relief officers, with the help of local and foreign donors. However, attempts are taken to close down these temporary camps at the earliest possible opportunity by re-establishing the displaced livelihoods to normalcy. Accordingly, P7 stated that, "NDRSC provided a monthly rental allowance of LKR 7,500 for families with completely damaged houses and an allowance of LKR 10,000 for the families with partially damaged houses to recover and clean the houses."

Post Disaster Needs Assessment (PDNA)

After the emergency rescue and relief work, PDNA is another important step in an effective disaster response process. Respondents P2, P5, P6 and P9 have been involved in the PDNA process. According to P2, "PDNA is used to quantify, calculate and estimate damages and to support the government to prepare a recovery framework and a recovery plan based on the estimates." United Nations Development Programme (UNDP) is one of the organisations involved in and aiming to improve the process.

3.2. COMMUNICATION BETWEEN AGENCIES AND COMMUNITIES

It is clear that there is an apparent issue in effective communication between relevant agencies and communities regarding early warning. In this study, such criticisms were found in newspapers and also confirmed by interview respondents of the ineffectiveness in passing the warnings to communities by responsible agencies. For example, N1 reported: "As with many previous disasters, a large number of affected people have not been told to shift." N4 has highlighted the severity of this issue by reporting that "They could have saved more lives had they been able to communicate critical information to the public at right times." Despite the early warning process followed by DMC, P2 and P3 also agreed that there are many people who did not receive warning messages. P2 expressed this perception by stating that "There is a considerable gap in how warning system operates at the national level and how it goes to the district level and particularly to the last mile." The point highlighted here is, although state agencies such as DMC and the Meteorological Department have good communication links, the effectiveness of communication diminishes when it goes to the local authority level and it further diminishes when it goes to the community level.

In this vein, the importance of follow up actions upon warning and monitoring is noted. N3 reported that "It was the duty of those in charge of disaster management to convey early warnings to people, with the urgency that it demanded, and take the necessary follow-up action to get the people moving to

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whatever necessary locations of safety, which did not occur with the speed necessary." This suggests that the relevant agencies have the responsibility of not only conveying warning messages, but also ensuring that communities move to safer locations. P3 also highlighted the importance of monitoring timely and proper communication of information by state institutions and other responsible institutions. Another shortcoming that P2 and P5 emphasised was the dependence on radio and television to transmit warning messages, stating the reason for the ineffectiveness as, "In the last event, rain occurred at night and when it is heavily raining people are reluctant to turn on their radio or television."

3.3. CHALLENGES IN DISASTER MANAGEMENT

As mentioned earlier, the interview respondents are from various branches of disaster management. Hence, the challenges identified by them (Table 3) were also of a wide range, covering many aspects of disaster management

Challenge	Sources	References
Lack of implementation building codes	3	6
Lack of prior disaster risk assessment	1	1
Inability of the Meteorological Department to give localised forecasts	1	2
Lack of required equipment for Meteorological Department	1	1
Lack of equipment of government agencies to respond to disaster situations	2	2
Under preparedness from the side of communities	3	3
Lack of coordination in disaster relief work	5	6

Table 3: Challenges in disaster management.

Despite the availability of building codes, these are not properly implemented. This responsibility lies with both the developers and the local authorities. A major shortcoming highlighted by both P1 and P10 is that, obtaining building permits is required for buildings under local authorities which are operated under the Urban Development Authority (UDA). However, P1 mentioned that, "*There are only about 110 local authorities under UDA, whereas for others, which are 300 or more, there is no compulsory requirement to get building permits*." According to P9, even in the local authorities under UDA, the approval process is limited only to the building planning stage, and variations in the completed building are not monitored. P1 highlighted this stating, "*After construction, no one is checking whether it is constructed accordingly.*"

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Similarly, according to P1, "NBRO [National Building Research Organisation] is authorised to provide the technical evaluation report for any development, but they are not responsible to see whether the developer is complying with the technical instructions given by NBRO." The risk in this situation lies with the fact that many local authorities which are not operated under UDA are usually situated far away from main cities including in the disaster-prone areas. Therefore, P1 asserted that the lack of knowledge capacity of people who are involved in designing and constructing owner built houses is a massive challenge in maintaining building codes.

Another challenge is assessing risk prior to disaster events and transferring information to vulnerable communities. P5's opinion in this regard is that, "*It is important to do a proper hazard assessment and develop the hazard profile and vulnerability profile to identify people who are in high risk areas and make them aware of resilience.*" Therefore, a proper hazard assessment is also helpful in identifying vulnerable areas to implement community-based awareness programmes.

The newspapers highlighted the inability of the Meteorological Department to give localised forecasts and predict the magnitude of rainfall accurately. As reported in N4, "*Meteorological Department cannot predict where the rain will exactly fall and boil it down to a particular localised area but can only give a general prediction province by province.*" P5 agreed to this statement asserting that, "*The current system is to issue warnings for an entire district or a division, which is a large area.*" P5 also asserted that the forecasts of this nature are ineffective and therefore it is vital to provide forecasts least at the village level.

Many newspapers have indicated the reason for this inability of the Meteorological Department as the lack of required equipment or frequent breakdowns. This was described in N1 as, "Lack of sophisticated radar technology prevented Meteorological Department from issuing detailed-enough warnings." P4 had the same opinion regarding the lack of required equipment available to the Meteorological Department. Moreover, P4 mentioned that the Automated Weather Stations (AWS), doppler radars and other technical instruments would be helpful in issuing accurate and detailed weather forecasts. Not only the equipment for early warnings, but also government agencies lacked equipment to respond to disaster situations and delayed in deploying them as mentioned by both P4 and P7. P7 mentioned that "There was not enough equipment such as boats to access people during the disaster period." However, P4 stated that the roads got blocked and some of the places could not be accessed even by boats. Furthermore, P4 accepted that

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there were not enough stockpiles of relief supplies and hence when the requirement arises it is difficult to obtain them immediately.

However, some respondents highlighted that the preparedness from the side of communities was also lacking. P3 argued that "Though people have seen the issue coming up, they were not prepared to move out of their houses to safer places." P7 stated that "Lack of awareness and response of people to early warnings is a challenge which is always there in disaster situations in Sri Lanka." However, P8 mentioned that, "The flood levels during the last five years have been way too high and the people in risky areas do not expect that kind of high levels of flooding resulted due to changes in upstream watersheds and deforestation."

Due to the delays of government agencies in providing satisfactory relief immediately after a disaster, socially responsible organisations such as media channels start collecting and distributing basic relief items to people in need. Even though this is an effort that should be commended, some of the respondents criticised this. P2 stated that, "Even though many parties were coming up with relief, there was no proper coordination." Furthermore, P3 added that, due to this lack of coordination, there was a lot of duplication and wastage. According to P3, these organisations do not have any mandated responsibility and hence are not accountable for what they are doing. Therefore, P3 had the opinion that "They are competing with each other, and use it as a marketing strategy." Similarly, P5 highlighted the problem of coordination, stating that, "As there is no central body to coordinate all these collections, sometimes there were repetitions, where some people received relief items several times while some people have received nothing at all." Moreover, both P7 and P8 agreed on the fact there is no or little coordination in disaster relief work. As a result, people tend to misuse these resources, as mentioned by P8.

3.4. SUCCESSFUL STRATEGIES THAT HAVE BEEN IMPLEMENTED FOR DISASTER RISK REDUCTION

Interview respondents pointed out several disaster risk reduction strategies that have been successful in the country. However, all of them were of the opinion that there is still a lot of work to be done and there is room for improvements.

Several respondents highlighted the importance of capacity building at the community level in order to reduce disaster risk. P2 mentioned that "Few years before there were district, divisional and village level disaster management committees, and communities had better awareness because of that." It had been a good practice; however, these committees have largely become

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dysfunctional. In addition to that, both P5 and P6 stated that community-based early warning systems have become really successful where they have been implemented, and suggested implementing such systems in all the disasterprone areas. However, P5 stated that, "In order to decide places to conduct this system, hot spots or the risky areas should be identified." Moreover, according to P5, these systems have been implemented by DMC and NBRO. P6 revealed that "People were given plastic rain gauges and were educated on threshold rainfall levels to identify landslide risks." However, both P5 and P6 agreed that the success of these programmes depend on public reaction in emergency situations. P5 mentioned that "Those who were interested in this have measured rainfall and decided when to escape, but people who neglected this lost their lives." Conversely, P2 claimed that the reason for the lacking response of communities lies in the fact that there are no properly designed premises to handle emergency situations with required basic needs and privacy stating that "There are no designated safe shelters and when an emergency happens people just run to the temple, church, mosque or school."

Moreover, several respondents shared their experiences in successful strategies used for emergency response. P4 and P8 identified the involvement of the armed forces in the emergency response process as a strategy that has become successful. P4 has more specifically stated that the use of communications systems of security forces like wireless (VHF and HF) have been highly helpful in communicating with local level stakeholders during emergency situations. On the other hand, P4 mentioned that the establishment of National Emergency Operation Centre within the premises of DMC has been highly effective in quick decision-making during emergency situations. According to him, National Emergency Operation Centre consists of personnel from all the relevant government institutions and having them all in one location helps to make quick decisions during disaster response. Moreover, P4 has explained that, DMC has taken the initiative to register suppliers for emergency relief work. For example, P4 mentioned that, "DMC have signed an MOU with suppliers, and they have to supply food packets within the first six hours."

P1 emphasised the importance of long-term mitigation projects for floods and landslides with examples of successful projects. Examples drawn by P1 include the Mahaweli project in which one of the expected outcomes was to control floods in downstream areas. As for other examples, P1 stated that "*Beragala to Bandarawela, we have done one mitigation for a stretch of about 2 kilometres. Otherwise road used to move during heavy rain, but now it is stabilised. Also in railway track near Watawala, NBRO has done some mitigation work.*" According to P1 the strategy which has been used here is lowering the water table. For that, pumps have been used to draw out water and also in some places directional drilling has been carried out. Moreover, P1 stated that in the

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Colombo area, several small inland reservoirs were created to increase the retention capacity.

Despite the successful strategies that have been implemented, all the respondents emphasized the inadequacy of work done and the necessity of government initiatives in implementing and continuing these strategies.

3.5. STEPS TO BE TAKEN IN FUTURE DISASTER RISK REDUCTION

Review of newspaper articles unveiled several suggestions as the steps to be taken to reduce future disaster risk, such as, removing illegal constructions nearby waterways, upgrading facilities of the Meteorology Department, introducing laws for the evacuation of people in the vulnerable areas and flood management. Table 4 presents the steps suggested by respondents.

Future Steps	Sources	References
Developing hazard maps	3	3
Improving appropriate construction techniques in	3	3
disaster-prone areas		
Community based capacity building for disaster	2	2
risk reduction		
Changing attitudes of people towards disasters	3	3
Creating designated safe shelters	1	1
Giving autonomy to the officials in disaster	1	1
situations		

Table 4: Steps for future disaster risk reduction

Developing hazard maps is one of the urgent requirements as identified by P1, P5 and P7. According to P5, developing hazard maps could be helpful in identifying exposure levels. On the other hand, both P1 and P7 asserted that once the maps are developed and the risky areas are identified, it is important to pass the information to people as they can use them as guidelines for land use. P7 highlighted the benefit of mapping and information sharing with the public on land use practices saying, "*People can anyway sell land, but when they buy land they have to be careful of what they buy.*"

Moreover, P9 stated that "Landslides in Ratnapura district, may be even in other districts, was due to the sloping that was not properly done during construction." Hence, it is necessary to inform and improve appropriate construction techniques in disaster-prone areas rather than applying the traditional practice of cutting hilly slopes and constructing buildings. According to P1, "Technical guidelines should be given not only to the public, but also to government agencies, and practice should start at least with public

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projects demonstrating how the floods and landslides could be mitigated." Similarly, P7 stressed the importance of implementing policies for building codes and land use without any political interference.

Several respondents have stressed the importance of capacity building for disaster risk reduction. P2 emphasised that, communities should be engaged in risk reduction programmes at the divisional or village level and taking responsibilities. As revealed by P3, with the experience in capacity building among people in vulnerable areas "As an organisation now we have started working with three local authorities to do a CBDRM [Community Based Disaster Risk Management] as a pilot project." Also, both P9 and P2 stressed the importance of creating an attitude to consider disaster preparedness as a routine in everyday life, in these areas. Accordingly, P2 asserted that, "Disaster management and risk reduction have to be something regular and everyday practice and people need to learn to live with the flood like an everyday thing." "We need to cultivate that culture and people should be mentally ready to leave no matter what if there is an early warning." P7 also supplemented the need for enhancing awareness of people to respond to early signs of disasters. However, as mentioned in section 3.4 and as pointed out by P2, creating designated safe shelters is necessary with government involvement where disasters are now frequent and should be prepared for the future. On the other hand, P5 contended that people are caught up in a "relief syndrome". This is because people totally depend on external help, rather than taking any precaution by themselves. Hence, according to P5, "We are creating a nation dependant on relief, rather than taking action to be resilient."

P10 stressed the importance of giving necessary autonomy to the officials, in a disaster situation to work out of standard operating procedures. According to P10, it is important to identify extreme situations and to act promptly without sticking to standard procedures or guidelines."

4. Conclusion

The frequency of disasters faced by Sri Lanka has increased and the impacts created by them are becoming severe. This study focussed on disaster management practices during the latest flood and landslide events, which occurred in May 2017. The death toll exceeded 200, reaching the highest from a disaster in the country since the Indian Ocean Tsunami of 2004. Damages to property were also high, impacting 15 out of the 25 districts. Initially a newspaper review was conducted to explore content related to recent disasters. Subsequently, the study was extended by carrying out interviews among experts in the field of disaster management. Findings were discussed under five categories as response to disaster events, communication between agencies and

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communities, challenges in disaster management, successful strategies and the steps to be taken in future disaster risk reduction.

The findings of the study highlighted the effective involvement of the armed forces and police in the rescue and relief operations. However, several shortcomings were identified in the overall disaster management process. There were many criticisms on the inability of the Meteorology Department to issue accurate and localised weather forecasts. Further, in spite of the satisfactory level of communication between state level organisations, communication between the state level agencies and local authorities was inadequate and it further diminished at the community level or the 'last mile'. Moreover, this lack of proper communication system was highlighted as the main reason for the significant number of human casualties. Lack of coordination among various parties involved in disaster relief work was highlighted as a major challenge in the disaster management process.

Furthermore, the study has revealed some of the successful strategies which have been implemented for disaster mitigation and response. However, all of the respondents agreed on the fact that there is room for further improvement in the field of disaster management in Sri Lanka. Therefore, as a country, facing frequent and severe disaster situations, it is important to take necessary actions immediately, to minimise devastation.

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IDENTIFICATION OF DRAWBACKS AND BARRIERS PLASTIC BASED UPCYCLING INDUSTRY IN SRI LANKA

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Abstract

The Upcycling converts waste materials into new products giving higher value and/or quality in their second life. Though it encourages low energy consumption and the law cost of raw materials, still it is not well-established industry in Sri Lanka which the country needs of sustainable businesses opportunities and waste management methods. Three case studies of Plastic based upcycling brands in Sri Lanka have been studied to identify the current state of the industry considering the manufacturing process, scale of production, distribution and manufacturers' approach to the industry. It mainly targets niche markets which appreciates eco-friendly and sustainable products. Product designs which can get the customer attraction by finishing, aesthetic and functionality could have achieved its target market and it does not depend on the manufacturing technique. In Sri Lanka, applying marketing strategies which can be used in promoting upcycling products positively much not have been practiced in the industry. Low awareness about the upcycle products is one of the issues appears in the local context. Through the study, inability of practicing product design and marketing strategies is identified as the barrier because of the low production cost and continuous supplement of raw material reduce the economic barrier in the plastic based upcycle industry in Sri Lanka.

Keywords: upcycle, plastic waste, industry, sustainable production, recycling

1. Introduction

The plastic wastage has been created a vast problem throughout the world while causing many environmental, economic and socio-cultural problems. Many product applications, even the traditional valued products are replacing with plastic material in Sri Lanka because of the low cost, durability and the light weight of the material. Sri Lanka has over 400 companies engage in plastic production in present day. The capacity of the plastic production industry is nearly 140 000 MT per a year. The growth rate is around 10%-12%.

But these wastes can be used to make economic advantages, reducing the harm to the environment. Land filling, incineration and energy recovery, Downgauging, re-use of plastic, plastic recycling are the main plastic waste management methods. Due to the economic barriers many waste incineration and energy recovery do not practice in Sri Lanka. Among them upcycling plastic practice has a potential because it uses low energy consumption

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comparing to other waste management methods while giving economic benefits. Sri Lanka has been ranked among the top 20 countries that pump 80% of the global 13 tons of plastic waste into the sea and with that every Sri Lankan throws 5.1 kilos of plastic and bottles. (Christopher.C, 2016) It convinces proper waste management methods as upcycling are needed to be refined in Sri Lanka.

"Upcycling is a process in which waste materials are converted into something of higher value and/or quality in their second life." (Sung.K, A review on upcycling: current body of literature, knowledge gaps and a way forward, 2015)

Upcycling is a creative process which encourages the designer to use different raw materials in non-conventional way, using the critical thinking to come out with innovative product. It makes the designer to think beyond the material capabilities. For designing upcycled plastic products, the current situation and the barriers of the industry are needed to be identified as a part of a product designer's process.

When considering the habitual practices of Sri Lankan people, upcycling is not a novelty concept for their culture. Besides that, they could have been applied it into industrial applications. In the world as an industrial practice upcycling companies have become multi-million-dollar enterprises. But in Sri Lanka, it still has been limited and there are potentials and possibilities to uplift. Through the research, these drawbacks and barriers which have caused to limit the upcycled plastic as an industry are trying to be identified to in order to establish the plastic based upcycling in Sri Lanka.

2. Methods and Methodology

This research employees qualitative approach in order to understand the reasons for the limitations of the industry. This information can be understood more effectively through a qualitative research. Therefore, detailed interviews and observation techniques to gather insights from three plastics based upcycle brands were conducted.

• Katana Upcycle (Katana), Yaal Fibre (Jaffna) and Rice and Carry (Ampara) brands are selected as the three cases to represent the plastic based upcycling industry in Sri lanka. The selections were based on, Manufacturing process: Katana Upcycle (Katana)– plastic with fabric, Yaal Fibre(Jaffna) -plastic with Bana Fibre (both more focused to heat press machine), Rice and carry (Ampara)- plastic waste without changing the qualities of the waste material

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- The scale of the production: comparing to Sri Lankan plastic based upcycle product manufactures: to identify how and which the variables do impact in the industry. Scaling up order: Katana Upcycle < Yaal Fibre < Rice and Carry
- Distribution: to understand the impact of geographical location in the industry,
- Manufacturers' approach to the industry: identify the potentials to enter in upcycle product manufacturing.



Figure 10, Case study locations Sri Lanka (Sri Lanka location map, 2010)

Marketing mix (4Ps- product, price, place, promotion) is used to explain the marketing analysis, because it is the method or action used by business organization to promote their products to the market.

3. Context and Background

Due to the irregular patterns of collecting waste, most of the wastes cannot be easily directed into the recycling process without further cleaning and sorting process. The studied brands have been built awareness around the area to separate the wastes and the way of wastes should be collected both domestic and industrial waste generation. High Density Polyethylene (HDPE), Low Density Polyethylene (LDPE), Polypropylene (PP) plastic types are mainly used in manufacturing process.

With the knowledge which is given through the project Australia-Sri Lanka university partnership to develop community based waste recycling business, Katana Upcycle and Yaal fibre brands have been started. Waste for life project is involving in providing knowledge in the project.

Mainly heat pressing is used as the manufacturing techniques in both brands. LDPE, HDPE and PP are mixed with degradable natural materials (wood, tree leaves) and fabric wastes to make materials in heat pressing technique. Non-plastic materials are laminated by using waste polymers. With those composites products are manufactured. The machines have been funded by Waste for Life project.

3.1. CASE STUDY ONE: KATANA UPCYCLE (KATANA)

Diary covers, files, file covers, book covers, bible covers, menu cards, bags and light fittings are produced using plastic or plastic composites plates. The products are mainly targeted the good market. (Kumarasiri.J, 2017) (It operates as a self-financing social enterprise. Vendors, partners, and supporters are working together and a small team handles day to day operations and provides community support).

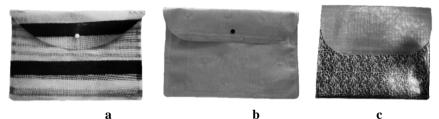


Figure 11: a,b,c file cover designs in Katana Upcycle

3.2. CASE STUDY TWO: YAAL FIBRE (JAFFNA)

Ability of extracting banana fibre for zero cost has been identified as the resource of the Jaffna community (Yaal Fibre) poses. LDPE is used as the polymer material type which is used for the heat pressing to laminate the banana fibre. In the research lab in University of Moratuwa, the product design potentials of banana fibre and LDPE composites are identified in order to design products. (Weerawardhana.H, 2017) The detailing and the finishing of the products are mainly concerned.

The brand is mainly targeted the luxury brands in Colombo. Barefoot, Prana Lounge, Lakpahana, luxury hotels and Good market are used to place the items. Co-operative organizations also have purchased the products. But it has an irregular demand because the purchasing is seasonal. (Liyanaarachchi.P,

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2017) Since, it is seasonal or occasional, it is unable to create a sustainable market.



Figure 12: Product designs developed to Yaal Fibre. Adapted from the project Australia-Sri Lanka university partnership to develop community based waste recycling business, 2017

3.3. CASE STUDY THREE: RICE AND CARRY (AMPARA)

Polypropylene plastic rice bags are mainly used as the raw material. Bags and accessory are the major productions of Rice and Carry brand. Back packs, hand bags, wallets, key tags are mainly manufactured under the brand of Rice and Carry. The cultural and traditional of Sri Lankan society has been combined to create brand identity.

The brand could create high quality products. Manufacturing techniques which uses, saves the energy usage and the man power. The qualities of the waste materials have been used itself other than it converting to another form of a material. These raw qualities could enhance the design qualities of the products and the products are highly detailed. Rice and Carry products are marketed in targeting middle upper class in Sri Lanka. The product is marketed in local market can be seen under luxury brands in Colombo. Barefoot, Prana Lounge, Good Market are the main local locations. The brand image has created with the luxury brands.

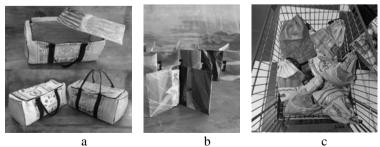


Figure 13: a. using sawing technique, b. using heat pressing technique, c. material combining /Rice and Carry product design Rice and Carry bags, 2017

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The brands with high quality and functionally designed products could have reached to better markets in Sri Lanka. The brands try to target middle upper and upper-class niche market which appreciates eco-friendly and sustainable products. To maintain their brand image additional price has marked. It is hardly seen any promotions or creative strategies in marketing under any case. Tourists based productions are mainly focused by manufacturers. Technological facilities which are poses with each brand are same. The community around the upcycle industry has been uplifted with it and the awareness of waste management has been build up parallel to it.

4. The drawbacks and barriers

Economic barriers are not much affected to limit the plastic based upcycling industry in Sri Lanka because of the zero o low raw material cost, low machinery cost and funds. Because of that the raw material of plastic based upcycle industry/the plastic waste is continuously produced and avoided the deficiencies in material supply. To gain the knowledge in designing and marketing may require a capital. Social media has been utilized in promotion powerfully in Sri Lanka to establish the concept as a trend in the society. It shows the promotions also can be successfully executed with a low cost. With the above facts, high capital is not mainly needed for the plastic based upcycle industry.

4.1. KNOWLEDGE OF THE BUSINESS AS A BARRIER OF PLASTIC BASED UPCYCLING INDUSTRY IN SRI LANKA

4.1.1 Applying Product Design Knowledge

The basic knowledge of the business which is going to involve with, is essential to engage with the business. Upcycling is a creative process which needs product design knowledge to manufacture a good product to the market. To practice design knowledge creative and critical thinking is essential. In the successful international upcycle trading companies, a group of designers or/and artists engage in designing process. It guides to manufacture high quality and detailed end products with making the customer attraction towards to it. In Sri Lanka the product design knowledge is highly affected to the industry as a barrier because engagement of product designers in the field is very low.

Though upcycle creates sustainable and green concepts, customer does not purchase a product without a value. Because waste is the raw material, the feel of waste should remove and give a new meaning to the product is required to reach the customer. The customer does not need to persuade to use the upcycle products but its functionality and aesthetic should be leaded to buy the products

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instead. To create the value of the product, design knowledge is essential. The products which unable to create this value are failed in the market.

Yaal Fibre uses defined plastic type and additional material which are coming through a defined source. It allows to use the same designs for a considerable time period. Katana Upcycle uses different raw materials and it has caused to develop the designs continuously, to maintain the product qualities and demand for the new products. To produce an innovative and inventive outcome, creative and critical thinking is essential. Some product types have failed in the market because the inability of applying this knowledge and failed to identify the material qualities properly.

There is no exact manufacturing method in upcycling. To design and manufacture a product, it is needed to think beyond the material capabilities. In the conventional way of manufacturing products has defined methods for each material. But in upcycling it is essential to explore new methods to create the required form or shape of a design. It sometimes allows to use the materials beyond their potential. Product variation is limited in Sri Lanka because of the inability of creating new forms and shape. Plastic as a raw material it does not create much patterns and textures on the surface. But through heat pressing technique, it can create attractive patterns and textures which leads to increase the aesthetic of the product. The product does not possess a good finish and attractive pattern to create an aesthetic value it is difficult to reach to the customer.

It is easy to create a product within a waste. But creating a meaningful product is the challenge. To achieve that it has to give a functionality while create a meaning to be in the space. It needs to understand sustainable design concepts while designing upcycle products. Through that it can be directed to the upcycling process. In the local context vast product variation cannot be seen and it has caused as a barrier to reach the different needs of the customer through upcycling solutions. The main weakness in the local context which is identified through the study is, most upcycle products do not have a label by mentioning the type of plastic to enter them into recycling process again.

4.1.2 Applying Marketing Knowledge

Upcycling is about giving a higher value to the product in the second life. The value can be increased through applying the product design knowledge. But in the end, the customer and/or the consumer should accept the given value to it. The true meaning of upcycle only can be achieved with the customer acceptance. Otherwise it becomes downcycling. (Downgrading the value) In

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Sri Lanka, applying marketing strategies which can be used in promoting upcycling products positively not have been used well practised in the industry. Because the concept of upcycling is novel to the Sri Lankan context, the consumer demand state is a non-existence demand. Hence, creating awareness is essential in the process with high quality products, to achieve the customer loyalty. But creating awareness of upcycling concept is in the lowest stage in Sri Lanka.

Marketing mix (4Ps- product, price, place, promotion) is used to explain the marketing analysis, because it is the method or action used by business organization to promote their products to the market.

Product

According to the study, product designs which can get the customer attraction by finishing, aesthetic and functionality could have achieved its target market. It does not depend on the manufacturing technique but the good quality. As an example, Rice and Carry uses both sewing technique and heat pressing technique and both products have targeted the same market. Though the technique is conventional it does not affect to reach the expected market.

Eco products, green products concepts are yet novelty to the Sri Lankan context. Every product type which is introduced through upcycling to the local context can be an innovative product which uses new raw material type. The customer and consumer feedback are essential to take for developing the product and its features. But it does not practise in the field and because of that some products are continuously failing in the market. Product, material and techniques development should be gradually improved. Yaal Fibre case study shows how the uniqueness of upcycling products can be created through using the materials which community possess and their skills. To avoid the feeling of waste, additional materials can be added and increased the value of the products. Not giving a high attention to take an advantage of additional materials is affecting as a fact to weak the both aesthetic and functionality in some of the upcycle product designs to reach to the market.

Price

P R O	EM	EM	
D U	EP EM	NP NM	
C T	NP	NP	

- 1. EM, EP: Existing Market, Existing Product
- 2. EM, NP: Existing Market, New Product
- 3. EM, NP: Existing Market, New Product
- 4. NM, NP: New Market, New Product

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	EP	NP		
_	EM	NM		
	NP	NP		New
		Existing	New	
	M A	R K E T		

Figure 14, Market Types

In Sri Lankan context upcycle products are new and there is no existing market to target these products. According to figure 5, the category which should target the upcycle products is number four. Yaal Fibre and Rice and Carry local upcycle brands target a niche as semi luxury brands. But, the Sri Lankan market is more price conscious. Targeting the low prices as, by giving the benefits of upcycling to the customers, has a potential to reach the attraction of domestic market and expand the concept around Sri Lanka.

Young eco-friendly market can be created to establish the concept of upcycling. It also helps to create a sustainable market to achieve the future goals. As the business concept Katana Upcycle more focused in production concept by admiring manufacture more products which need short time period in manufacturing and tries to price the in lowest price.

Place

According to the case studies, local upcycle product manufacturers place their products under luxury retailers. Both Rice and Carry and Yal Fiber brands target the tourist market. But the products only can be seen around the Colombo (Capital of the country) area though production locations are far from Colombo.

Promotion

Low awareness about the upcycle products is one of the issue appear in the local context. To reduce that creative marketing concepts which carrying the concepts of waste management green and sustainable concepts can be positively used in social media. But in Sri Lankan context to create awareness about these products, promotion campaigns with creative approach is hardly taken in the industry.

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Among the studied cases, Katana Upcycle is the smallest upcycle brand and the implementation of product design and marketing knowledge is in the lowest stage. Without implying marketing strategies but with good product designs Yaal Fibre could be able to reach the market, more than Katana Upcycle brand. Applying marketing strategies more with good product designs, Rice and Carry could be able to reach the market more than any other upcycle brands in Sri Lanka.

5. Conclusion

Through the examples that have studied in the research, it proves if product design and marketing knowledge is applied, they would have been more successful and sustainable in the industry.

Product designs which can get the customer attraction by finishing, aesthetic and functionality could have achieved its target market. It does not depend on the manufacturing technique but the good quality. The true meaning of upcycle only can be achieved with the customer acceptance. Otherwise it becomes downcycling. In Sri Lanka, applying marketing strategies which can be used in promoting upcycling products positively not have been practised in the industry. But the technology and the machines are available in the industry and same facilities have created different achievements in the market due to the product qualities and the brand image. Low awareness about the upcycle products is one of the issue appear in the local context. To reduce that creative marketing concepts which carrying the concepts of waste management green and sustainable concepts can be positively used. Through the study, inability of practicing product design and marketing strategies is identified as the barrier because of the low production cost and continuous supplement of raw material reduce the economic barrier in the plastic based upcycle industry in Sri Lanka.

The research is more focused on the usage of upcycling to gain economic benefits rather than the waste management method. Directions for future research areas were identified such as: case study of successful product implementations and possibilities, the potential of household producers and individual upcycling, consumer attitudes towards the upcycling practices, historical study on upcycling, product/ material based cased studies, upcycling as a waste management process.

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ANALYZING A MORPHOLOGY OF DOMESTIC LEGACIES

An investigation into the inherited pattern of domestic space arrangement in the shop houses of Shakharibazar, Old Dhaka

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Abstract

Shakharibazar in Old Dhaka, one of the first streets to be built in the region of South Asia, is a sanctuary to a very specific ethnic group, and the only known home to some craftsmen. Shop house is the generic archetype of existing urban fabric of Shakharibazar. A striking characteristic of this distinctive 'plan unit' is oblong and linear plots with very narrow frontal widths. Defence mechanisms, community interaction, commercial, residential and service interfaces were the bases for the spatial features of individual houses. This paper investigates the patterns of configuration of domestic space that historically fostered its growth and explores the potential of the settlement pattern and space layout to function as an important tourist destination. The methodology consists of literature review, site survey, house survey, formal and informal interviews with the inhabitants of selected houses and an elaborate spatial analysis using space syntax. The street is syntactically responsible for very high pedestrian movement and community activities. The shop is the most integrated space of the ground floor, whereas the changing room is the deepest. There are instances of gendered space, that are segregated to some extent. The control values coincide with the air flow pattern, and VGA analysis demonstrates privacy and security. Conservation of this lifestyle and spatial pattern is more necessary than merely conserving existing structures.

Keywords: Heritage Urbanism, Shakharibazar, Shop House, Domestic Architecture, Space Syntax.

1. Introduction

Shakharibazar in Old Dhaka, Bangladesh, was one of the first streets to be built in the region of South Asia, using the river network as major transportation route and home to invaluable artisans in the 17th century (Figure 1). As Smita (2014) has described, it is a sanctuary to a very specific ethnic group, and the only known home to some craftsmen. Therefore, this street is a rich treasure of both tangible heritage and 'intangible heritage'. Unfortunately, the survival of these crafts is under threat, as the artisans seem to be changing their livelihood

PRINCE. A & AHMED. B

due to disconnected cultural ecology. Shop houses, which are the generic archetype of existing urban fabric of Shakharibazar, are eloquent testimony to the history, culture and tradition and are 'images' of the past with which people still identify Old Dhaka. But sadly, most of these historical buildings are either diminishing through ignorant renovations or collapsing due to neglect, resulting in hazardous living conditions for the unique artisans and migrants. If these present conditions persist, it will not be long until many of these structures, along with the intangible heritages they house, are lost forever.

The historic urban fabric of Shakharibazar is also facing extermination due to rapid urbanization, insufficient legislative framework, changing economic opportunities, higher cost of urban land, inadequate financial support, absence of development control regulations and lack of awareness and resources. This paper investigates the anatomy of this condition.



Figure 1. Location and image of the street. (Source: Render Authenticity by Smita, P)

2. Aim and Objectives

The aim of this paper is to investigate the patterns of configuration of domestic space that historically fostered the growth of a community of craftsmen and artisans and to explore the potential of the settlement pattern and space layout to function as an important tourist destination by focusing on the conservation of this unique cultural heritage within the city. The objectives are -

- To find out morphological evidences causing the growth of an artisan village,
- To understand domestic activities and lifestyle pattern responsible for the existing domestic space pattern,
- To relate historical findings with the existing space layout,
- To analyze spatial configurations and to interpret the the correlation between syntactical measures and spatial typology,

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• And to suggest the means to conserve this unique heritage with reference to key findings.

3. Methodology

The adopted methodology is thorough case study of the domestic space patterns of the urban 'plan unit' at Shakharibazar and it will consist of house survey, i. e. measuring and drawing of house plans and furniture plan; a literature review to analyze the occupancy pattern and historical evidences; formal and informal interviews with the inhabitants of selected houses, followed by spatial analysis of the domestic spaces and an elaborate analysis of the obtained data. The method used for spatial analysis of the existing configuration was space syntax via tools such as DepthMap and JASS.

4. Analytical Approach

This section blends study, survey and analysis together and discusses key findings with interpretations. It includes literature review of the city's history, morphological analysis of the urban fabric, house plan analysis for spatial typology and syntactical analysis of domestic space.

4.1. LITERATURE REVIEW

Birt (1975) and Dani (1962) suggest that Dhaka has grown from a small trading center to a metropolis in Bangladesh while its antiquity can be traced back to the 7th century A.D, proved by the discovery of two mosque inscriptions and remains, traditions and literary evidence. N.K Bhattashali (1936) has reconstructed the extent of the city of Dhaka of pre-Mughal (Old Dhaka) and Islam Khan's city (New Dhaka) from the pages of Mirza Nathans Baharistan-i-Ghaibi. Tabassum (2008) argues that spatial patterns suggest phase developments in both old and new domains of Dhaka, among which two distinct phases are clearly observed, Old Dhaka and New Dhaka, existing side by side. According to Siddiqui et al (1991), Old Dhaka is the 'indigenous' historic core and New Dhaka is the 'informally' developed extemporaneous settlement of recent years. Nilufar (2004) adds that the historical core of Old Dhaka retains the traditional features of the urban settlement that it has inherited from the past and the natural endowment of its organic morphology is valued for its 'indigenous' urban pattern. The residential neighborhoods of Old Dhaka, locally known as 'mohallas', were the enclaves of caste or craft groups considered as the morphological archetype of the old part. Imamuddin et al (1989) suggests most of these 'mohallas' (neighborhoods) were developed as Hindu trader's settlement and named after the specialized trades and crafts for which they are engaged such as TantiBazaar, ShakhariBazaar, Bangla Bazaar, Lakhsmi Bazaar, Kamar Nagar, Sutar Nagar, Goala Nagar etc. These

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neighborhoods mainly indicate the predominance of the Hindu artisan and professionals among the population of Pre Mughal Dhaka's urban center that had flourished with their craftsmanship during the Mughal period.

4.2. MORPHOLOGICAL ANALYSIS

This analysis relies on information gathered from literature review, field surveys and informal interviews with a few inhabitants. Shakharibazar's unique cultural features resulted in the area becoming a distinctive urban "Plan Unit". (Figure 2) Conzen's (1960) Plan Unit is a group of buildings, open spaces, lots, and streets which form a cohesive whole because they were all built at the same time or within the same constraints undergoing a common process of transformation. A striking characteristic of the area is the oblong and linear plots with very narrow frontal widths. It is noticeable that this linear pattern is the consequence of the transformed cultural lifestyle of the craftsmen, who prioritised the shops to embody their visible identity and to commercial advantages, and relied on defence mechanisms and community interaction as a significant basis of space arrangement.

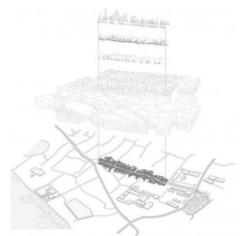


Figure 2. Urban Morphology of Shakharibazar. (Source: Render Authenticity by Smita, P)

Imamuddin et al (1990) established the following points as the basis of this morphological character:

• Each original owner may have received a plot with street frontage so that living and trading could be practiced together. However, as business flourished, the living quarters could only expand backwards. Such expansions could only proceed up to 70 to 80 feet as similar backward growths from an opposite lane set limits.

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- Security aspect, such as threats of burglary or robbery, may have encouraged Shakharis to build closely-packed houses along narrow streets whose only two openings could easily be sealed, shutting off the whole area if necessary. Narrow houses, approachable only through narrow dark corridors and unexpected stairways, were deliberately designed to confuse intruders.
- Another reason for narrow plot sizes could be the subsequent divisions among successors each requiring a street frontage.

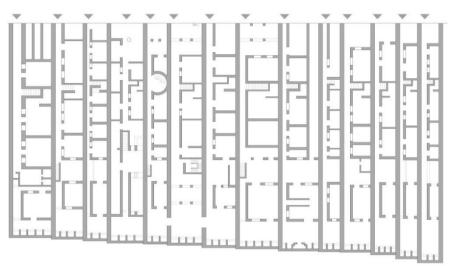


Figure 3. House plans showing entry from street. (Source: Field Survey)

4.3. HOUSE PLAN ANALYSIS

This analysis also sythesises information gathered from literature review, field surveys and interviews. Shop house is the generic archetype of existing urban fabric of Shakharibazar. These houses, during the mughal period, used to house Burmese dancers that had been carried all the way from the now Myanmar using the river network. Artisans also used to transport raw materials for many Hindu products e. g. Shakha from Myanmar. Many Burmese products are still being imported for the craftsmen, but modernisation led to them pursuing other businesses of crafts (e. g. Crowns, Statues of Hindu deity, Ornaments) while the shop interface remains the same (Figure 4). However, since the houses were vulnerable to attacks by Portuguese pirates, the inhabitants tended to develop defence mechanisms. The linear configuration also allowed them to seal their houses very efficiently in case of emergency, as the only option for access was from the street. (Figure 8) The clear height at ground floor is only 8 feet and some doors are still 4 feet in height, designed to halt Portuguese men, who were very tall. The clear height in upper floors range from 10 to 11 feet. The upper floors have verandas at the front, used for interaction with the members

of the house just opposite, at a small distance of 10-12 feet. Each house, at present, is occupied by many families.



Figure 4. Images at the left are of the old street and an old Shakha shop; in the middle, of other crafts than Shakha now in practice, while those at right shows the innermost bathing area. (Source: Web & Field Survey)

Imamuddin et al (1990) highlighted the following points about the space arrangement inside the house (Figure 3):

- Houses are divided into three segments, the commercial part facing the street, the residential area in the middle and the service precinct, consisting of toilets and washing areas, in the open courts at the rear.
- Access to the inner part of the house is through a corridor placed at the side of the house. Corridors are usually divided by a party wall to provide access to other rooms and to upper floors through stairways. Corridors ultimately terminate at the service areas in the rear.
- Upper floors are mostly used for residential purposes. No separate cooking spaces are provided; cooking is mostly done within family bedrooms.
- Rooms are arranged within two parallel parry walls along a narrow corridor from which two stairways lead to the upper floors.

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• Absence of light-wells on the ground and first floors results in poor lighting and ventilation. Light penetration to these two floors is through the building's front and rear only.

4.4. SYNTACTICAL ANALYSIS

Analysis was carried out through literature review, and simulations in JASS and DepthMap. The order of analysis is from macro level to micro level.

4.4.1 Morphology of the City

The integration core of Dhaka City shifted from time to time gradually from Old Dhaka towards the north as the city expanded with time. Figure 5 shows the transformation of the global integration map of the city starting from the 1600s upto 2007. Although the integration core changed, some streets of Old Dhaka always remained well-integrated. Shakharibazar is one such street in Old Dhaka, and it has managed to hold together its cultural identity for hundreds of years.



Figure 5. Integration core of Dhaka, from 1608 to 2007. (Source: Nilufer et al)

In the Integration R=3 map of Dhaka City produced in DepthMap (Figure 6), the average integration R=3 value of the axial lines of Shakharibazar street is 3.88, while the average value of all lines in the axial map is 2.20 with a standard deviation of 0.81. Integration R=3 signifies pedestrian movement (Jones and Fanek, 1997). Evidently, shakharibazar street attracts significantly more pedestrians than most other streets of such width in Dhaka. This explains why the craft business flourished for hundreds of years and as a consequence, the settlement survived.



Figure 6. Integration R=3 map of Shakharibazar and Dhaka streets.

The VGA map (Figure 7, generated using DepthMap) of Shakharibazar street and surrounding streets also demonstrate that the Shakharibazar street is full of highly integrated zones, responsible for the growth of a successful business center.

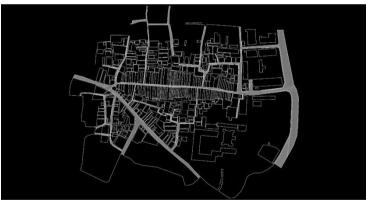


Figure 7. VGA map of Shakharibazar and surrounding streets.

4.4.2 Morphology of the House

A diagram (Figure 8) for each floor is prepared showing the relationships of the spaces. It is evident from this relationships that toilets sit at the most isolated space of the house, which is generally open to sky, and the corridor provides the main access. In the upper floors, small courts provide lighting and ventilation, and sometimes these floors are provided with living rooms and single-flight stairways to upper floor. Deeper spaces can be found as one goes higher. Sometimes Kitchen is the innermost room in the ground floor, followed

by a staircase, light well, changing room and bath court. The Kitchen, in many cases, holds the access to a habitable room, a clear example of gendered space that is inaccessible from the corridor, which is a common space. Veranda is the outermost space in the upper floors.

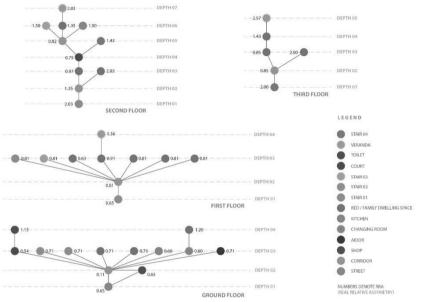


Figure 8. JASS Analysis of House Plans.

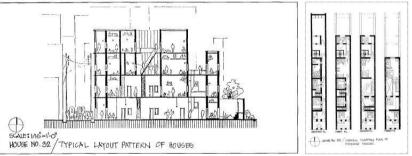


Figure 9. Typical House Section and Plans. (Source: Imamuddin et al)

4.4.3 Space Syntax in Domestic Space

In the Integration map (Figure 10) of the houses with the street, the axial lines of the street has an average integration value of 3.82, while the average value of all lines in the axial map is 2.73 with a standard deviation of 0.68. This shows that the narrow street (12 feet max.) is very important in their lifestyle and activities, and signifies factors such as community interaction, customer attraction, import of raw materials and commercial advantage. Among other

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spaces the shop has the second highest average integration value (3.57) followed by the Aidor (3.50) and the corridor (3.34). 'Aidor' is a space behind the shop that had been used as a meeting place for guests with the women of the house. It is now being used as another shop or shop storage, accessed from the corridor.

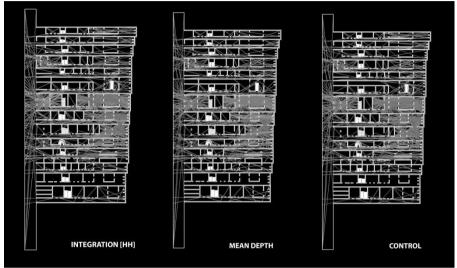


Figure 10. Axial maps using DepthMap

In the Mean Depth map (Figure 10), the axial lines of the street has an average mean depth value of 2.84, while the average value of all lines in the axial map is 3.70 with a standard deviation of 0.63. Among other spaces the shop has the slightly higher mean depth value (2.87), but mean depth is highest in the room just before the court with toilets (4.98). This room is used for changing dresses before going for a bath or to the toilet, which is a prevalent custom in the lifestyle of the inhabitants. The toilets and the attached court (most often provided with a water source e.g. a well), used by the inhabitants of all floors, is the innermost space in ground floor (Figure 4) and is segregated due to issues of privacy, smell, tradition and isolation. A single linear house is typically occupied by people related by blood and inheritance. Finally, in the control map, the street (1.27) and the corridor (1.02) have the highest average control value of the constituent lines of the axial map. Control in DepthMap is a dynamic local measure of the degree to which a space controls access to its immediate neighbours taking into account the number of alternative connections that each of these neighbours has. The street and the corridor are the spaces through which access is controlled, with no alternative access, predictably due to a sense of security. This syntactic pattern coincides with the air flow characteristic of the place, which evidently demonstrates that these two spaces are the most airy. The street is along the north-south direction and

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invites air form the Buriganga, and this air pass through the corridors due to tunnel effect.

The VGA (Visibility Graph Analysis) map (Figure 11), shows that visual integration values are highest in the street, with an average value of 6.80 for all grids in the street. The overall average is 3.99 with a standard deviation of 1.46. The second highest visual integration values are found in the shop (4.54) followed by Aidor (4.30) and the corridor (4.24). The visual integration values are lowest in the habitable spaces, ranging from 2.26 to 2.93. The second lowest value is found in the changing room (2.47). These values account for privacy in domestic space, and highlights the use of the front of the building for commercial exposure.

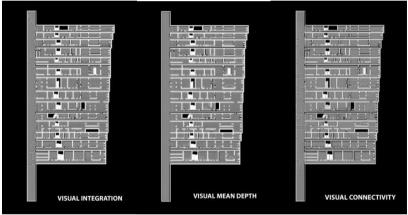


Figure 11. VGA maps using DepthMap.

Other VGA maps, e. g. the connectivity map (Figure 11) gives an important graphic, which shows how the road's connectivity values are much higher than the spaces inside the building. This symbolises their sense of protection, which led to the houses surviving for hundreds of years in the urban context. This also proves that the street is a vibrant public place for many community activities and a lot of movement. (Figure 12)



Figure 12. The street, a famous host for festivities. (Source: S. Ripon & Mithun)

5. Conclusion

All findings relate to the lifestyle of the inhabitants of Shakharibazar, who need technical and monetary assistance for this unique heritage within the city to be conserved. The existing craft business need to receive official support and coordination so that the culture can live for many more years. While architectural conservation and reform works are necessary, the lifestyle patterns discussed and analyzed in this research must receive encouragement and promotion so that the integrity of the place can be conserved. Urban design ideas must consider these unique cultural aspects and focus on integrating Shakharibazar as a tourist destination and thus provide opportunity for the inhabitants to generate income. This study will help carry out further research on settlement patterns and enable researchers to compare patterns of human behaviour in the history of the globe. It will also help designers to build densified, but workable models of the city.

6. Acknowledgements

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REVISITING THE ROLE OF ARCHITECTURAL DESIGN IN CREATING GREEN BUILDINGS - *CRITICAL REVIEW OF GREEN BUILDING RATING SYSTEMS*

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Abstract

In the context of drastic requirement of efficient use of resources and reduction of the adverse impacts of their blatant use like greenhouse gas emissions, contemporary architectural design is being driven by the paradigms of sustainable architecture & green building design. These theories are supplemented by codes comprising of categories & parameters like energy efficiency, water efficiency, materials and resource use & waste management, using which rating/certification systems have been developed that provide a certification/label of 'greenness' to the building. For the purposes of economic incentive and for complying with policies on local and global scale, almost every new building is aspiring for a 'green' certification based on the amount of credits that it accumulates as specified by the rating systems.

An initial study reveals that many of these 'credits' can be achieved by employing efficient active systems or by using upgraded technology systems. The results vary depending upon the use, type, design & the location of the project resulting in variations in investment, performance results and efficiency. A detailed study of certain certified buildings has been carried out and it was found that very few buildings attempted the credits mentioned for overall efficiency through a passive design approach.

The manner in which these rating systems have been formulated reveals that the scope for the architect to use architectural design as a tool to achieve a green/sustainable building design has been constrained. This paper studies and compares the categories available for rating systems and compares weightage of credits towards categories. As a conclusion, the paper tries to reinvigorate the significance of architectural design and highlights the inclusion of credits for architectural design in the rating systems.

Keywords: Green building rating systems, Architectural design

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1. Introduction

The building and construction industry has been tagged as culprits of being one of the substantial energy consumers and carbon dioxide emitters(IPCC, 2014). With the global building stock expected to increase from 151.8 billion sq.mt in 2014 to 171.6 billion sq.mt in 2024 (Business Wire, 2015), the one thing evident is the increase in the number of buildings labelled 'green'/'sustainable'. As shown in figure 1, the number of buildings 'certified green' is expected to increase, where the green building rating systems will be the driving force behind this movement.

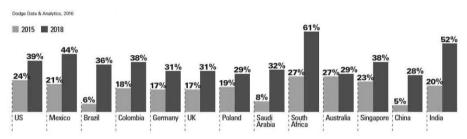


Figure 1, Data showing percentage of green buildings completed by 2015 & to be completed by 2018 (Source : Dodge Data & Analytics, 2016)

It wasn't until the oil embargo of the 1970's (Robert Cassidy, 2003) when the terms 'energy' & 'environment' were being spoken of in the same vein. The movement towards sustainability & sustainable design resulted in the creation of BREEAM in the UK as the first green building rating system (Vierra,2016) in 1990. USGBC created LEED in 2000 for the US. The growing concerns for holistic environmental development amongst countries and to ensure measurement of environmental performance of buildings led to the creation of green building rating systems like GRIHA, PEARL, GBI, CASBEE, GREEN GLOBES to name a few, with the aim to address sustainable development of the upcoming building stock by giving prioritising concerns related to specific contexts.

Figure 2 attempts to give an idea of popularity by showing the number of countries with Green Rated Projects, with a Green Building Council & with a Green Building Rating Tool. The number of countries having a green rating system along with significant number of green rated projects is evidence of the current popularity of any green building rating system(s).

From figure 2, one can conclude that there are global concerns to step-up efforts towards creating green buildings & towards sustainability.

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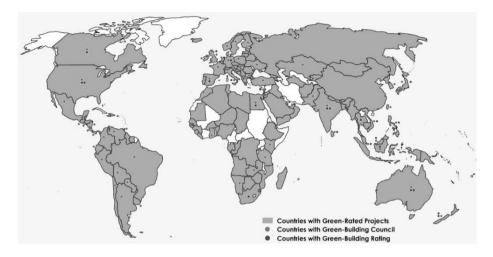


Figure 2, Image showing countries with green rated projects, Green Building Councils, Green Building Rating Tools as on date (*Source : Author*)

However, the matter of discussion is whether this concern is either a marketdriven phenomenon that promotes and facilitates growth of a specific range of products, technologies, equipment's to facilitate a particular individual or a group; or there is a genuine concern towards making better buildings through design, materials and technology which can be comprehensively called green buildings..?

2. Market Influence

As shown by figure 1, the influence of green building councils as well as the green building rating tools corresponds to the increasing number of buildings being certified/rated 'green'.

Cole(2005) highlighted the increasing number of clients/people demanding a green building has had a major contribution in creating & increasing the market demand for green buildings. A report published by USGBC with Dodge & Data analytics(2016) attributed environmental regulations, client influence, marketing strategies, social & environmental causes as some of the reasons for the growth of the green building market. The same report highlighted environmental regulations and consumer demand as prime reasons for the growth of green buildings market as well as the increase in the number of green buildings in India.

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An example of this practice can be found amongst state development organizations like Jaipur Development Authority & Greater Noida Development Authority, who are providing developers with 5% additional FAR for IGBC projects certified gold or above. The Energy Conservation Building Code in India is a voluntary code (barring eight states in India) & nor is green rating mandatory for any building in India. Hence the reason highlighted by the report cannot be accepted. Actual reason for growth and popularity of green buildings as highlighted by McGraw-Hill Construction and the USGBC (2008) is its use as a public relations vehicle. Hence, it is imperative to look at how green buildings are being designed and delivered.

3. Data Collection

Recognized green buildings are the ones certified by a/any green building rating system. Any green rating tool created comprises of sections dealing with specific parameters. Several researches have been carried out on comparing the weightages and indicators in various rating systems. Several researches have been carried out on comparing the weightages and indicators in various rating systems. Lee (2013) compared BREEAM, LEED, CASBEE, BEAM Plus & the Chinese ESGB for a comprehensive review of their evaluation parameters, and concluded that the use of typical parameters in each of the systems can be used for the development of more localized rating schemes to address specific needs. Doan et al. (2017) highlighted the extensive published research that has been carried out and compared BREEAM, LEED, CASBEE, Green Star NZ rating tools. They recommended that the tools should create & include parameters for institution & economic factors. Chethana et al. (2017) examined LEED, BREEAM, Green Star, Green Mark, Green Building Index, IGBC, Beam Plus, CASBEE and attempted to establish key credit criteria amongst these rating tools as a basis to develop new tools.

Fowler & Rauch (2006) analysed BREEAM, CASBEE, GBTool, Green Globes & LEED for the GSA (General Services Administration) to assist in the comparison of rating systems and pointed out that a rating system should stable to not alter building performance evaluation drastically & that it should track quantifiable achievements in sustainable design.

This paper considers 9 rating systems for evaluation – LEED, BREEAM, GRIHA, IGBC, PEARL, GREEN STAR, GBI, GREEN GLOBES. Table 1 describes the categories under which credits can be achieved. It is evident that the maximum number of credits in the rating systems under consideration have been allotted towards energy and energy efficiency. Although this analysis as well as the one done by Chandratilake & Dias (2013) confirm the fact that

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energy is the prime category of intervention for the rating tools, there is a need to clarify the means through which they need to be achieved.

RATING			CREDIT	CATEGORI	ES WIT	TH CREDITS	ALLOTTED	
SYSTEMS	Sit	Wate	Energ	Material	IE	Innovatio	Managemen	Waste/
	e	r	у	s	Q	n	t	Emission
								s
LEED	10	11	33	13	7	6		
BREEAM	10	16	39	12	25	10	21	22
GRIHA	8	17	20	14	12	4	21	6
IGBC	14	19	34	8	12	7		
PEARL	12	43	44	28	23	3		
GREEN								
STAR	6	12	22	22	17	10	14	
GBI,								
MALAYSI								
Α	16	10	35	11	21	7		
GREEN								
MARK	20	8	30	18	30	20	10	3
GREEN								
GLOBES	115	138	388	125	160		50	50

Table 1 Credit systems with respective categories and credits allotted (Source: Author)

As pointed out by Lee (2013), in the current context, building and construction industry is the focus group for environment policies & action agendas and that getting a green certification for some fees, can help to comply with achieving targets towards environmental sustainability. This leads to an increased dependency over energy efficient systems and researches into material procurement, processing & use. A building may acquire a green-rated certification if it can fulfil criteria that require implementation of equipment's, systems, fittings, metering, performance monitoring-leading to the question how does an architect fulfil his obligation to achieve sustainability using spatial design? It becomes important to know how to achieve green building credits. The credits could be achieved by following any of these four strategies-

 Design (D) – When the intent of a credit can be achieved only through design, the credits are categorized as Design (D) credits. For example, In IGBC NC, the credits under the category of Sustainable Architecture and Design for indicator Passive Architecture can only be achieved by adopting passive architectural design features to minimize negative environmental impacts. Similarly in Green Globes rating system, under

- 2. the category of Climatic Responsive Design, the indicator of Spatial Quality and Internal Organisation can only be achieved through design response.
- 3. Technology intervention (T) When the intent of a credit can only be achieved by deploying technology. For example- in Green Star, under the category of Management, the indicator of Metering and Monitoring can only be achieved by installing meters and monitoring the measurement metered. Similarly in LEED, under the category of Energy and Environment, the indicator of Fundamental Refrigerant Management can only be achieved by selecting right type of equipment which uses approved refrigerants.
- 4. Management (M) The credits which can be achieved by managing the facility appropriately are put under the category of Management. For example – under the category of construction management, credit Air and water pollution control can be achieved my controlling air and water pollution on site during construction by adopting right practices of construction. Similarly under BREEAM, credit of Commissioning & testing schedule & responsibilities under the category of management can be achieved by properly commissioning the installed equipment.
- 5. Design/Technology (D/T)- certain credits which can either be achieved through design or technology are clubbed under this category. These credits are the ones which are most critical as the same intent can be fulfilled by investing more in design and less towards equipment or otherwise. For example- in PEARL Estidama, the credits of Exterior Water Use Reduction: Landscaping under the category of Precious Water can be achieved either by designing landscaping using native species and xeriscaping such that less water is required or by using efficient equipment such that lesser amount of water is consumed. Same intent is fulfilled through two approaches.

4. Analysis & Problem Definition

All the rating system under study were studied for their intent and means to achieve the intent. Table 2 shows a fragmentation of all the credits offered by the rating systems into 4 strategies that can be used to achieve them: Design, Technology, Design & Technology & management.

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Rating Systems		Strate	gies to achieve credits	
	Design		Design	
LEED	10	LEED	10	LEED
BREEAM	23	BREEAM	23	BREEAM
GRIHA	6	GRIHA	6	GRIHA
IGBC	14	IGBC	14	IGBC
PEARL	15	PEARL	15	PEARL
GREEN STAR	12	GREEN STAR	12	GREEN STAR
GBI, Malaysia	10	GBI, Malaysia	10	GBI, Malaysia
GREEN MARK	16.5	GREEN MARK	16.5	GREEN MARK
GREEN		GREEN		GREEN
GLOBES	88	GLOBES	88	GLOBES

Table 2 Strategies listed by the rating systems to achieve credits (Source: Author)

It is clearly seen that most of the credits in all the rating systems can be achieved by means of technology-either by installing upgraded & efficient equipment or using high efficiency material produced by research or calibration and software modelling. Such a scenario is leading to more dependence of green buildings on equipment, systems and fittings, metering and performance monitoring rather than architectural design.

To get a clearer idea, further investigation was done to check credits under each category for different rating systems. The intent of credits and the means to achieve a credit was analysed and categorized for each category as shown from Table3-6.

Table 5 Strategy analysis for Site & IEQ p								parameters (Source. Mathor)										
	Site							IEQ										
Design	3	6	4	5	8	4	6	10	30	2	2		4	2		2		17
Technology	3	3	2				1		22	7	8	6	11	12	9	11	20	60
Design+Tech.	2		1	4	4	4	3	10	46	2	7	6	10	6	8	5	8	83
Management	6	1	1	1			6		17	1								

Table 3 Strategy analysis for Site & IEQ parameters (Source: Author)

Table 4 Strategy analysis f	or Water & Innovation	parameters (Source: Author)

		Water							Innovation									
Design	4									1				1			2	
Technology	13	3	9	10	27	12	8	8	86	1							16	
Design+Tech.	2	8	4	6	16		2		23	4	5	4	10	2	10	6	2	
Management			2							1	1					1		

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		Energy							Management									
Design				3				1.5	13									
Technology	34	15	20	34	19	22	15	26	351			8	6		5			35
Design+Tech.		18		2	25		17	2.5	24				4		2			
Management							3					9	11		7		10	15

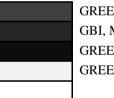
Table 5 Strategy analysis for Energy & Management parameters (Source: Author)

Table 6 Strategy analysis for Materials & Waste parameters (Source: Author)

		Materials								Waste								
Design				1	1	8			28				3				1	
Technology	5	6	14	4	15	7	6	10	10				9					38
Design+Tech.	8	5		7	6		2	8	71				5					9
Management	3	2		2	6	7	3		16			6	5				2	2

Where

IGBC LEED GRIHA BREEAM PEARL



GREEN STAR GBI, MALAYSIA GREEN MARK GREEN GLOBES

Analysis indicates that maximum credits under the category of site are achievable through design. While most credits under water, energy and emissions are achievable through technology. Credits under the categories of material, IEQ and Innovation are achievable through Design/Technology. Rest of the credits are achievable through management techniques. On the whole 54% credits can be achieved only by deploying technology while 26% can be achieved through D/T (through design or technology or both). If one wants, a green rating can be achieved by earning 80% of credits using technologically advanced systems deployed in the building. Such a building could reach the highest ratings and may also perform efficiently. But as far as the architectural design input is concerned, there is no role for an architect to play in that.

5. Case Study Analysis

However, this is a theoretical construct. In case a building is more design oriented, it may achieve 36% credits through design as well. To explore the trends in green buildings, we selected few available case studies from each

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rating system and analyzed the credits they achieved in different categories. For majority of the case studies, details of credits were not available, hence salient features, as highlighted in the brief information page, were procured through trusted sources. A comparison was made to analyze the more preferred and popular strategies adopted in certified green buildings. Table 7 shows a list of all buildings studied under various rating systems.

 Table 7 Case Studies Analyzed under given Green Building Rating System (Source:

 Author)

Rating System	Case study 1	Case study 2	Case study 3	Case study 4
LEED	Stony Brook Millstone Watershed Associat	UND Gorecki Alumni Center	Wedgewood Academic Center	TCCD Energy Technology Center
BREEAM				
GRIHA	Manipal University Jaipur, Campus	South Asian University		
PEARL	Midfield terminal building			
GREEN STAR	The spot, Melbourne University	Department of environmental affairs (dea) head office		
GREEN MARK	47 Jalan Buroh	Beach Centre	JTC Furniture Hub @ Sungei Kadut	
GREEN GLOBES	Steeles Technology Campus, Toronto	BCE Place, Toronto		

From the analysis, it was found that the most preferred strategies to achieve credits were-

- Use of low-VOC products throughout the project,
- Reduction in water use through low flow fixtures
- Reduced flow to sewer, via use of a blackwater treatment plant
- 100% fresh air with 200- 250% increase on AS rates
- Solar PV generation plant
- Full energy monitoring and control through a central BMS System.
- Domestic hot water through a solar thermal system;
- High efficiency lighting and control,
- Night flush ventilation,
- Rain and greywater harvesting,
- Performance glazing,
- Façade shading and insulation

- Use of sustainable construction materials such as green cement and recycled concrete aggregates to reduce building's embodied energy
- Energy efficient chilled water plant, VFD for Pumps & Cooling tower fan
- Façade with high performance DGU glazing,
- Energy audit/evaluation
- Site location with proximity to amenities and public transport
- Increased soft scape
- Construction management best practices

From these, it can be seen that more emphasis is laid on technology driven credits rather than design oriented credits.

6. Conclusion

The green rating systems have been created to enhance environmental awareness of building practices & give direction to the construction industry as a way forward. However, it can be concluded from this study of existing rating systems that more weightage is given to technology in the creation of green buildings. Because of this, the green building industry is predominantly an engineering oriented industry where there is minimal scope for architects to play. In the absence of relevant credits that examine and award good design, building owners and developers tend to shift towards credits that are easily obtained by installing high efficiency systems and fittings. This not only disregards the appropriateness of a building to its context, it also makes green building a typical model which can be replicated for any site with minor modifications.

Some serious steps, as listed below, need to be undertaken to digress from the already established trend-

- Rating systems must introduce credits where performance of a building design toward thermal comfort can be awarded (without the presence of artificial systems)
- Minimum performance of building envelope must be made as mandatory criteria where whole building performance method shall be allowed only once building envelope has proved to perform up to a benchmark.
- Thermal comfort achievement through building design must be modelled and evaluated in order to give preference to design prior to installing high efficiency mechanical and electrical systems.

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EMERGENCY PREPAREDNESS IN THE HOSPITALITY INDUSTRY IN SRI LANKA

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Abstract

This study investigates the emergency preparedness of the hospitality industry in Sri Lanka, focusing on hotels and restaurants in the southern coastal belt. A questionnaire on emergency preparedness was provided to 30 randomly recruited participants from the industry. The survey consisted of 30 open and closed ended questions, focusing on basic demographic information, information about emergency preparedness of the facility, food safety, and issues regarding power management. An online and a hard copy version of the survey were prepared. The findings of this study provide insight on the emergency preparedness of the hospitality industry in Sri Lanka as well as provide insight into how improvements can be made in future developments of similar nature especially in terms of emergency mitigation efforts. These findings also provide suggestions on areas that need to be improved through educating the industry.

Keywords: Emergency Preparedness, Hospitality Industry, Facility Management

1. Introduction

Tourism is an important economic sector for many countries' growth and survival (Ritchie, 2004). A factor that Ritchie (2004) states, contributes to increased pressure on managers to develop strategies to manage emergency and disaster related situations. Emergencies by their very nature create a series of problems for organizations to cope with in terms of their abilities to co-ordinate their activities in times of acute organizational stress (Smith & Sipika, 1993). King (2002) highlighted that being able to effectively respond in the event of an emergency is relevant to an organization's survival. Whether or not an organization is prepared for a potential emergency depends upon senior officials, and other personnel operating within the company. Corporations with established emergency management teams are able to communicate and effectively respond in the event of an emergency.

The hospitality industry is heavily dependent on nature and the environment. It is therefore, crucial for mitigation measures, disaster and emergency preparedness planning, (inclusive of pre, during, and post disaster). Hospitality personnel therefore, have to strategically plan to effectively manage emergency situations if and when they arise. The question therefore, is how best can we co-exist with the above mentioned emergencies and how swiftly can we

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recover when one occurs? Garcia (2006) states that in most cases of emergency, the leadership team is not adequately prepared to manage such an incident. Mishandling an organizational emergency can have negative, long-term consequences for an establishment's profitability, reputation, market position, and human resource management systems.

This study is rooted in the Facility Management domain and a survey was designed with questions pertaining to emergency preparedness. Emergency planning & business continuity is one of the 11 core competencies in Facility Management as stipulated by the International Facility Management Association (www.IFMA.org, 2017). The survey consisted of 30 open and closed ended questions, focusing on basic demographic information, information about emergency preparedness of the facility, food safety, and issues regarding power management. An online and a hard copy version of the survey were prepared. The survey was designed to be sent to hotels and restaurants around the world. The current study focuses on the data collected in Sri Lanka. The survey was sent through email to Hotels and Restaurants in the southern coastal area of Sri Lanka which was impacted by a tsunami triggered by a 9.0 magnitude earthquake off the coast of Sumatra on December 26, 2004.

2. Natural Disasters and the Hospitality Industry

Natural disasters are a part of life and their incidences are increasing (Mckintire, 1999). Disasters in the past such as the Bird Flu in 1997 – 1998, 2001 – 2002, 2003, in Eastern India in 2008; the 9/11 attacks in 2001; the incidence of SARS in 2002 in Southern China and in 2003 in Hong Kong; the outbreak of the Iraq War in 2003; a killer tsunami (2004) and Hurricanes like Charley, Francis (2005); the London Bombing (2005), Paris in 2015 and many others have made the world realize that the future is definitely uncertain. Manmade as well as natural disasters are seemingly on the rise and due to globalization, these events can have a wide impact. The hospitality and tourism industry is especially vulnerable as it operates 24/7 and for 365 days a year. Furthermore, as guests and employees are part of the product itself, it is difficult to control services. This means that the industry is overly sensitive to risks, which can escalate without warning (Malhotra & Venkatesh, 2009). Given the importance of the hospitality industry and the rising natural and manmade disaster rates, it is important to protect and develop emergency preparedness plans for the industry.

Natural as well as manmade disasters affect people and the way they live. Leaning and Guha-Sapir (2013) stated that natural disasters can be categorized as, biological, climatic, and geophysical. Guha-Sapir and Vos (2012) stated that, since 1990 natural disasters have affected over 217 million people annually. Furthermore, studies have shown that climatic change plays a major role in affecting the increase in natural disasters (Leaning and Guha-Sapir, 2013). Terrorism is another type of disaster that affects people and their way of life. There is continuing increase in terrorism worldwide, for example, in 2013 there was a 44% increase in global terrorism (Institute for Economics and Peace, 2014) as compared to 2012.

Apart from random isolated incidents, global tourism has shown a continuous growth. The increase in global tourist arrivals have risen from 25 million in 1950 to 278 million in 1980 to 527 million in 1995 and 1133 million in 2014 (UNWTO tourism highlights). Furthermore it is expected to reach 1.8 billion by 2030. In the Asian region alone there was a 30% increase tourism receipts during 2014. Given the fact that the hospitality industry is responsible for 5% of the global Gross Domestic Product (GDP) and employs 1 out of every 12 workers (UNWTO, 2012), the industry considerably effects global economy. Given the importance of the hospitality industry and the rising natural and manmade disaster rates, it is important to protect and develop emergency preparedness plans for the industry. Banipal (2006) highlighted devastation experienced as a result of hurricane Katrina indicating critical resources necessary to sustain life. These included prediction systems. Network failure was also identified and problems in the recovery and rescue mission. Banipal (2006) also cited negative feedback and possible decline in visitor arrivals based on activities which took place after the hurricane. The chaos was attributed to the communication failure. Furthermore, Banipal (2006) concludes his paper by re-emphasizing the importance of strategic emergency preparedness planning and communication systems. These information systems would aide in successful rescue missions, analysis of overall damages and use of well needed resources.

The 2004 tsunami in South East Asia highlighted short comings or under preparedness of nations for natural disasters. Oloruntoba (2005) alluded that governments in this area "should not only endeavour to set up an Indian Ocean tsunami early warning system for the region but also should seek to integrate it with the Pacific Ocean tsunami early warning systems". A public awareness drive and employee training programme should be implemented. Being proactive is critical to a symbiotic existence between 'man' and 'nature' or 'man' and the 'environment'. Oloruntoba (2005) as well as Moe and Pathranarakul (2006) share similar views regarding the necessity for training on emergency preparedness plans.

Oloruntoba (2005) in the summation of his paper on the occurrence of the 2004 tsunami suggested that authorities in South East Asia should work with donor agencies as well as relief agencies seeking focus on pre-disaster risk reduction

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for example assisting countries in creating ways to speedily evacuate persons from hazardous areas. He further suggested that long term emergency preparedness planning is needed over sporadic decision making. This is in agreement with Schmidt-Thome (2007) where it was stated that "most examples of hazzard mitigation approaches are reactive responses based on negative experiences made by catastrophic losses".

Countries in the Asia-Pacific are considered to be key players in the world economy (Chatterjee, Gupta, Nakano, Shiwaku, & Shaw, 2015). Over the past decade Asia has experienced approximately 1730 natural disasters with an estimated loss of US\$752 billion (Guha-Sapir, Below, & Hoyois, 2015). Countries within this region are considered key players in the global economy. Therefore, a reduction in the fatality of life and property is considered critical to sustain growth within the region and by extension global growth (Chatterjee et.al., 2015).

3. Emergency Management Theories & Strategies

Several scholars (Evans & Elphick, 2005; Fink, 1986; Kolb, 1984; Richardson, 1994) have coined various theories such as Cobra and Python Disaster Typologies, Chaos Theory, Educational Theory and Loop Theory that are applicable to emergency management. Aside from the theories there are also several strategies such as the Disaster Management Framework (Faulkner, 2001; Ritchie, 2004) Stages in response to disaster at the community level (Fink, 1986; Roberts, 1994) Strategy Development (Turner, 1994) Strategy Implementation (Quarantelli, 1986) that have been developed to mitigate against disasters and emergency situations. Researchers such as Cassedy (1991) suggested components for a tourism disaster strategy. Faulkner, (2001) however, established the first tourism specific emergency management framework that we focus on in this study.

The tourism disaster management framework as seen in figure 1, consists of six phases. The framework outlines elements of the emergency management responses and principal ingredients of the emergency management strategies for each of the six phases. This study focuses primarily on the pre-event stage, where action can be taken to prevent disasters (e.g. growth management planning or plans aimed at mitigating the effects of potential emergencies).

The Pre-Event stage can be considered the most important stage in the emergency management process as it is designed to help minimize the damage caused by an emergency situation. The stake holders in this stage can be either public or private organizations, where emergency preparedness plans are developed. Preparing emergency plans beforehand enables a more effective means of managing an emergency (Burnett, 1998; Kash and Darling, 1998). Heath (1998) states that planning properly for an emergency situation will help reduce risk, time wastage and poor resource management.

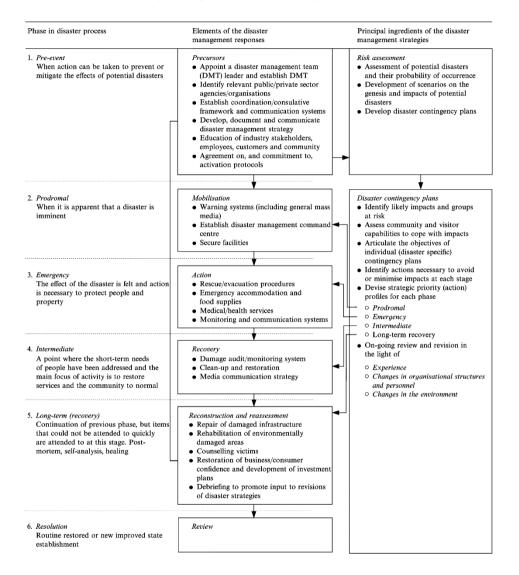


Fig 1: From Faulkner (2001). Framework for tourism disaster management

4. Method

This study is rooted in the facility management domain and a survey was designed with questions pertaining to emergency preparedness. The survey

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consisted of 30 open and closed ended questions, focusing on basic demographic information, information about emergency preparedness of the facility, food safety, and issues regarding power management. The survey instruments mainly focused on the Pre-Event stage (Faulkner, 2001) with the intention of obtaining information about the hospitality industry in a certain geographic area and their emergency preparedness plans.

An online and a hard copy version of the survey were prepared. The survey was designed to be sent to hotels and restaurant around the world. The current study focuses on the data collected in Sri Lanka. The survey was sent through email to hotels and restaurants in the southern coastal area of Sri Lanka which was impacted by a tsunami triggered by a 9.0 magnitude earthquake off the coast of Sumatra on December 26, 2004. Email addresses were collected by conducting an online search and were sent to 316 hotels and received 29 responses which yielded a response rate of 9.18%. Lozar Manfreda, Bosnjak, Berzelak, Haas, & Vehovar (2008) states that online survey response rates are lower than other type of surveys and can be around 11%. The response rate in this study was lower than what was expected. It is suspected that this might be due to geographical constraints.

5. Analysis and Discussion

Statistical analysis was conducted using SPSS statistical package version 20. Most of the analysis consisted of identifying percentages of the responses that were provided. Regression analysis was conducted to understand correlations between certain variables.

Initial questions were used to assess the scope of the emergency preparedness plan. 100% of the participants stated that their emergency preparedness plan included sections that discussed the procedures to follow during a Tsunami. This was probably due to the fact that the establishments were located in a coastal area. 100% of the participants stated that their emergency preparedness plan included sections that discussed the procedures to follow during a fire. 30% stated that their emergency preparedness plan included sections that discussed the procedures plan included sections that discussed the procedures to follow during a fire. 30% stated that their emergency preparedness plan included sections that discussed the procedures to follow in the event of a terrorist attack. For a country healing from a history of terror attacks, this result was unexpected. 80% stated that their emergency preparedness plan included sections that discussed the procedures to follow during flooding. This was most likely due to tsunami related flooding. 100% stated that they were insured against the threats that they had mentioned.

38% stated that their emergency preparedness plans were documented and the rest stated that it was common knowledge. The researchers wanted to

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investigate if the emergency plan was not documented would drill sessions be conducted frequently? A simple linear regression analysis was conducted to identify any correlation between the having a documented or undocumented emergency preparedness plan and plans being drilled regularly. Plan documentation explained a significant proportion of variance in Drill frequency, R2 = .43, F(1,27)=20.483, p < .001. There was a moderate correlation between the two variables. 43.1% variance in the dependent variable (drill frequency) was explained by the independent variable (plan documentation).

With regard to power management during an emergency situation, 20% of the participants stated that their emergency preparedness plans did not include a plan in place for dealing specifically with an extended power outage situation. This was interesting because securing food is extremely important for these businesses. However it was interesting to note that only 10% of the participants stated that their businesses had a standby electricity generator.

Multiple answers were provided as to what they consider as barriers to increasing their company's overall state of preparedness. 59% stated that they were adequately prepared and do not need to increase the company's overall state of preparedness. The lack of financial support for preparing such plans were stated as one of the main barriers for increasing their company's overall state of preparedness.

6. Conclusion

This study was designed to investigate the emergency preparedness of the hospitality industry in Sri Lanka, focusing on hotels and restaurants in the southern coastal belt. The study is a part of a larger project which intends on investigating emergency preparedness in the hospitality industry in different regions of the world.

It was interesting to note that 20% of the participants stated that power management during an emergency situation was not included in their emergency preparedness plans. In this industry, food safety should be a priority and emergency preparedness plans should take that into consideration. It would also pertinent to investigate alternate options other than using standby electricity generators.

The main results that the study provides are insightful and can help in better preparing the hospitality industry in this area. All of the participants stated their establishment had an emergency preparedness plan in place; this was a very positive finding. One suggestion this study can make is that the local government agencies that focus on the hospitality industry should provide knowledge on preparing an emergency preparedness plan (if there is no program already in place) since "the lack of relevant knowledge" was stated as one of the barriers in establishing an emergency preparedness plan.

The findings of this study provide insight on the emergency preparedness of the hospitality industry in Sri Lanka as well as providing insight into how improvements can be made in future developments of similar nature, especially in terms of disaster mitigation efforts. These findings also provide suggestions on areas that need to be improved through educating the industry.

Limitations and Future directions

The main limitation of this study was conducting it remotely through email and online questionnaires. Onsite availability and paper based questionnaires would have increased the number of participants in the study.

Future directions are seen in increasing the number of participants by conducting the study onsite as well as well as continuing the study in other regions of the world. Currently, the researchers have collected data from India, Thailand, and Jamaica. The researchers plan on collecting data form Mexico in the near future.

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"MICROCLIMATIC DIVERSITIES" AROUND URBAN HIGH RISE BUILDING FORMS IN THE CONTEXT OF BIO CLIMATIC DESIGN: A CASE OF COLOMBO

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Abstract

The outdoor microclimate around a building varies creating diversified vertical and horizontal climatic conditions. Suddenly blooming up high rise buildings (HRB) in Colombo, without looking climatic adaptations and environmental impacts, cause bad influences occur in near future. Therefore the relationships between the building design and the outside microclimatic diversities are important when applying bio climatic, adaptive and interactive solution in architecture. This study mainly focuses on identifying these micro climatic diversities around HRB forms for a bioclimatic design. Through a heuristic study on HRB in existing context of Colombo, the HNB tower, Seylan tower, BOC tower and Mahaweli building were selected as main case studies with diversified forms to investigate boundary layer climatic diversities. The main conclusion of the study points out, that the designing process of HRB should pay more attention to bio climatic character and diversity, rather than following typical two dimensional planning methods. This will result in better and practical design outcomes which will increase users satisfaction and improvements in energy saving.

Keywords: Building micro climatic diversities, High-rise buildings, Bioclimatic approach.

1. Introduction

With the increasing population and urbanization where need for more built environment facilities are ever growing, energy demand and associated environmental problems is currently being a topic for discussion all over the world. To address these issues, concepts such as bio-climatology, environmental sustainability, energy conscious building practices emerged in the world (Vale, B., & Vale, R., 1991). Research evidence shows a significant contribution from the building practice for global scenarios happening. (Baker, N. & Steemers, K., 2000)

Yet, due to misunderstanding the true meaning of these concepts are blinded by deceptive and misleading interpretations. The validity of a proper architectural design of a building lies in the optimization of climate, building and occupant interplay. This is known as bio-climatic design (Olgyay, V. & Olgayay, A.,

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1963). Unless this interplay is manipulated to make passive approaches, the possibility of energy saving would not last long (Hyde, 2008)

When come to the Sri Lankan urban context the growing population are living in urban areas highlights the need for cities to expand and densify. Architects and planners play an important role in this discussion as buildings are a key contributor towards striking a balance between development goals, climatic issues, energy efficiency and quality of life for its inhabitants.

The new development proposals for Colombo suggest high density developments with high Floor area Ratios. Literature suggests that these buildings in an urban setting can modify its outdoor microclimate and vice versa. Therefore the relationship between the in and out plays an important role in energy efficiency targets in an urban setting.

The most trending archetype found in urban areas consisting of single and less diverse prototype high rise buildings without thinking of design interventions especially like building envelopes in facades. In such a context, building projects that claim benefits of such a bio climatic design approach are examined in the light of the results and practices of previously conducted researches and design projects done by Architect Ken Yeang.

As the specific focus of the research it attempts to identify how the urban microclimate effects on the HRB, horizontally as well as vertically in tropical climate of Sri Lanka and how it should integrate when creating bioclimatic designs for a better environmental sensitive approach with the involvement of architecture.

2. Building microclimate in urban precincts

Research focuses on the micro climate which is the variation of localized climate of a building. Buildings themselves create microclimate around themselves and the other buildings as well. The term "microclimate" in urban planning always refers to the climate connected with a group of buildings in the urban fabric or to the climate around a single building. But, within a particular building, a small-scale pattern of "building microclimate" is found, which is different from the microclimate related to the urban fabric scale.

Similarly, the building microclimate is significantly influenced by building form, orientation (spatial organization), vegetation and landscape in building and construction materials. (Givoni, 1998: p 15) The essence of architectural bioclimatic design is to understand the local climate and utilize appropriate

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design strategies for building form generation and material selection, in order to create or modify the building microclimate required for a comfortable living environment.

2.1 BUILDINGS IN TROPICAL CONTEXT

The climate of Sri Lanka can be identified as tropical and warm humid. As a result of slight seasonal climatic variations, the physiological thermal requirements and the building characteristics are equal for entire year. Two main issues occur in constructing in warm humid zones are avoidance of excessive solar radiation and provision for moisture evaporation by breeze.

Thus the buildings in tropical context should be design to prevent heat gain, maximize heat loss and to remove any excess heat by mechanical cooling. The first two objectives can be achieved by means of 'microclimatic control' through site-layout and inner space- planning, controlling and planning air movements, external wall and space orientation and the use of structural and constructional passive means of control.

3. Bioclimatic approach on high rise buildings – "Ken Yeang"

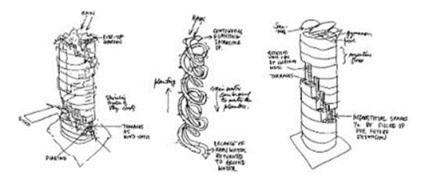


Figure 1: Conceptual ideas on bio climatic designing- Archt. Ken Yeang Source: (Yeang, K, 1999)

Designing bioclimatic Sky scraper involves configuring its build form and operational systems as low energy systems that are non-dependent. All bio climatic skyscrapers from the practice of Ken Yeang, have an analysis on solar situation (during different times of day, month and year). According to his studies, this plays an important role to get maximum profit from alternative natural energy resources. This bio-climatic approach, in which it is aimed to design low-energy use passive buildings with a focus on better occupant comfort and environmental sensitiveness. (Yeang.K, 1999)

3.1 FOUR-PARTIAL MODEL BY VICTOR OLGYAY

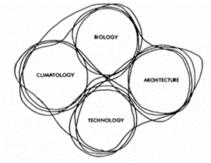


Figure 2: Victor Olgyay Vitruvius- Bioclimatic design Source: (Olgyay, 1963)

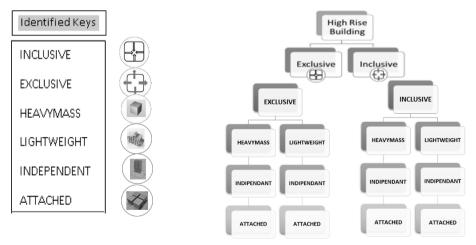
Victor Olgyay created this four-partial model introducing fundamental relationship between: climatology-biology-technology-architecture in 1963 before Ken Yeang implementing his bioclimatic approach.

4. Sri Lankan scenario of HRB: A case of Colombo

Colombo for now has small amount of skyscrapers established but there are a vast range of skyscrapers coming up in the megacity. Through the study it was investigated the prevailing situation of local context of high rise buildings through an empirical study before selecting relevant case studies.

4.1 EMPERICAL UNDERSTANDING OF HIGH RISES

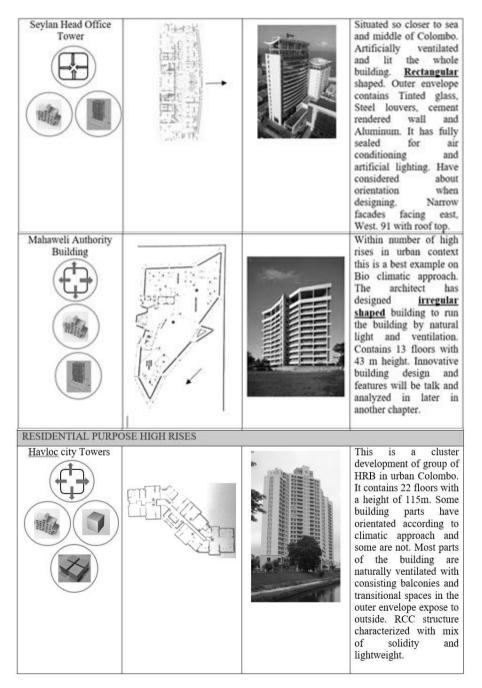
uildings can be categorized according to its design and the respond for outside climate it stands. The randomly selected 10 high rises, according to its primary use were examined through this process using a chart which divides the character of the building using main six keys.



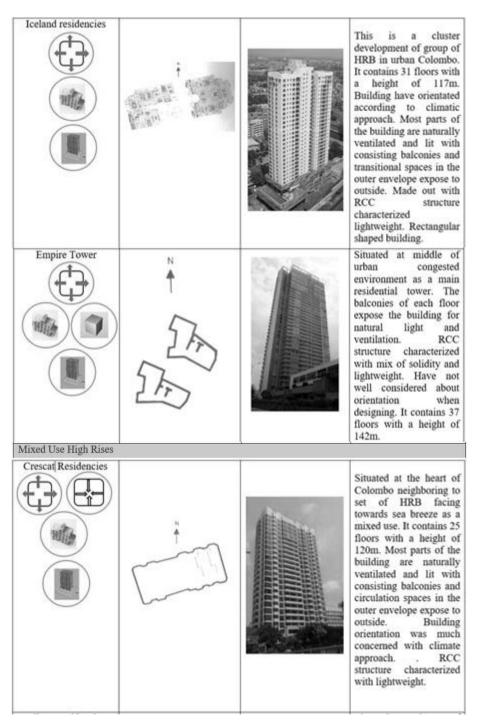
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Building & Contextual responses	Orientation & Plan	Identification	Features & Qualities on context of bio climatic approach
COMMERCIAL PURPO	DSE HIGH RISES	ð	
BOC Head Quarters Towers			It is an iconic <u>cvlindrical</u> building in middle of Colombo, the commercial capital of the island facing towards sea breeze. Entire building is artificially ventilated and lit. So all the building have sealed excepting service floors. The outer envelope contains aluminum cladding with few glasses. Building orientation doesn't emphasize climatic
HNB Head Office Tower			Situated at middle of urban congested environment in Colombo. Normally Square shaped. Outer envelope contains number of materials like clear cladding glass, cement rendered wall, tinted glass, Aluminum. This is also artificially lit & ventilated. Orientation doesn't support to bio climatic approach. Height 84.11 m with 23 floors.
World Trade Center Tower			approach. Have 32 floors with 105m height. Standing over 152 m (499 ft) from the ground, consists of two identical 40-story east and west towers at prime location in the heart of the city neighboring to lot of HRB. Entire building was artificially ventilated and lit. Have both <u>curve</u> and <u>flat</u> facades . Outer surface consisting with reflecting glass cladding. Both east and west facades designed to resist direct solar radiation. Building design was not much climatically considered.

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PATHIRANAGE. N.M.Y & RAJAPAKSHA. U.

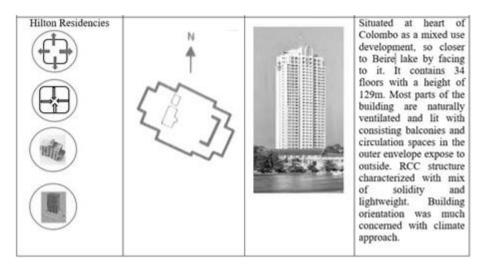


Table 1: Detailed heuristic study on Urban High Rise buildings in Sri Lanka (Classification of building design according to its co-relationship for the outside climate) Source: By Author

Analysis

There is no any diversity among built form and structure and most of the condominiums have typical square or rectangular compacted plan forms as a trend. Each and every building have designed without even thinking about simple factors that affect to regulate the process in building climate interplay. Further no concern has been given to both vertical and horizontal diversity of microclimate to address the needs of each level to create more occupant friendly interiors.

5. Selection of case studies

Non-residential office buildings with diversified building forms (like square, rectangular, circular and irregular) were selected as the case studies for field investigation.

5.1 FIELD STUDY PROGRAMME

Objective of the study is to focus on the individual buildings to measure and investigate the micro climatic diversities around various built forms. There were two stages carried out in onsite investigation. At the initial stage, specific selected cases through the empirical data collecting, were studied to pursue building design and main climatic approach of it. Then the in-depth investigation was conducted to study the microclimatic behavior around the building facades. Through the Field study air temperature, Relative humidity,

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and Natural lighting levels and wind velocity of the each floor of the building was monitored in 1 hour intervals to identify the basic horizontal and vertical climatic character of the building. After all they were analyzed and compared.

At field study, measurement values obtain on different levels of the building (ground, middle, upper) at the same time period (Example: 9am-10am) and apart from that the measurements were taken by considering the basic four directions of the building at one level (north, south, east and west side) to identify the horizontal character with reference to its direction.

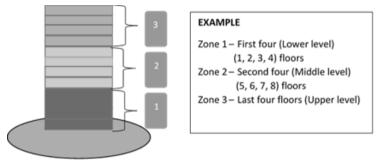


Figure 15 : Vertical zoning of the building Source: By author

5.2 INSTRUMENTATION AND DATA PRESENTATION

Climatic Parameter and Unit	Data Collecting Equipment
Air Temperature (⁰ C)	Hobo Meter (both indoor and outdoor)
Relative Humidity (%)	Hobo Meter
Wind velocity (m/s)	Anemometer
Natural Lighting levels (Lux)	Lux Meter

Collected data were inputted in excel spread sheets and presented through charts for analyzing.

5.3 PLANS AND BUILT FORMS OF SELECTED CASE STUDIES



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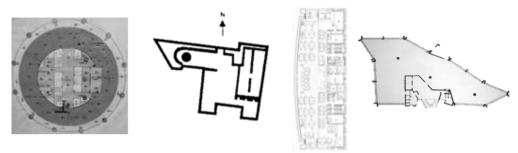


Figure 16: Plans and built forms of selected case studies (left to right in order) - BOC Head Quarters Towers, HNB Head Office Tower, Seylan Head Office Tower, Mahaweli Authority Building Source: By author

5.4 IDENTIFY THE HORIZONTAL CLIMATIC DIVERSITY

Here the data that collected from the BOC tower was presented to analyze the horizontal climatic diversity. The same process was conducted for all case studies and got similar findings with small variations.

The data was collected at twelve points were grouped into three main groups considering the three zoning levels (Ground, Middle & Upper) for identify vertical diversity and from four facades in each level to identify horizontal diversity was then compared vertically.

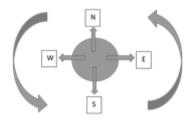
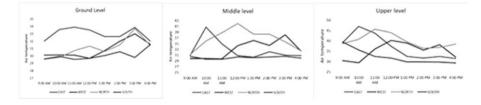


Figure 17: Location of measurement taken points in four facades at each level (BOC building) Source: By author

5.5 ANALYSIS OF DATA

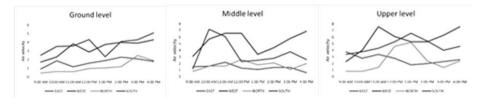
1. Horizontal climatic diversity of Outdoor Air temperature.



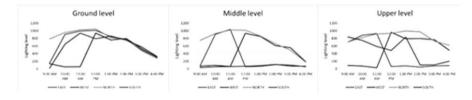
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2. Horizontal climatic diversity of outdoor Average relative humidity.

3. Horizontal climatic diversity of outdoor Air velocity.



4. Horizontal climatic diversity of outdoor Lighting level.



According to the data analysis this suggest that the façade design of a building even at a single level has to be different to address the horizontal variation of the microclimatic conditions when creating bioclimatic high rises in urban context.

5.6 IDENTIFY THE VERTICAL CLIMATIC DIVERSITY

The data that was collected from Mahaweli authority building was used to compare and analyze the vertical climatic character. All most all findings through other selected cases were same excepting small deviations.

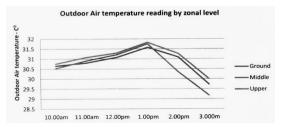


Figure 18: Vertical character of outdoor Air temperature Source: By author

The mean values of hourly outdoor air temperature at each zonal level were plotted in to the graph against the day time. By analyzing the graph it is clear that the outdoor air temperature was slightly vary with the height of the building but the fraction of impact is negligible because of the minor lags between measurements. When compare each levels,

Ground to middle level air temperature varies by 1^oC Middle to Upper level air temperature varies by 0.5^oC

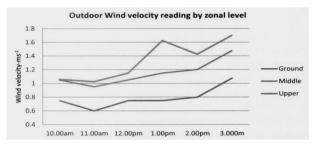


Figure 19: Vertical character of outdoor wind velocity Source: By author

By analyzing the graph it is clear that the outdoor wind speed was clearly varying according to the height of the building. According to the graph, the ground levels experience the less air movement and the amount of wind floor was increasing with the height.

Ground to middle level wind velocity increase by 0.3ms⁻¹ Middle to Upper level wind velocity increase by only 0.1ms⁻¹

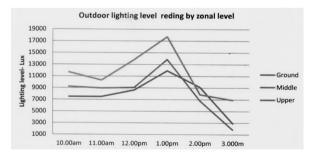


Figure 20: Vertical character of outdoor lighting level Source: By author

According to the graph, the ground levels experience the less amount of light condition with compare to the middle and upper floors. This results that the amount of lighting level increasing with the height. Ground to middle level lighting level increase by 1500 Lux

Middle to Upper level lighting level increase by 2500 Lux

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6. Conclusion

The field investigation data analysis clearly points out that in different vertical levels the outdoor climatic conditions and their effect on each level vary. Thus the design of HRB has to address this vertical diversity in climatic conditions.in order to design tall buildings that are thermally comfortable for the occupant in each level. The façade design, openings, shadings and etc. of each level should address the vertical climate rather than being monotonous.

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ENERGY AND THERMAL PERFORMANCE IN COMPLEX DESIGN IN A HIGH-DENSITY URBAN CONTEXT:

Educating environmental sustainable design in B. Arch graduation theses

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Abstract.

Building sector consumes a considerable portion of energy and is contributes to global warming due to relevant emissions. Therefore the request for environmental sustainable development poses a critical challenge to human society, particularly to developing countries, as it is of paramount importance for the nations to balance between fast development and low environmental impact. Environmental sustainable design education is gaining popularity in architectural schools worldwide. Many of them are for graduate students. This paper reports an attempt to teach environmental sustainable (or passive and low energy architecture) design in a Bachelor of Architecture final-year design studio. Under the framework of the so-called "principles-tools-applications" knowledge triangle, the 16-week studio aims to equip the students with theoretical and practical experiences in passive and low energy design through a real-case design. The syllabus and the process of the course are elaborated, the final output of each studio member is presented, the lessons learned and experiences gained through the 16-week teaching experiment are shared, and suggestions to integrate environmental sustainable design agenda into the complete teaching circles are proposed.

Keywords. *environmental sustainable design, climate responsive, passive and low energy architecture, interdisciplinary, graduation theses*

1. Introduction

In the context of global climate change, deterioration of the ecological environment and accelerating urbanization, passive and low energy architecture and climate-responsive urban design has become a heated topic. Consequently, environmental sustainable design education is gaining popularity in architectural schools worldwide. For instance, the M.Des program of Harvard Graduate School of Design (GSD) that requires a design research into form follows energy and design with energy(Malkawi, 2017); the M.Sc and M.Arch in Sustainable Environmental Design (SED) provided by AA School of Architecture (Yannas, 2017); and the M.Sc in Sustainable & Environmental Design offered by School of architecture, Chinese University of Hong Kong

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(Ng, 2017). In order to support for the realization of the EU's near-Zero Energy Building plan (nZEB), many universities in the European Union work together to foster the learning environment for knowledge and skills on environmental sustainable design at all stages in the field of architectural education, e.g., the EDUCATE project (Altomonte et al. 2012) and IEDS-EDU project (Brunsgaard et al, 2014). Efforts has also been made to integrate sustainable knowledge into architectural education in the UK and USA system (Ismail et al 2017).

As its current status, the architectural technology courses in the undergraduate curriculum in Chinese universities often classified as "auxiliary courses", that is, the class hours and credits are significantly less than the "main course" i.e., architectural design studios. These courses usually transfer specific knowledge (thermal, acoustics and light) by lecturing. Conducive to laying a comprehensive and solid theoretical basis, these courses doesn't conform to "learning by doing" that has been a tradition in architectural professional education, and therefore the outcomes are often unsatisfactory. In recent years, architectural educators in China has carried out many explorations on the pedagogy reform (Ge and Zhu, 2015), curriculum construction (Zhang et al, 2009; Zong et al, 2012), professional knowledge and professional ethics training (Chen and Kang, 2011) and so on, to promote integration of environmental sustainable design. The general practice is to strengthen general education in order to stimulate interests among undergraduate students, while to conduct research-oriented design training in studios for graduate students

In the construction of environmental sustainable design teaching system, the graduation thesis in the final year of B. Arch is often neglected. Graduation thesis is a summary of the undergraduate study, and is also a simulation of professional practice based on knowledge and skills accumulated in the past 5 years. Graduation thesis often occupies an entire semester, and demands higher degree of completion compared to other design studios. At department of Architecture in Tongji University, it is a two-way choice between tutors and students at the beginning of the graduation thesis semester, therefore students interested in environmental sustainable design have better chance to pursue their interests with professors in this field. This paper reports the authors' attempt to integrate sustainable environmental design (SED) into B.Arch graduation thesis at Dept Architecture Tongji University. The syllabus and the process of the course are elaborated, the final output of each studio member is presented, the lessons learned and experiences gained through the 16-week teaching experiment are shared, and suggestions to integrate environmental sustainable design agenda into the complete teaching circles are proposed.

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2. Syllabus

The content of Sustainable Environmental Design (SED) architectural education can cover three areas, namely, general architectural design principles, analytic decision-supportive tools and passive and low energy architecture design strategies, which is visualized in the "principles-toolsapplications" Triangle (EDUCATE 2012) (Figure 1). The present course takes three parallel aspects in teaching, that is, topical lectures, desk critic, and handon software workshops. The study of environmental sustainable design, climate responsive and passive and low energy architecture runs through various design stages including the conceptual design, design development, and detail and technical design. As architectural students, they need to complete the design task independently. Therefore, these students are required to play the roles of architects, engineers, and green building consultants. They are required to master, through intensive training, the basic principles of environmental sustainable design, the application of environmental performance simulation software, and knowledge and skills about architectural mass form and envelope optimization based on environmental performance simulation.

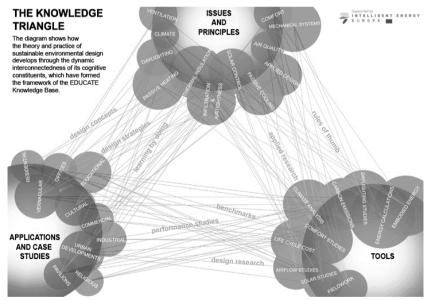


Figure 1: The Knowledge Triangle for environmental sustainable design (Source: http://www.educate-sustainability.eu)

Graduation thesis should be a research-oriented design, that is, to carry out a thorough study for a particular design issue, and draw the corresponding design solution. According to the scale of the graduation thesis group (5-6 students / 1

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teacher), make each student's graduation design / thesis topic focus on a specific subject under a unified framework. A complex project of moderate scale is selected: architectural design of a college complex building in a university campus in Shanghai. The site is located in historical preservation area of Jiangwan, Shanghai, adjacent to a Shanghai cultural relic conservation unit: the old Shanghai special municipal government building in the 1933 Master plan (now the office building of the university). The site area is about 9000 m2 and the floor area ratio is about 2.5. The building functions include office room, training area, athlete apartment and the reservation and renovation of the existing restaurants in the base. The purpose of the thesis is to make each student complete the overall architecture design and environmental sustainability research, and furthermore conduct a thorough technical design on a single building (such as office buildings) for different results.

The curriculum requires to master preliminary knowledge and skills of environmental sustainable design through learning and practicing Sustainable Integrated Design Process, which is characterized by inter-disciplinary. At the end of the thesis, students should obtain a clear understanding of the relevant professional issues and solutions on environmental sustainable architectural design. Specifically, students are required to study and consolidate the design principles of office building, hotel building, restaurant building and complex building, and learn to use at least one passive energy-saving design strategy demonstrated in an "architectural manner". Using numerical simulation or scale model test or other methods to quantify the above ecological strategy is also necessary, as well as the sense of response to the existing social and cultural traditions.

3. Process

The graduation thesis lasts for 16 weeks. the teaching plan formulated and executed is shown in Table 1. Based on experiences of the tutors throughout the course, the following issues seem worthy of discussion.

Climate-responsive strategies and techniques in a difficult climate. Comprehensive analysis and visualization are carried out on parameters which influence thermal comfort and energy consumption in the site's climate zone by using climate data analysis software, and quantify the improvement of environmental performance of different responsive strategies to determine the main climate responsive strategies / methods / techniques. Shanghai is classified as hot-summer cold-winter climate zone, and the analysis pointed out that natural ventilation and shading of building facade are the most effective strategies. These conclusions can be drawn even from daily life

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experience, but it still helps to validate empirical evidence and master general analysis methods of different climate responsive strategies based on data analysis.

Architectural understanding on environment and energy consumption analysis. It is undeniable that the theoretical basis for such simulation analysis comes from the field of Heating Ventilating & Air Conditioning (HVAC). Environmental sustainable design thus is an essentially multi and cross-disciplinary design process. It would be best if architects possess the relevant professional knowledge and master the software operation. In the course, while spending considerable time on software operation, the teaching still focuses on fundamental theories, simulation principles and best practice guidelines. Architects should understand the "garbage in, garbage out" problem, and set the boundary conditions reasonably based on understanding of basic knowledge and principles of the simulation software, in order to carry out effective wind-thermal environment simulation.

Focus on right aspects and choose right tools. That is, tutors keep to the ontological status of architecture as a discipline, and the design strategies or tools which is not closely related to architectural design should not be emphasized. For instance, there are many factors affecting building energy consumption, e.g., building mass, envelope and openings, orientation, and also other important factors which are not the focus of architecture field, such as equipment energy efficiency. Focusing on the architectural aspect of energy use, the so-called "shoe box" simulation tool is used in teaching, by which the energy consumption of the unit room rather than the whole building is simulated. Therefore, the design focuses on the facade materials, construction details, thermal performance of windows, and energy efficiency of shading devices. Such tools are particularly suitable for hotels, dormitories, office buildings and typologies with a large number of repetitive units. Similarly, introduction to the green building evaluation systems is not to encourage students to achieve a certain level of green label, but to hope that students can understand the complete framework of green building evaluation through their own design.

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Wk	Actions	Design Progress Diagram Illustrated
1	Site inspection, program assimilation,	设计构思及策略
	building massing analysis.	1. NURLANDAR
2	Lecture : architectural design principles	
	(office, hotel and exhibition center); site	
	planning fundamentals.	L - SINUPARIZAR
	Discussion: massing and site planning	MARKED AND AND AND AND AND AND AND AND AND AN
	analysis.	- 3. KORNETTIE
3	Lecture : introduction to climate-responsive	
	design method	
	Software workshop: integrated climate	方案推进优化 日期期19年 第54章759年 日期期19年 第54章759年
	simulation software.	
	Discussion: the environmental impact of site	
	planning: solar radiation, shading,	
4	ventilation, sunlight, etc Lecture : architecture design and natural	
4	ventilation (1).	
	Discussion: qualitative analysis of	
	ventilation performance – outdoor and	
	indoor wind field; form optimization	カ公、公寓单体房间通风采光分析
	response to environmental factors (wind,	RESERVENTION OF CONTRACT ON CONTRACT OF CO
	light and radiation).	UNITY AND A CONTRACT OF A CONT
5	Lecture : architecture design and natural	Bold Bold Bold Bold Bold Bold Bold Bold
	ventilation (2).	MALE SALAR
	Software workshop: wind simulation.	
	Discussion: quantitative analysis of	
	ventilation performance -outdoor wind field	
	and wind pressure distribution on façade,	
	form optimization response to wind field.	
6	Mid-term review and discussion: integration	BACKENINGSEN, HYERRE, BRETTONINGUILISE
	of function, form and energy saving technology.	2A121510(2020)
7	Mid-term inspection	- 1. RSNR 2. ion-IEN-REASHS 1. ion-IEN-REASHS
8	Software workshop: quantitative analysis of	
0	ventilation performance : indoor wind	
	simulation; adjust the form and skin.	allanderstraden is verseenderstocksaaderstaten R. Referenze valatissuccentristoperson valenze
	Case study: building design with NV	
9	desktop crit / Case study: building design	
	with mixed ventilation	
10	Lecture : energy consumption: distribution,	办公、公寓节能措施综述及细部设计
	influencing factors and estimation.	
	Software workshop: energy consumption	
	simulation.	
11	Lecture : introduction to green building	
	evaluation methods.	
	Discussion: optimize the overall design with	
10	evaluation tools.	
12	Synthesis : desktop crit	
13	Synthesis : desktop crit	
14	Design documentation	
15	Design documentation	
16	Submission, final review	Accounting and Accounting

Table 1: Schedule

ENERGY AND THERMAL PERFORMANCE IN COMPLEX DESIGN IN A HIGH-DENSITY URBAN CONTEXT:

4. Outcomes

Selected design works of students are shown below as final review panels (reorganized and with abridgements).

4.1. SCHEME 1

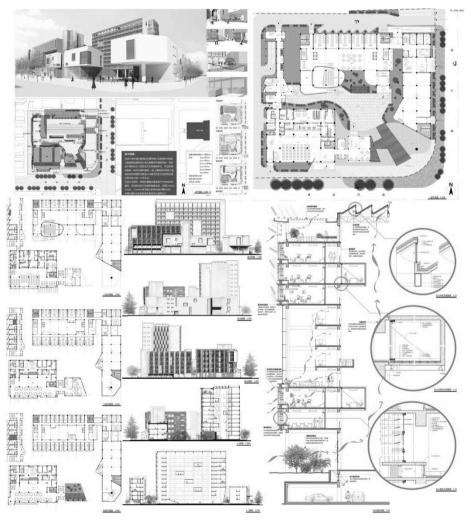


Figure 2: scheme 1 (student: Wang Guoyuan)

The scheme (Figure 2) reasonably reflects the environment sustainable architectural design process "principles - tools - applications" from the beginning to the end. The site analysis, overall layout, individual building design and detail design are all guided by the concept and method of passive

and energy-saving architecture (the design process is shown in Table 1). Facing with many contradictions such as complex functions and high density, technical means are applied reasonably, and design assistant tools are used effectively to carry out environmental performance simulation and help scheme comparison and optimization process. The form of the main office building, the eastern facade and the interior space may still have room for further optimization. The scheme won the excellent graduation design / thesis award of the University.

4.2. SCHEME 2

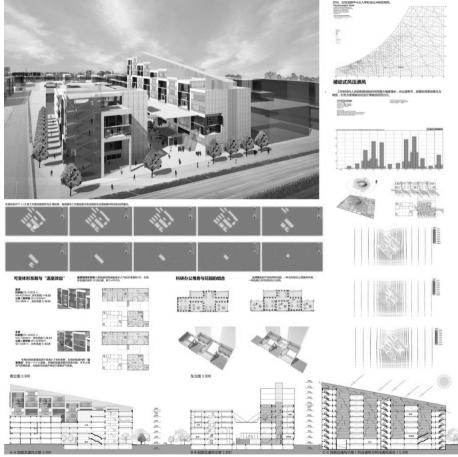


Figure 3: scheme 2 (student: Zhang Qianning)

This design (Figure 3) mainly focuses on natural ventilation, optimizing building form and skin for wind-driven ventilation. The building height is low in the south and high in the north, which is conducive for natural ventilation under the dominant wind direction in summer. The public space covered with

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shading device facing the Green Tile Building (the heritage building nearby) provides a landscape view. South atrium and internal air system are introduced, combined with adjustable southern double skin, so that the building shape coefficient is variable between winter and summer. In summer and transition seasons, the courtyard opens to the south, increasing the windward surface area, reducing the depth and promoting ventilation. In winter, the glass surface of the courtyard is closed to reduce building shape coefficient and heat dissipation, and to increase greenhouse effect. In the absence of wind, the inclined roof can also be heated to form thermal buoyancy ventilation, and natural ventilation can be formed by vertical shafts combined with the atrium.

4.3. SCHEME 3

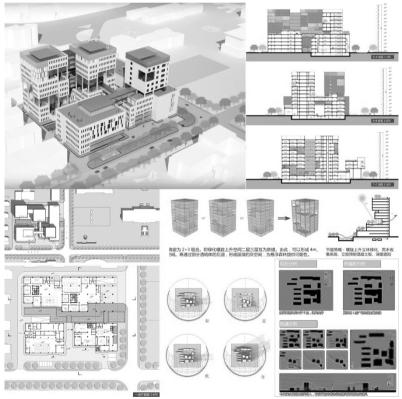
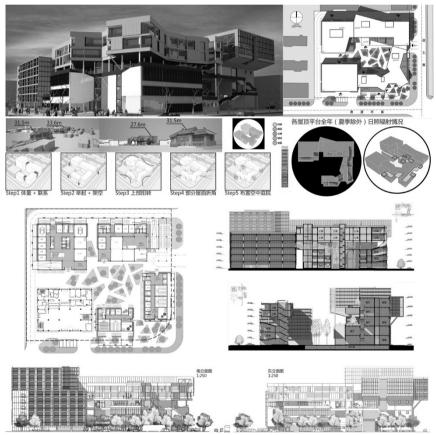


Figure 4: scheme 3 (student: Liu Huiling)

The scheme (Figure 4) is inspired by Ken Yeang's bioclimatic tall building. It focuses on the form of the building, the selection of materials, the use of passive and low-energy technology and the combination of site micro-climate and meteorological data to reduce energy consumption, and to achieve the

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purpose of passive energy conservation. The green space rises in a spiral manner , thus forming the outdoor space in heights of 4m, 8m and 12m. The vertical continuous green spiral rises up to break the square form of the tower, creating several transition spaces inside and outside of the building. Windows facing the transition space is also conducive to natural ventilation. The courtyard allows people to experience the outdoor environment in high-rise buildings and improve comfort. The subtraction of the form makes it easier for sunlight to shines into the transitional space of the building(the courtyard), which also improves the comfort of the space.



4.4. SCHEME 4

Figure 5: scheme 4 (student: Zheng Siyu)

This scheme (Figure 5) emphases on shaping outdoor and semi-outdoor space system, and optimizing the thermal comfort of the environment under high floor area ratio condition. By analyzing the relation and synergy of each function block, the master plan with a semi-enclosed courtyard is determined.

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Radiation and ventilation analysis shows that the thermal environment and comfort of the courtyard can be poor. The quality of the outdoor communication space are improved through the following two ways: first adjust the upper part of the building in the southeast to improve the sunlight accessibility of the inner courtyard in winter; then in the vertical dimension introduce the air system and create a semi-outdoor space facing the main landscape and the dominant wind in summer. The geometry and the air courtyard system are optimized through radiation and ventilation analysis.

5. Discussion and Summary

This paper reviews the teaching practice of the authors in the course of B. Arch graduation thesis, with a focus on environmental sustainable design. For future development, there are several aspects for improvement:

1. A multi-disciplinary team can better tutor the SED studio. Research design studio of this kind demands knowledge and know-how from several disciplines, not easily coped with by faculty members from only Architecture. In present studio, the authors acted as instructors in architecture, building physics, environmental engineering, HVAC and other fields, as well as technical instructors of a number of software. In retrospect, hard working as we were, there were still many ways in which the teaching process could be refined. A natural solution is to set up a team of professors from all relevant disciplines. Special events can be used to realize it for graduate studio, e.g., the Solar Decathlon competition that Tongji U has participated in for three times. The teams consist of professors and undergraduate students from various faculties, working concertedly on constructing a self-feed zero energy solar house. In fact, Prof. Qian, one author of this paper is the leading professor of Tongji U team. This can be perfect projects for a graduation thesis. Using the event like this as a starting point, the cross-disciplinary teaching team can continue to develop and improve year after year.

2. Environmental sustainable design theories and methods should be embedded in curriculum throughout the undergraduate study, with graduation thesis being the last step of the subject. It'd be better if students have certain theoretical and application basis when starting the graduation design, so that teachers and students can focus more on the architectural design ontology, rather than spending remarkable time to "cramming" theory and skills in the beginning of the course. 3. Properly handle the relationship between architectural design and environmental sustainable technology. On one hand, the validity and credibility of environment analysis (and simulation) must be dealt with very seriously. Environmental simulation outcomes should not be considered merely as decoration, the rationality and accuracy should not be pursued. On the other hand, it is not possible to generate architectural solutions relying solely on environmental thinking. The birth of a good scheme must rely on designer's comprehensive response to a series of aspects such as site and place, climate and rituals, materiality and tectonics.

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DETAILING FOR TOLERANCE: A STUDY OF ARCHITECTURAL DETAIL AS A MEDIUM TO ACCOMMODATE PERMISSIBLE ERRORS

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Abstract

This study is a critique of architecture, through the lens of architectural details. It moves from a dual hypothesis: (1)both 'detail' as a product and 'detailing' as a process can be 'designed' to tolerate various socio-economic, socio-cultural and socio-technical constraints of building production, and (2) such interpretation and practice of 'detail' may allow practitioners to participate in building production activities that are socially motivated, organized and constrained.

Exploring the abovementioned research position, the study inquires whether methods of assembly and erection can be designed to enable substantial swings in the quality of on-site work, without hindering the successful delivery of their expected performative outcomes. In evaluating this somewhat intellectually decisive research question, the study has set upon 3 objectives as its fundamental aims and intentions: (1) to identify an idea of detailing that allows practitioners to tolerate general shortcomings of on-site building work, (2) to evaluate whether buildings can be designed to accommodate both 'precision' in performance (structural, environmental, aesthetic and spatial), but 'looseness' in the making, and (3) to critically review the notion of detail and its function within social building production spheres.

Using three case study projects as the basis for evaluating the aforesaid objectives, the study defines a framework for a design and construction language that draws upon its technical and formal prerogatives on the ideas of 'permissible errors', 'allowable failures' and 'designing for tolerance'.

Keywords: Architectural design, Detail, Detailing, Tolerance, Permissible errors

1. Introduction: The idea of building

Buildings in general tell stories about how they were made, by whom, and for whom; they convey meanings about how the spaces are used, what environmental situations they brace against, and which experiential qualities they are meant to articulate. In short, buildings are by-products of a specific socio-cultural, socio-technical, and socio-economic context upon which they are birthed off. A more construction-specific definition identifies a "building" is a "physical embodiment of a number of systems and subsystems that must necessarily be related, coordinated and integrated with each other as well as with the three dimensional form and spatial organization of the building as a whole" (Ching, 2008, p.51). Ching (2008, p.51) further identifies a "system" as "an assembly of interrelated or independent parts forming a more complex and unified whole and serving a common purpose".

Understanding buildings as systems of parts and components will inevitably urge us to look at how they are physically put together: i.e., a process of incremental production and assembly. The success of a building project therefore relies on its building process as much as it is about the final product. Throughout of its course of production, a building evolves through various stages of procurement (from design conception to handing over) and is shaped by the input of many different social actors (architects, engineers, clients, contractors, labourers, etc.). The particular organization of these design and construction stages, along with the input and interplays of subsequent actors, will determine the success and quality of the final building outcome.

Today, these various roles and relationships are experiencing their most vigorous rearrangement and redefinition, especially in countries such as Sri Lanka, which are still 'developing' in political, economic and industrial dimensions. In particular, the skill base of the construction workforce and their understanding of on-site building work are diverse and varied across the building industry. This has resulted in a turbulent construction environment, as evident by the plethora of sub-standard building outputs mushrooming in the island.

Steven Groak (1992) identifies four factors as critical to the success of any given building activity. The first of these factors concerns with material usage - i.e., the selection, composition and assembly of materials in building systems, parts and components; the types and ways of selecting materials may vary according to their availability and supply. Secondly, the organization and supply of labour – and the subsequent knowledge base and craftsmanship skills

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of the workforce – will have a greater bearing on the process of assembling the final product. Thirdly, the intentions, strategies and principles pursued in the conception, development and implementation of construction systems, components and methods – in other words, the construction objective – can shape how the final product is organized and performed. The fourth factor concerns with the context of understanding the implementation of building systems – i.e., the technical, cultural, economic, political and experiential (or aesthetic) contexts, upon which a building system is identified, developed and implemented.

While the above four factors generally determine the performative capacity of a building, the standard of performance assigned to any given building is subjective and scalable. In other words, different building conditions and contexts (technical, cultural, economic, political, experiential, etc.) will determine different performance levels, standards and expectations for buildings; while some may seek a specific level of precision in their performance, others may tolerate – either by design or by default - a certain degree of performative errors and imperfections.

2. The permissible error

The ideas of scalability and tolerance with respect to the performance of any given building activity bring us to an important theoretical position of this study: should every building perform within an absolute level of precision in terms of its technical, environmental and formal performance, or can buildings function with permissible errors without compromising their constructional and phenomenological ethos? In other words, should buildings be able to function with certain "errors", without compromising the expected formal and environmental performances.

In this study, the term "permissible error" refers to an error that can be permitted, allowed or tolerable because it does not contribute to altering the building's expected technical and environmental performances. A "seminal error", on the other hand, is one that results in the collapse of a building or an environmental failure. As Pathiraja (2010) notes, defining the level of permissible error would require a proper understanding of a building system's limits of 'robustness', margins of error, tolerance bands and failure thresholds. In summary, a permissible error is subjective to a particular socio-cultural, socio-technical and socio-economic conditions of a building activity, where certain – and often unavoidable – mistakes could happen in the process of the building's realization, but without hindering the expected performance of the

building. In fact, it can even be argued that accommodating such permissible errors may even make certain building environments perform better, especially in conditions with a limited access to building knowledge, technical skills and spending capacity (Pathiraja, 2010).

3. The notion of Architectural Detail

The two key arguments built in the previous sub chapters -i.e., (1) the idea of building as a system of parts and (2) errors of production can be permitted if the subsequent performance is not compromised - bring us to a critical third argument concerning the jointing of building parts; more specifically on the idea of 'architectural detail'. According to Edward Ford (2011), there can be many interpretations to the notion of 'architectural detail'. Mostly, a detail is understood as the jointing of two materials to bring up an ethereal effect, based on notions such as contrast and porosity; this definition centres purely on a phenomenological ground, with creation of space as its ultimate and noble intent. Another definition views detail as a fragment in which the whole building is presented. In such definition, architecture is nothing without details, as the whole is the sum of its parts and no more. In contrast, a third position sees detail as a small-scale architectural design, where the whole generates the part. Summarising all these different perspectives, Ford (2011) develops five categories and expectations of an architectural detail: as an abstraction, as a motif, as an order, as a joint and as a subversive activity.

What is more crucial to this study however, is inquiring on the process of 'detailing': how a detail (the product) is put together, irrespective of whether the end objective is phenomenological or constructional... an abstraction or a motif? This issue becomes much more significant for construction activities that take place within certain socio-economic, socio-technical and socio-cultural limitations. In other words, as Groak (1992) claims, putting together a detail as either a phenomenological or a constructional product will entail satisfying the requirements and capacities of many different factors and actors.

Firstly, there would be socio-economic factors such as the spending capacity of the client, the availability of material and other resources, and the cost of production and labour. Secondly, a detail would have to satisfy a large set of socio-technical factors such as material performance, jointing of components, environmental protection, structural behaviour, durability and performance in use, etc. Thirdly, socio-cultural factors, such as the organization of the labour gang at site, their skill bases and knowledge capacities, and the aspirations of users, etc. will have to be identified and responded to. All these different factors – concerning materiality, labour, capital, performance, etc. – will eventually dictate how a detail is put together on a construction site.

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4. Designing for tolerance

The process of conceptualizing, planning and assembling an architectural detail within constrained technical environments brings up the main research questions of this study: (1) can methods of assembly and erection be designed to enable substantial swings in the quality of on-site work, without hindering the successful delivery of initial design expectations, and (2) what is the interpretation of such approach to the definition of the idea of "detail" and "detailing"?

This study moves from the position that designing buildings to tolerate different social, technical, physical and economic conditions of building production would require an acknowledgment of a design framework that can function with permissible errors, but without compromising the architectural ethos of space, program and performance. Referring to imparting labour upskilling possibilities during the assembly and erection processes of a building, Pathiraja (2010) says: "this requires strategic tolerances to be built into the targeted building systems to avoid production errors that may require rework - or result into structural and environmental failures - of the system (or the building) put in place". In defining what he terms as 'robust technology' Pathiraja (2010) further claims that, when applied in construction conditions with limited skills and resources, "technological systems should have a latitude for errors and non-optimal application, in order to adapt to the level of complexity required and the level of expenditure possible without penalizing the expected performance of the building, culturally as well as technically".

Both Groak (1992) and Turin (2003) have stated that planning for design tolerances is a must factor when buildings are produced with low skilled or semi-skilled labour, or in situations where material and technical imperfections are unavoidable. Pathiraja (2010), on the other hand, has introduced 6 strategies that are useful in what this study terms as 'designing for tolerance'.

4.1 FORMAL/DIMENTIONAL TOLERANCE

Dimensional tolerance can be understood as allowing or accommodating planned/unplanned variations in dimensions. In other words, a system is designed in such a way that variations in dimensions can be accommodated, without compromising its intended formal and technical performances. In order to do so, the system cannot rely on the need to be precise in the lengths and widths of its parts/components, or strictly accurate in the specified distances between two or more. The system should expect that these dimensions may change, and therefore should be built-in with a mechanism or strategy to accommodate such change.

4.2. ALLOWABLE FAILURE

Since determining the level of permissible errors is a subjective factor, the application of this strategy would vary according to the space, function, and economic situation of a given project. Nevertheless, the expected end result would be to convert the permissible - and allowable - error in to a positive aesthetical and spatial experience, thereby reinforcing the success of the project. One strategy hence would be to transform the permissible error in to a constructive aesthetic experience. Another would be to pursue a language of building, whose ethos is not compromised by the permissible errors.

4.3. ADJUSTABLE FIT

When we connect - or fit - components together, there may be needs to adjust their fixing, composition and placement. These adjustments are often the results of unplanned - or unforeseen - errors transferred to the components during their planning, designing and manufacturing phases. These variations, offsets occur different jointing disparities and in situations of assembly/erection, could lead the detail - or the project - in to failure if they are not accommodated/responded well during both the design and construction processes. One strategy would be to use a third element as an 'adjustor' between two components. Secondly, devices can be designed to accommodate a certain level of adjustment when assembling the components together.

4.4. SYSTEMIZATION OF WORK

Planning buildings and components as a flexible and adaptable 'system' of parts can reduce the complexity of both design and assembly, and therefore would be able to accommodate permissible errors during the construction phase in particular. For example, building systems with a modular, 'kit-of-partsstrategy would make it easier to plan and undertake the manufacturing of components, as well as to eventually put together the components in the building site.

4.4. FLEXIBLE COORDINATION

In those construction sites that rely on less-skilled labour and limited resources, the coordination of elements and parts – as well as labour – needs to be flexible, to accommodate unforeseen and unplanned changes during the construction phase. Flexible coordination between systems can be achieved via flexible joints and permissible dimensional tolerances, which in turn can accommodate construction irregularities and material imperfections, thus contributing the final product to perform well as a whole.

4.5. SCALABILITY OF APPLICATION

This can refer to two conceptions. The first is the idea of the range that a certain system, detail or principle is applicable; the technical, environmental

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and aesthetic range which the system or detail can be applied without resulting in a failure or collapse of the system. Secondly, it refers to the capability of a system, detail, or process to be enlarged – or reduced - in order to accommodate a variety of situations, without compromising its' performative attributes.

5. Research Methodology

The succeeding methodology to investigate and validate the afore-mentioned theoretical positions and hypothesis was born out of a 4 phase approach. Firstly, the research background was set up through a broad literature survey inquiring, among others, the notions of 'precision', 'error', 'failure' and 'permissible error'. Secondly, a research position and an analytical framework were established on the tasks of conceptualizing, theorizing and designing a 'precisely loose detail'. Thirdly, three case study buildings were used as the basis to analyze the aforementioned research framework and validate the research assumptions. Finally, a cross-building analysis of the three case-study buildings was undertaken to source out possible design strategies for what the study terms as 'designing for tolerance'.

The selection of the three case study projects was strategic in the way in which they represent three different building typologies but all built within extremely challenging economic, social and technological conditions: a library, a community centre and a tourist lodge. For every case study building, 6 details were selected and drawn in axonometric, sectional and perspective views, thereby analyzing their technical, material and phenomenological objectives in the context of 'designing for tolerance'. This documentary analysis was supported by communications with and interpretations by the actors who were involved in the design and production of the three selected buildings.

The objective review of the case-study findings was carried out in eight detailed steps, each step gradually building upon the previous steps in the process of analyzing both individual projects as well as the cross-building analysis. The basis for this analysis relied on a multifaceted theoretical framework bringing together the six strategies of 'designing for tolerance' – i.e., Formal/dimensional tolerance, Allowable failure, Adjustable fit, Systemization of work, Flexible coordination, Scalability of application (Pathiraja, 2010), the four conditions affecting the idea of detail as a product – i.e., Material usage, Skill of assembly/labour, Construction objective, and the Context of understanding the implementation of building systems (Groak, 1992), and the three seminal conditions that challenge detailing as a process – i.e., actors and staging (cultural), skills and techniques (technical), and cost and resources (economic) (Turin, 2003). Subsequently, the collective analysis

focused on the notions of Detail, Detailing, Design strategy, Spatial outcome and Technical outcome.

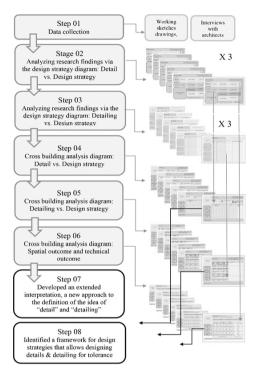


Figure 1, Research design (Source: By author)

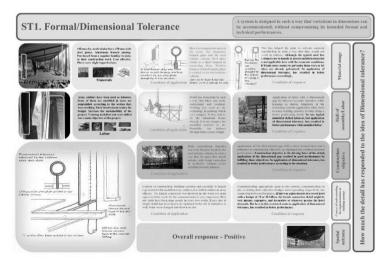


Figure 2, Analyzing case study one via the design strategy diagram: Detail vs. Design strategy– i.e., Formal /Dimensional Tolerance (Source: By author)

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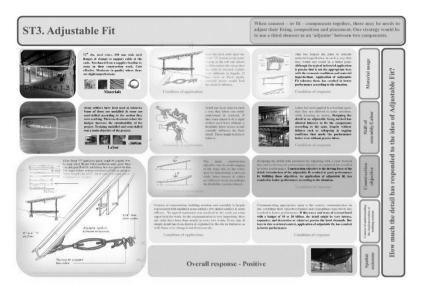


Figure 3, Analyzing case study one via the design strategy diagram: Detail vs. Design strategy– i.e., Adjustable Fit (*Source: By author*)

The objective review of the case-study findings was carried out in eight detailed steps, each step gradually building upon the previous steps in the process of analyzing both individual projects as well as the cross-building analysis. The basis for this analysis relied on a multifaceted theoretical framework bringing together the six strategies of 'designing for tolerance' -Formal/dimensional tolerance. Allowable failure. Adjustable i.e.. fit. Systemization of work, Flexible coordination, Scalability of application (Pathiraja, 2010), the four conditions affecting the idea of detail as a product – i.e., Material usage, Skill of assembly/labour, Construction objective, and the Context of understanding the implementation of building systems (Groak, 1992), and the three seminal conditions that challenge detailing as a process i.e., actors and staging (cultural), skills and techniques (technical), and cost and resources (economic) (Turin, 2003). Subsequently, the collective analysis focused on the notions of Detail, Detailing, Design strategy, Spatial outcome and Technical outcome.

6. Research findings

The cross-building analysis has revealed common outcomes and patterns of responses in terms of the buildings' action and reaction to material usage, skill of workface, construction objective and spatial/technical context. More specifically, common relationships concerning how the three buildings have responded to the six strategies of 'designing for tolerance' can be identified. It must be noted that the following are generic observations only, but they form an argument on the conditions of how the case-study buildings have achieved tolerance to social, economic and technical context.

It was found that dimensional tolerance is generally applied in situations where cost effective materials and components have been used, such as in an event of using re-cycled and found materials whose dimensions vary from one component to the other. It is also applied as a strategy to mitigate errors transpired as a result of using less-skilled workforce who fails to achieve dimensional rigor in sizing and manufacturing of components. A common technical solution to tolerate dimensional errors has been to use a third element as a jointing mechanism to tolerate, adjust and accommodate dimensional variations of the first two components. Another solution is to connect components in such way that they would not meet physically or touch each other, but separated by a gap; the gap invariably is the third component that accommodates the dimensional irregularities. A third solution is to design components in a manner that their formal and aesthetic performance would not rely on dimensional accuracy of either making of the components or during the process of their assembly.

Allowable failure, on the other hand, is used in conditions where workmanship standards are very low, thus the possibility for accuracy is undesirable. It is also used in situations where different materials are connected to each other, such as jointing of steel to masonry and so on. It must be noted however that the term 'failure' here is subjective in its definition and depend on the 'context' of particular building activity. For example, an allowable environmental failure can be allowing rainwater penetrate the façade, but only in situations where wetting is not a problem for using the subjected spaces; an allowable aesthetic failure can be letting moss to take over a masonry wall, but if designed within a favorable design language, this permissible error can be transformed in to a constructive aesthetic experience.

In the case study projects, 'Adjustable fit' is used as a strategy to connect materials and components with different technical properties and textural forms, especially in situations where there are many unknowns in terms of labour skills and on-site workmanship conditions. Often the strategy has been to use a third element, as an 'adjustor' between two components, in order to mitigate possible errors of production. Designing components with the capacity to be adjusted require a certain level of insight and effort both on the part of the designers as well as builders.

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Systemization is another strategy used to organize construction of building components where labor skills are not of the highest order, irrespective of whether those components are made of similar or dis-similar materials. Designing components as a part of a flexible and adaptable 'system' can reduce the complexity of construction; repetition of components – and modularity – can result in an ease of erection, especially if the assembly process does not rely on excessive precision. There is however, a very strong spatial impact of this strategy as repetitive modularity can define how a space is volumetrically composed and visually perceived.

Flexible coordination, on the other hand, is mostly applied in situations where systems are built with more than one material component. Imparting a certain level of looseness in coordination allows the system to accommodate different textural, dimensional and formal discrepancies - and variations - of multiple material components as they are put together to form the system. More specifically, components are made to coordinate with appropriate levels of tolerance, by not impinging on rigid and accurate placements, sizing and jointing. This strategy has been applied in cases where both skilled and less skilled labor are involved. The context of understanding and application of this strategy is challenging than the others, and often have resulted in a significant impact on the spatial attributes.

Designing systems and components with a level of scalable applications is a strategy rarely used in the case study projects. In one instance, the application of welding joints with different levels of technical complexities is used as an opportunity to accommodate indifferent levels of workmanship. Here, the details and joints are designed in such manner that they can be applied in different construction situations without compromising expected performance; systems and components are developed to withstand unforeseen changes in economic and cultural context of building, particularly the skills and knowledge of the workforce.

7. Conclusions

The analysis of the case study projects concludes that the particular approach to detail - based on the notions of tolerance and allowable failure - has helped overcoming material imperfections and scarcity, while accommodating differently-skilled labor without compromising the expected building performances. A critical outcome of the study is the observation that the ideas and strategies for 'tolerance' must be planned and 'designed' into building systems at a very early stage of the design process. In other words, both the technical strategies and formal repercussions of 'tolerance' must be framed as

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an integral part of the building's architectural language, so as to transform the so-called 'failures' into a constructive aesthetic experience. The case study projects reveal that such attitude to detailing and resolution of building joints would result in better spatial outcomes; flexible detailing accommodates unforeseen changes during the construction phase and allows the spatial ideas to be realized without technical or volumetric compromise.

Overall, the application of these strategies and the subsequent idea of 'designing for tolerance' have resulted in better performance of the buildings in general, and details in particular. While the aesthetic reading of a detail is still considered as a principal objective, most of the jointing strategies have moved primarily from a constructional objective, thereby suggesting that a detail is not a mere motif or a constructional joint. What is more important is the critical thinking embedded in conceptualizing, developing and realizing a detail in order to organize a positive behavior of a product, irrespective of the socio-economic, socio-technical and socio-cultural limitations of the building process.

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CREATING BLUE NETWORK: A SOLUTION OF PRESENT WATER LOGGING AND TRANSPORTATION PROBLEM FOR THE DHAKA METROPOLITAN AREA.

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Abstract

Dreaming of a future condition for our own beloved cities, we always think that, the problems those we are facing today would not being faced tomorrow. Besides this, the city will blend harmoniously with natural environment also. The above scenario is very much true for Dhaka, the capital city of Bangladesh. Currently, the worst problems faced by Dhaka are traffic congestion and water logging. The city can be brought to a standstill due to less than an hour of rainfall because of poor water management and lack of natural drainage system. Though, this was not the scenario in the past. As geographical location suggests, Dhaka is a city of many rivers. In past, this resource was used for human settlement but now we are facing our back to these rivers. Due to lack of proper follow-up plans and reluctance of implementing new plans, Dhaka which was founded based on its strong connection to water has almost lost that bond. It is time to revive that natural connection. This paper explores the prospect of connecting the whole Dhaka city through water network. The water way is the cheapest means of transportation. In Dhaka city, the roads are in north-south oriented and these rivers are situated in east-west. So, the combination of both can be a great fruitful thing for overall Dhaka city. The main proposition is to re-connect the water bodies of Dhaka city and link them to the surrounding rivers to form a 'Blue Network' through the city to solve the water logging and transportation problem. To do this, literature surveyed has been done to search for the historical evidence of water connection through Dhaka city and new scope for bringing back that connection again. The possible outcomes resulting from numerous changes in the present condition of Dhaka will be also discussed which can make this city to go further to become an eco-city, which is our ultimate goal as a dweller of our own beloved Dhaka.

Keywords: Water logging, Traffic congestion, Natural drainage, Blue network.

1. Introduction

Rivers have always been the life line of human civilization. From the dawn of history, rivers have played vital role to support human population by providing them source of fresh water and connectivity to flourish trade and commerce. As for this reason, most of the modern cities were generated on the banks of great rivers of near to coastal lines and Dhaka is also not an exception. Human settlement in Dhaka can be traced back as early as the 12th century (Ahmed, 1986). Before the Mughals came to power, Dhaka was a small Hindu trading centre (Ahsan, 1991) lying between the Dhulai Khal and the Buriganga river.Since that humble beginning, Dhaka has flourished and became one of the major cities in the subcontinent. Most of its success can be attributed to the strategic location of Dhaka and its vast network of water bodies which made the city a vital trading point.

However, as the city saw a rapid growth in later part of the twentieth century, Dhaka started to lose its water bodies which is resulted the loss of connection of its water network. As much of the city is prone to annual flooding, the water bodies of Dhaka used to act not only as means of drainage, but also as storage for large amount of water during the monsoon season. Water bodies and wetlands around Dhaka are facing destruction as these are being filled up to construct multi-storied buildings and other real estate developments. Coupled with poor waste management and lack of open green space, even a small amount of rain is enough to waterlog the city and put the traffic stand still. Urban traffic is reaching nightmare proportions, often causing massive delays in covering small distances with associated productivity losses. Several international agencies have rated the quality of living in world cities and Dhaka scored very poor on most of them. United Nations' City Development Index (CDI) ranked it 7th worst; Economist Intelligence Unit (EIU) ranked it 3rd worst with a ranking tied with Lagos; Asia week (2000) placed it 39 out of 40 cities (Ahmed and Ahmad et al. 2005).For present day Dhaka, urban flooding and transportation problems has become the major problem for the city dwellers. Therefore, it is high time that proper steps should be taken to revitalize the water bodies to create a blue network within the city.

2. Objective

This study aims to propose a solution of water logging and transportation problem of Dhaka by creating an inter-connected network of water body throughout the city. By analysing the geo-morphological history of Dhaka, potential water bodies are marked which needed to be revived or developed

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further. Problems for creating this connected network are discussed and potential benefits from creating of this 'blue network' are analysed.

3. The context of the study

Bangladesh is in the tropical monsoon region and its climate is characterised by elevated temperature, heavy rainfall, often excessive humidity, and fairly marked seasonal variations. Dhaka, the capital city is located in central Bangladesh at 23°42′N 90°22′E (fig. 1), on the eastern bank of the Buriganga River. The city lies on the lower reaches of the Ganges Delta and covers a total area of 306.38 square kilometres (118.29 sq. mi).

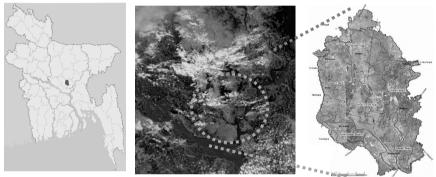


Figure 1, Physiographic setting of Dhaka

Tropical vegetation and moist soil characterize the land, which is flat and close to sea level. This leaves Dhaka susceptible to flooding during the monsoon seasons owing to heavy rainfall and cyclones (BBS, 2016). Dhaka experiences a hot, wet and humid tropical climate. Under the Köppen climate classification, Dhaka has a tropical wet and dry climate. The city has a distinct monsoonal season, with an annual average temperature of 25 °C (77 °F) and monthly means varying between 18 °C (64 °F) in January and 29 °C (84 °F) in August (BBS, 2016). Nearly 80% of the annual average rainfall of 1,854 millimetres (73.0 in) occurs during the monsoon season which lasts from May until the end of September. The number of annual rainy days of Dhaka City varies from 95 to 144 days (Faisal Ahammed et al. 2014).

4. Methodology

The paper is structured in two main sections. The contents of the sections can be summarised thus:

1. To identify the problems behind the water congestion and urban flooding for Dhaka and discusses key concepts relating to blue network.

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2.Providing suggestion and mitigation strategies to solve the crisis Relevant published documents as well as researches previously conducted on the wetlands of Dhaka and its importance for the existence of the city have been extensively studied. Historical maps and previous master plans were studied to find out the pattern of ever decreasing water bodies. In order to compare the water bodies, satellite images from various time periods have been used and analysed.

5. Literature review

5.1. GEOGRAPHY OF DHAKA CITY

The area represents mostly flat land with slight undulations and stands few meters higher than the surrounding area. A large part of this city is covered by low-lying depressions. The metropolitan and its surrounding areas are covered with Pleistocene Madhupur clay and Holocene sediments of floodplain origin (Alam et al. 1990). The storm runoff accumulates in the low-lying areas, flows through *khals* and local rivers and ultimately discharges to the major rivers. These lowlands and wetlands are performing important drainage function by storing storm water and keep the relatively higher lands free from rainfall flooding (Chowdhury et al. 1998).

5.2. GEOMORPHOLOGY OF DHAKA

Historically Dhaka's urban life and living was interwoven with the system of rivers, canals, lakes and ponds scattered and crisscrossing the city (Mowla, 2008) (fig. 2). In the earlier days, a network of natural canals within the city served as the means of drainage of the rain runoff and water during the events of flood, besides these canals served as a good means of transportation. But gradually in course of time this natural drainage system is being almost destroyed.

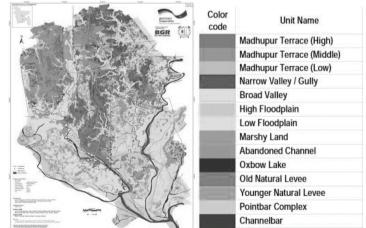


Figure 2, Geomorphologic map of greater Dhaka city, source: Geological Survey of Bangladesh,2014

Destruction of these water channels and depressions has resulted in the disruption and alteration of the natural process of land accretion, land formation and ecosystems.

5.3 REDUCING WETLAND IN DHAKA

As the geography suggested, Dhaka was crisscrossed with numerous canals and low-lying areas (fig. 3). But as the rapid urbanization progressed, the wetlands of Dhaka started to decrease rapidly. These water bodies were destroyed, occupied or threatened due to unabated encroachment, dumping of waste and sheer negligence. But many are still salvageable. As the city is already plagued by water logging, we must preserve what remains and build new ones

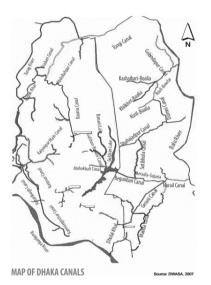


Figure 3, Map of canals in Dhaka, source: DWASA, 2007

According to a study by Bangladesh Centre for Advanced Studies, 84 percent of wetlands and water bodies in and around Dhaka have disappeared since 1947. According to WASA, there are 43 canals flowing through Dhaka city. However, 17 of these exist only in map. 5 of the rest 26 canals have been filled up by dumping waste and encroached by illegal settlers. Most of the surviving 21 canals have been reduced to shallow streams of filthy sewer water (Shahnawaz Khan, 2017). The remaining, shrinking stream of the canal ends up as part slums which are also filled up with tons of garbage dumped on it every day.

From the Permanent Wetlands maps of different years, a comparison has been made based on the area statistics that were extracted (Karim, 2014). By analyzing the satellite image, it is clearly noticeable. Analysis of satellite images of Corona Space photo 1967 revealed (fig. 4) that most of the eastern part of Dhaka city was covered by lowlands in the form of the marsh-land or peaty areas of the Balu River floodplain. Western boundary of the city was also covered by the marshy lowlands. These lowlands in the west of Muhammadpur and northwest of Pallabi are generated within the floodplain of the Buriganga and the Turag river. Marshy land of the Turag floodplain area was extended into the built-up areas towards the northwest part of city near Pallabi. By

comparing satellite images of 1977 to 1967, we can see that there is no meaningful change in wet land (fig. 4 & 5).

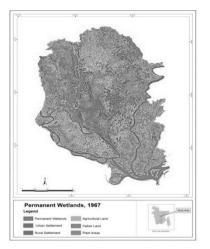


Figure 4, Permanent wetlands of 1967

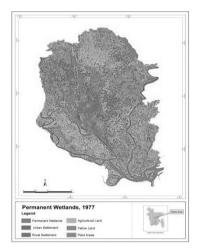


Figure 5, Permanent wetlands of 1977

On the other hand, from 1989 to 2010 wetland sharply decreased (fig. 6 & 7). From 1989, an increased amount of urban development on northern (Mirpur, Uttara) and eastern (Muhammadpur) part of the city is noticeable. The wetlands in the south-western corner retreat towards the Turag river in between Mirpur and Muhammadpur area (fig. 7).

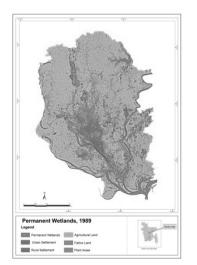


Figure 6, Permanent wetlands of 1989

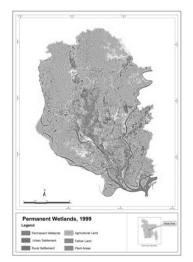
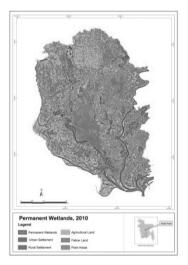


Figure 7, Permanent wetlands of 1999

Images from 2010 satellite picture shows that the areas of lakes (Gulshan and Dhanmondi) have shrunken and narrowed down. Some khals and channels are not identifiable or missing in the southwestern (Muhammadpur) and southern (Motijheel) area of the city. Reduction of the wetland has been occurred in the Pallabi-Cantonment area as well (fig. 8), where low-lying areas were filled and levelled for the urban extension.



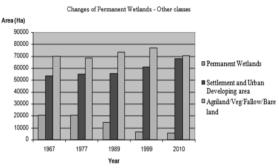


Figure 9, Scenario of how Permanent Wetlands degraded degraded by other classes from 1967-2010. Source: (Karim, 2014)

Figure 8, Permanent wetlands of 2010

It is reveled from the study that the Permanent wetlands reduced from 14% to 4% from 1967 to 2010. The rate of permanent wetland reduction is 353 ha/year (Karim, 2014) (fig. 9). Area covered by wetlands in the city significantly reduced over the period. It is found that in 1960 total areas of water-bodies and lowland were 2952.02 and 13527.58 hectares. But in 2008 total areas of water-bodies and lowland found 1990.71 and 6414.57 hectares. (Shahidul et al., 2012). The growth of urban infrastructures have been taking place in unplanned way; as a result it destroyed natural drainage systems, fill-up the water-bodies, causing water-loggings during rainy season in various part of the city.

5.4 CONCEPT OF BLUE NETWORK

Blue network planning includes the rehabilitation and maintenance of the "blue" water cycle in urban areas as well as complementing conventional engineering solutions. A naturally-oriented water cycle can be recreated through a blue network while contributing to the amenity of the city. The blue network focuses on using natural systems in the region to structure the plan and the future development strategies. It involves analyzing the spatial configuration and composition of the urban space, specifically integrated

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networks of green, blue and grey spaces relevant to the scale of analysis (Bacchin, T. et al. 2014). Blue networks address the city (catchment), neighbourhood (sub-catchment), and community (micro-catchment) planning level and their interrelationships.

6. Increasing threat due to extreme rainfall events

The frequency, intensity, duration and pattern of rainfall events are changing due to the impact of climate change (Nielsen, 2012). Murshed et al. (2011) studied annual daily maximum rainfall of Dhaka City and trend analysis conducted by them for 30 years data series (1980-2009) showed an increasing rate of 2.7 mm. Annual rainfall of Dhaka City varies from 1169 to 3028 mm. Trend analysis for fifty-seven years(1953-2009) rainfall data shows that there is increasing trend of 4.54 mm per year; however, the recent ten years (2000-2009) trend shows the increasing rate as 55.90 mm/year(Faisal Ahammed et al., 2014). The highest amount of daily rainfall was recorded in Dhaka as341 mm on September 14, 2004 followed by 333 mm on July 28, 2009. These were extreme rainfall events and more than two thirds of the city was inundated (Ahasan et al., 2011).Most of the streets were flooded and traffic system was collapsed on these days (Murshed et al., 2011).

7. Water logging in Dhaka

Dhaka suffers floods and water logging almost every monsoon. In recent years, rapid indiscriminate urbanization and the gradual filling up of low lying flood plains, rivers and canals have further worsened the problem.



Figure 10, Dhaka during 1998 flood, Source: (1) M. A. Taher, (2) bangladesh2000.com

In 1988, catastrophic flood inundated about 82,000 sq km (about 60% of the area) and estimated return period to be 50-100 years; Rainfall together with synchronization of very high flows of all the three major rivers of the country in only three days aggravated the flood, in Dhaka, the flood lasted 15 to 20 days (BBS, 2016).

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Figure 11, Street conditions of Dhaka city, source: (1) Nashirul Islam, Dhaka Tribune, (2)Syed Zakir Hossain, Dhaka Tribune.

Due to sudden heavy rainfall, Dhaka city is normally affected by storm water flooding when the regulator and sluice gates were closed to prevent river flooding during the monsoon season. It was found that with a rainfall more than 10mm for a day can cause surface drains in many areas clogged, contributing to water logging, and thereby creating traffic jam (Murshed et al., 2011).

8. Possibilities of creating the blue network:

Historically Dhaka had a strong connection with water. The city grew alongside its rivers and waterways. Dhaka was regarded as the Venice of east or the city of channels (Dani 1962). Unfortunately, due to urbanization without considering the geo-morphology of Dhaka and reluctance of implementing new plans, Dhaka which was founded based on its strong connection to water has almost lost that connection. Water, which was the life line of Dhaka, has become the major urban problem for the city. We have built embankments and filled the channels with concrete to fight against water. But Dhaka demands gradients not walls, dynamic planning not defined land uses, harmony of nature not hard edges. It demands the accommodation of wetlands and channels, not a war against it. Though much of the wetlands have been lost, there still remain some possibilities to create a blue network.

By studying the geomorphology of Dhaka, eight locations can be identified which can be linked with existing water network through minimum intervention in order to create a blue network.

Location 1- This is the location of the lost connection between Gulshan Lake-Hatir jheel with Dhanmondi Lake. At present there is road under which a box culvert was created in the past. By reviving the connection, a continuous water network from the north-east to south-west can be created.

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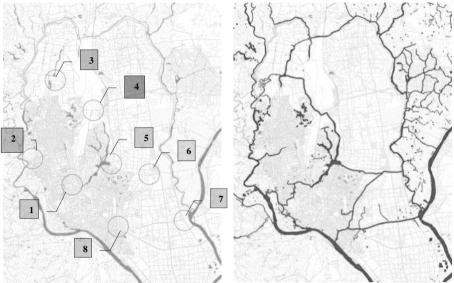


Figure 12, Possible intervention points

Figure 13, Proposed blue network

Location 2- Reviving the ever shrinking Kalyanpur canal can play vital role in minimizing the water logging problem of the surrounding area.

Location 3- Connecting multiple smaller water body (previously connected) with the Turag River.

Location 4- Creating new canals through Dhaka cantonment area.

Location 5- Connecting Banani Lake with Gulshan Lake which will eventually connect with the network of Location 1.

Location 6- Connecting Hatir jheel and Begunbari canal with Balu River.

Location 7- Widening existing canals and connecting it with Balu River.

Location 8- Reviving Dholai khal and linking it with Buriganga River

9. Benefits of the blue network infrastructure

Figure 14 shows the benefits of blue network. Blue network is more than a storm water management policy which aims at improving important ecosystem services and providing socio-cultural benefits for the urban system. Key functions include restoring natural drainage channels, mimicking predevelopment hydrology and improving water quality, reducing imperviousness and increasing infiltration, surface storage and the use of water retentive plants. One of the main benefits of blue network is to contain rainwater for keeping the city dry. By creating the blue network, water logging problem in the capital can be solved. It will improve water quality of the city and help to recharge the ground water.

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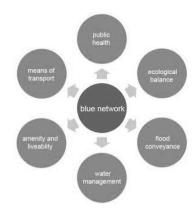


Figure 14, Environmental and socio-cultural benefits of creating the blue network

The inclusion of water management in urban planning can reduce flood risks imposed by climate change. By avoiding impermeable surfaces will further decrease the urban flood risk.

Well-designed and integrated blue networks promote connectivity which provides corridors for animals, improves habitat and increases qualities for recreation. Since blue-green network planning generally combines ecosystembased solutions, it ensures that ecosystems remain healthy which allows local populations to benefit from the provided environmental services including the provision of clean water and protection from extreme weather events.

Waterways system can also be developed under the loop network. A loop of waterways provides a means of transport and continuation of ecological balance. It brings the health of city dwellers and amusement for them. Water ways provide better conveyance for flood and water management as it always leads to bigger water bodies.

10. Proposed guidelines

On the basis of the findings, some guidelines are being proposed here. They are-

- 1. At first, we need to locate the previous water channel of Dhaka city, those are already dead.
- 2. We need to define the annual amount of inundation area for Dhaka city.
- 3. After that, we need to restore some water channel or previous water bodies to make some store areas for this flood water.
- 4. Later we need to take a step to make this water storing area as a water channel to prevent future inundation.

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- 5. We need to make a master plan only for making a water channel through Dhaka city and need to strict with it to be implemented.
- 6. When we can make a plan for a water channel then it will guide us to provide a water way transport inside Dhaka city, which was actually a dream for a Dhaka city. Once Dhaka was called the Venus for eastern world, which can be restored.
- 7. Water ways are more convenient than road way and it also improve the environmental and aesthetic matters of a city.
- 8. After introducing a blue network, Dhaka should be re-planned as a water sensitive city to improve the economy and health of city dwellers.

11. Conclusion

Main focus of the paper is to identify the problems faced by the people of Dhaka city presently and proposed a solution. This study also showed the reason behind proposing the mentioned solution. Unless existing wetlands and water bodies are protected, the drainage system of eastern Dhaka will collapse and many of its areas will be inundated. Our proposal is not only to reduce the inundation areas but also to make the Dhaka metropolitan city as a water sensitive city with better transport system with a convenient way.

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HOUSING CHARACTERISTICS AND LIVEABILITY OF 'LINE HOUSES' IN RAKWANA

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Abstract

In the 19th century, the colonial British sought labour forces of Indian origin Tamils for fulfilling the labour needs of the Estate Plantation sector in Sri Lanka. These communities were provided with housing known as 'Line rooms'. The majority of the migrated workers were single unmarried men and women, so the dwellings were created to fulfil the space needs of one person. But with time plantation sector communities were formed and these units became dwellings for families and extended families. The living conditions of these line rooms deteriorated through the years due to high density of inhabitants, lack of maintenance, and upgrades and unfit for human habitation.

This research explores the residents' perceptions on liveability of line rooms and its housing characteristics. 30 households are observed and interviewed in 3 housing schemes in Rakwana, Sri Lanka. The hierarchy of needs and liveability indicators as perceived by the residents are analysed using the Analytical Hierarchical Process (AHP). The study identifies the most important indicators for 'liveability' based on resident views. Results indicate that dwelling size, sanitary facilities and the household density are critical factors for liveability and need significant attention in the rebuilding of line houses for optimizing liveability.

Keywords: Liveability indicators, housing characteristic, 'line housing', residents' perceptions, AHP

1. Introduction

'Line rooms' in Sri Lanka are the housing schemes which were provided to estate labourers by the estate owners during the British colonial period. There are about 163,580 line rooms and 777,730 population within them all over Sri Lanka and most of them are older than 100 years (Ilyas, 2012). The plantation community or upcountry Tamils, make up for about five per cent (5%) of the island nation's population (Illyas, 2012), and they still live in 'line rooms' that the British constructed for their ancestors. They have no confirmed ownership of these line rooms.

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The social structure of these communities forms the basis for the hierarchy of the physical structure. It follows the South Indian rural social structure. The communities were generally bounded by the caste system. Those who were considered in higher casts such as "Vellalas", "Kallar", "Agamudaiyar", " Maravar", "Naidus", "Reddiars" and "Nairs" were the owners of the first row of line rooms. They did jobs such as factory work and grinding of tea which considered reputable by the majority (Sivathamby, 1995). The workers, who were considered as low caste, live in the dwellings that are away from the bungalow and the factory. This lower caste people of "Pallar", "Paraiyars" and "Sakkiliar" castes, are washers, barbers, sweepers and clothe changers who were at the lowest level of this structure (Radhakrishnan, 2008). The majority of the people in plantation houses are devoted Hindus and their belief has influence on the architecture of their homes.

The physical character and form of "Line rooms" are barrack type structures with limited space where natural light, ventilation and privacy are restricted. The original purpose of such housing was merely to provide accommodation for labourers in the estates and does not address the needs of a family unit. Hence its liveability as a dwelling is in question. 10-15 housing units are attached to each other in a linear arrangement (Illyas, 2012). One unit is approximately 200sqm in area and consist of a large room, which is considered as the living and a narrow corridor at the front door. The construction materials were bricks or stone for walls and Aluminium sheets for the roof with windows of wood and mesh and have an identical exterior appearance. With time, exterior and interior modifications have taken place such as partitions, flooring, and fenestrations to improve the living conditions of the houses reflecting the desire of inhabitants to improve their living conditions and liveability with the limited resources.

The concept of liveability does not have a clear definition but differs from one community to another. Most researchers have reported liveability as a concept that is difficult to define and measure (Wheeler, 2001; Balsas, 2004; Heylen, 2006). However it can be argued that the concept of liveability is determined by the residents' perceptions, based on their lifestyles, culture, religion, economic and social backgrounds. According to Leby and Hashim (2010) liveability dimensions include; social, physical, functional and safety elements. Study by Heylen (2006) identifies liveability indicators as quality of housing, quality of physical environment, quality of the social environment and Safety of the neighborhood.

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The most common problems regarding liveability in line housing sector is infrastructure, lack of space for social life (Kowsalya ,2014; Illyas ,2014) Some other factors are health and education issues, high dwelling or household density, lack of ventilation and lack of privacy (Illyas, 2014; Chandrabose and Sivapragasam, 2015). As per literature review 10 criteria relating to housing characteristics for liveability are identified such Natural Lighting level; Natural Ventilation level; House Size; Sanitary Facilities; Cleanliness of the Scheme; Level of Privacy; Protection; Security in Residence; Household Density; Material Usage (Omuta, 1988; Holt-Jensen, 2001; Visser, vanDam and Hooimeijer, 2005; Heylen, 2006; Leby and Hashim, 2010; Ibem, 2012). But further study is required to understand the resident's views and hierarchy of needs related to their perception on liveability. This is a preliminary study to identify housing characteristics that resident's associate with liveability as a step towards further study on how such characteristics can be incorporated when housing these communities in the future.

2. Methodology

Three cases were explored namely Allerton estate, Madampe estate and Dalveen 'B'in Rakwana, Sri Lanka and a total of 30 respondents (10 from each case) and their households were visited. Respondent sample consisted of both male and female in percentages of 40% and 60% respectively. The respondents had similar degree of educational qualifications.

The main objective of this research is to explore the perception of residents in 'line houses' towards the liveability. Study also explores the liveability indicators, evaluation and current status of line housing and architectural solutions.

Housing characteristics identified in literature are evaluated through the questionnaire as a Pair-wise comparison survey. Questionnaires, Semi Structured Interviews and observations carried out in selected cases were applied for the qualitative and quantitative survey. Quantitative analysis was done following the Analytical Hierarchical Process (AHP) described in next section.

ANALYTICAL HIERARCHICAL PROCESS (AHP): This process is a multi criteria decision making method that was originally developed by Prof. Thomas L. Saaty (1977). The total process reveals the relative weight, consistency check of the details through pair -wise comparison and statistical evaluation. For the purpose of this study only the relative weight analysis was carried out.

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The relative weight analysis consist of three main steps such as,

- i) Pair-wise comparison
- ii) Making comparison matrix
- iii) Priority vectors

All the 10 specified criteria were analysed through this process for the 3 cases separately at the first step. Following which the overall result was evaluated.

3. Results and Discussion

3.1 ALLERTON ESTATE RAKWANA

The responders of the Allerton estate were interviewed and given the questionnaire for exploring their perceptions on liveability. The results of the evaluation of AHP give the final result as follows (Table 1).

Housing	Responder	Natural	Natural	House	Sanitary	Cleanliness	The	Protection	Security	Household	Materia
Estate		Lighting	Ventilation	sizes	Facilities	of the	level			Density	Usage
		level	level			scheme	of				_
							privacy				
							p,				
Α	1	12.91%	21.63%	2.25%	17.26%	19.50%	9.66%	6.30%	5.91%	1.16%	3.43%
L											
L	2	6.01%	4.59%	19.89%	16.85%	1.92%	4.72%	8.48%	17.21%	18.89%	1.44%
E											
R T	3	14.12%	17.48%	16.66%	3.17%	8.22%	11.25%	7.64%	4.86%	14.70%	1.90%
ò	4	4.57%	5.69%	6.17%	16.44%	8.36%	13.18%	2.15%	17.08%	9.15%	17.22%
N	-	4.3770	5.65%	0.1770	10.4470	8.30%	15.18%	2.1370	17.08%	9.1370	17.2270
	5	18.84%	17.29%	10.03%	3.70%	2.79%	3.08%	4.66%	5.32%	28.22%	6.07%
	6	6.75%	15.94%	18.56%	12.82%	14.26%	9.01%	3.57%	1.58%	10.66%	6.85%
	7	15.48%	8.47%	25.50%	9.22%	3.35%	17.30%	6.88%	2.62%	4.98%	6.20%
	8	2.54%	1.32%	19.57%	20.88%	2.70%	16.39%	4.48%	6.91%	17.49%	7.72%
	9	17.14%	18.47%	12.08%	4.63%	2.98%	2.54%	4.26%	5.43%	26.87%	5.61%
	10	11.54%	16.10%	18.19%	18.41%	15.01%	8.37%	3.44%	1.37%	4.91%	2.64%

Highest Percentage for a criteria of an individual

Lowest Percentage for a criteria of an individual





Figure 2, Front view of Allerton estate (Source: Perera Y)

HOUSING CHARACTERISTICS AND LIVEABILITY OF 'LINE HOUSES' IN RAKWANA

House size has awarded the highest number of turns for highest percentage. And house hold density, natural ventilation and sanitary facilities have reacted twice of each as critical factors. Material usage has once marked as critical. But among them, natural ventilation and house hold density also have marked as lowest impact on liveability by one respondent. This has made sanitary facilities more crucial than both of them. On the other hand natural lighting level, cleanliness of the scheme, level of privacy, protection and security have none of highest percentage for high concerned. And the final result can be presented as below (Table 2).

Housing Characteristics	Sum of	Sum of the	Percer	Percentage		
	the	Lowest			-	
	Highest					
			Highest	Lowest		
Natural Lighting level	0	0	0%	0%	6	
Natural Ventilation level	2	1	20%	10%	3	
House sizes	3	0	30%	0%	1	
Sanitary Facilities	2	0	20%	0%	2	
Cleanliness of the scheme	0	1	0%	10%	7	
The level of privacy	0	1	0%	10%	7	
Protection	0	1	0%	10%	7	
Security	0	3	0%	30%	10	
Household Density	2	1	20%	10%	3	
Material Usage	1	2	10%	20%	5	

Highest Percentage for a criteria

Lowest Percentage for a criteria

Table 2, Liveability ranking in Allerton estate (Source: Perera Y)

Three out of 10 view house size as the major housing characteristic that effect on livability. And again two respondents have reacted to sanitary facilities as critical while another two reacted to household density.

Based on residents' perceptions hierarchy of livability indicators in Allerton estate is identified below.

House size> Sanitary facilities> Household density= Natural ventilation> Material usage> Natural lighting> Privacy level= Protection= Cleanliness of the scheme> Security

3.2. MADAMPE ESTATE - RAKWANA

The collected data through questionnaire and interviews carried in Madampe estate led to following results (Table 3).

Housing	Responder	Natural	Natural	House	Sanitary	Cleanliness	The	Protection	Security	Household	Materia
Estate		Lighting	Ventilation	sizes	Facilities	of the	level			Density	Usage
		level	level			scheme	of				
							privacy				
M	1	15.62%	8.50%	25.50%	8.50%	3.80%	17.30%	6.90%	2.60%	5.00%	6.20%
D A	2	14.09%	8.86%	17.93%	19.42%	4.14%	17.56%	3.36%	2.93%	7.45%	4.25%
M P	3	8.61%	7.44%	27.31%	16.26%	3.24%	14.39%	7.47%	2.03%	9.05%	4.20%
A W	4	2.57%	1.33%	19.68%	20.95%	2.77%	16.45%	4.56%	6.30%	17.61%	7.78%
A T	5	5.43%	4.85%	31.43%	19.42%	10.11%	7.31%	2.88%	1.64%	14.02%	2.91%
т н	6	3.11%	3.78%	19.88%	29.36%	9.53%	2.99%	5.09%	1.72%	18.95%	5.60%
E	7	9.17%	6.96%	18.73%	14.00%	6.09%	19.15%	6.32%	0.73%	17.48%	1.36%
	8	4.58%	7.64%	19.31%	14.71%	4.76%	9.81%	21.00%	1.60%	6.16%	10.44%
	9	7.23%	9.46%	3.67%	21.19%	18.05%	6.35%	7.42%	4.36%	20.17%	2.10%
	10	5.72%	8.60%	5.31%	16.96%	15.67%	5.44%	12.69%	5.59%	22.29%	1.73%
	Highest	Percen	tage for	a crite	ria of a	n 🛛	Lo	west Pe	rcenta	ge for a c	riteria
_	individua	al				_	of	an indiv	idual		

PERERA Y.M & COOREY S.B.

Table 3, percentage for each housing characteristic of each respondent

Sanitary facilities are viewed as the most critical factor for liveability followed by house size, privacy level, protection and household density. Security is viewed as the lowest impact on liveability while material usage and natural ventilation getting 2 and one votes as least critical, respectively.



Figure 3, Front view of Madampe estate (Source: Perera Y)

Housing Characteristics	Sum of the Highest	Sum of the Lowest	Percentage		Livability Rank
			Highest	Lowest	
Natural Lighting level	0	0	0%	0%	6
Natural Ventilation level	0	1	0%	10%	9
House sizes	3	0	30%	0%	2
Sanitary Facilities	4	0	40%	0%	1
Cleanliness of the scheme	0	0	0%	0%	6
The level of privacy	1	0	10%	0%	3
Protection	1	0	10%	0%	3
Security	0	7	0%	70%	10
Household Density	0	0	0%	0%	6
Material Usage	1	2	10%	20%	5
Highest Percentag	e for a crite	ria	Lowest	Percentage fo	or a criteria

HOUSING CHARACTERISTICS AND LIVEABILITY OF 'LINE HOUSES' IN RAKWANA

Table 4, Livability ranking in Allerton estate (Source: Perera Y)

The results show that sanitary facilities record the highest percentage which is 40% of the total influence of housing characteristics on livability while security is 70% and the lowest impact on livability based on respondents views. The ranking of these criteria in ascending order from most important for livability to least important is as follows.

Sanitary facilities> House size> Protection = Privacy> Material usage> Household density = Natural lighting= Cleanliness of scheme> Natural ventilation> Security

3.3 DALVEEN 'B'ESTATE - RAKWANA



Figure 4, Houses aside middle alleyway of the Dalveen 'B' estate (Source: Perera Y)

PERERA Y.M & COOREY S.B.

Housing	Responder	Natural	Natural	House	Sanitary	Cleanliness	The	Protection	Security	Household	Materia
Estate		Lighting	Ventilation	sizes	Facilities	of the	level			Density	Usage
		level	level			scheme	of				
							privacy				
							,,				
D	1	3.65%	3.93%	18.63%	29.22%	9.52%	2.99%	6.10%	1.79%	16.61%	7.56%
Α											
L	2	9.29%	6.33%	18.86%	16.23%	5.90%	15.55%	6.04%	2.50%	16.06%	3.22%
v											
E	3	11.92%	16.20%	18.31%	17.67%	14.78%	8.47%	3.57%	1.34%	5.05%	2.69%
E											
N	4	9.89%	15.20%	2.72%	24.28%	16.47%	11.88%	6.11%	3.68%	5.71%	4.07%
'B'	5	8.13%	7.83%	29.35%	13.70%	3.25%	15.73%	7.41%	2.04%	8.45%	4.10%
	6	18.13%	9.87%	17.10%	20.46%	6.79%	12.41%	2.67%	2.38%	6.67%	3.52%
	7	4.20%	17.80%	14.87%	20.05%	11.58%	8.39%	4.08%	1.75%	13.51%	3.78%
	8	7.47%	8.89%	22.81%	13.39%	6.18%	16.16%	4.61%	2.59%	8.69%	9.21%
	9	8.55%	8.28%	26.79%	19.92%	4.14%	13.76	4.70	2.66	6.99%	4.21%
	10	3.96%	7.42%	23.53%	17.27%	3.97%	19.14%	3.57%	4.68%	8.07%	8.39%

The result in Dalveen 'B' estate is shown below (Table 5).



Highest Percentage for a criteria of an individual

Lowest Percentage for a criteria of an individual

Table 5, percentage for each housing characteristic of each respondent

Results reveal that only the house size and the sanitary facilities are critical liveability factor for the residents in Dalveen 'B' estate, based on residents' perceptions. But House size is also viewed as the least important factor by one respondent. Security is the lowest effective housing character towards liveability as per the perceptions of 8 respondents. These results lead to the following liveability ranking.

Housing Characteristics	Sum of the Highest	Sum of the Lowest	Percentage		Livability Rank
			Highest	Lowest	
Natural Lighting level	0	0	0%	0%	3
Natural Ventilation level	0	0	0%	0%	3
House sizes	6	1	60%	10%	1
Sanitary Facilities	4	0	40%	0%	2
Cleanliness of the scheme	0	0	0%	0%	3
The level of privacy	0	0	0%	0%	3
Protection	0	1	0%	10%	9
Security	0	8	0%	80%	10
Household Density	0	0	0%	0%	3
Material Usage	0	0	0%	0%	3

Highest Percentage for a criteria

Lowest Percentage for a criteria

Table 6, Livability ranking in Dalveen 'B' estate (Source: Perera Y)

HOUSING CHARACTERISTICS AND LIVEABILITY OF 'LINE HOUSES' IN RAKWANA

The table data shows that house size is in the first place in ranking having highest percentage of 60%. Security is least important with 80% of lowest percentage. Also except house size, security and protection, none of the other indicators identified as important or relevant to liveability based on residents' views. The ranking if liveability indicators in Dalveen 'B' estate is as follows:

House size> Sanitary facilities> Natural lighting= Natural ventilation= Cleanliness of the scheme= privacy level= Household density= Material usage> Protection> Security

3.4 RESIDENTS PERCEPTIONS IN ALL THREE CASES

Residents' perceptions and views of all three cases show the most important factors for liveability among residents of line rooms. As per the liveability indicators identified through literature and tested among the residents of line rooms the following hierarchy of importance is identified.

House size > Sanitary facilities > Household density > Natural Ventilation level > Level of privacy > Protection > Material usage > Natural lighting level > Cleanliness of the scheme > Security

Housing Characteristics	Sum of the Highest	Sum of the Lowest	Percentage		Livability Rank
			Highest	Lowest	
Natural Lighting level	0	0	0%	0%	8
Natural Ventilation level	2	2	6.67%	6.67%	4
House sizes	12	1	40%	3.3%	1
Sanitary Facilities	10	0	33%	0%	2
Cleanliness of the scheme	0	1	0%	3.3%	9
The level of privacy	1	1	3.3%	3.3%	5
Protection	1	2	3.3%	6.67%	6
Security	0	18	0%	60%	10
Household Density	3	1	10%	3.3%	3
Material Usage	1	4	3.3%	13.3%	7

Highest Percentage for a criteria

Lowest Percentage for a criteria

Table 7, Livability ranking as an overall (Source: Perera Y)

The people in 'line houses' highly prefer house size as the most crucial liveable factor followed by satisfactory sanitary facilities and comfortable household density respectively. Security and cleanliness of the immediate environment are considered least important for liveability. Development or rebuilding of 'line houses' should be concerned on dwelling sizes and sanitary facilities as important criteria for liveability.

4. Conclusion

Liveability of a residential environment depends on the resident's perception, on their living environment. The spatial aspects and housing characteristics have an impact on the perceptions of dwellers and their views on liveability. The study focused on testing some important housing characteristics and tested the residents' views on same. Based on the results the house size is the most important indicator for liveability among the line room dwellers. This is acceptable as the line rooms were not meant for families but single dwellers. As the occupation grew into families and extended families these barrack type structures did not allow for enough adaptations and expansions horizontally or vertically, hence families are restricted within the space and faced with overcrowding. In some instances expansions are done with minimum resources, space, material use and knowledge hence important factors such as privacy, light and ventilation are deprived. As the density of inhabitants grew the infrastructure and facilities still remained the same resulting in poor sanitary facilities and infrastructure of services to serve the day to day needs of the residents. Overcrowding also leads to the lack of privacy. The personal space of individuals and families are hindered and inhabitants are deprived of privacy. The linear arrangement of barrack type dwellings also restricts the light and ventilation into the overcrowded dwellings. The residents' views on most important indicators for liveability are in line with the actual physical conditions and restrictions faced in line rooms. Study further established the need for immediate attention to rehouse these communities in liveable dwellings taking into consideration the family sizes, need for family growth and extended families. The results have highlighted house size, sanitary facilities, privacy and light & ventilation as important factors for consideration in developing the housing for estate workers based on residents' views on liveability.

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DEVELOPMENT OF METHODOLOGY TO ANALYZE ROAD LANDSCAPE OF ACCIDENT BLACK-SPOTS; A CASE STUDY WITH REFERENCE TO SOUTHERN EXPRESSWAY, SRI LANKA.

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Abstract

Driving is an action of humans, which allows him/her motion through space from place to place. The road landscape creates the character and the spatial quality, which is vital to decide the driving safe. 'Southern Expressway', which was introduced recently, allowed people to move quickly from Western to Southern destinations of Sri Lanka and time to time accidents were also recorded. So, the spatial qualities of the existing road landscape might have impacted on the accidents happened on Southern Highway from its initiation. Identification of accident prone areas (Black-Spots) is a vital factor of road safety management process. The study focused on to develop a methodology to analyze road landscape with using a visual analysis in an identified Black-Spots in Southern Highway. Data is collected and analyzed as two phases; one is from recorded accidents data and other from live recording of the expressway driving stretch. In this study highlighted that the possibilities of analyze identified 'Black-spots' by using Photographic analysis method. In conclusion, the study emphasizes that the identified methodology to analyze road landscape can be developed up to more advanced level to identify driving behaviour related Black-Spots and to take mitigatory actions.

Keywords: Road safety, Black-Spot, Driving behavior, Road landscape

1. Introduction

The road accidents are one of the hazardous situation face by the society today, with their development of the roads and infrastructure,. Road traffic accidents are the tenth leading cause of all deaths globally, and as estimated 1.2 million people are killed in road crashes each year and as many as 50 million are injured. If the present trends continues, road traffic injuries are predicted to be the third-leading contributor to the global burden of deceases and injuries by 2020.

Also in Sri Lanka, there was 100% increase of total accidents happened from 1989 to 2005, and 47% of increase of fatal accidents from 1989 to 2005. As mentioned by Somasundarawaran(2006), the road accidents are increased in Sri Lanka as the result of two factors, increases in number of vehicles and very poor development of road infrastructure. So, the annual death rate in the country due to accidents is 12.1 deaths per 100,000 and government spends

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about Rs.1100 million per year for the treatments. Therefore, it is very much essential to mitigate road accidents and ensure road safety.

The term 'Black-Spot' is commonly use in road safety management. In any kind of roads when it is on functioning period, can identify accidents prone areas, which are commonly known as 'Black-Spot'. Accident black-spot defined as 'a place where road traffic accidents been concentrated'. The accidents may have occurred due to variety of reasons and to mitigate road traffic accidents, identification of Black Spots in a roadway is much important.

2. Road Accidents

The roads are planned routes or ways which allow people to travel between two places by different modes, earlier by horse, cart etc. and later by motor vehicles. The road accidents are unplanned and uncontrolled event which can be occurred on the road with the public traffic, which may leads to personal injuries, property damages and loss of human or animal life. The road traffic accidents are increasing day by day becoming a threat to public health and national development of the country.

3. Factors affect to Road Accidents

The road accidents are influenced by major three categories, the human factors, the physical factors and the environmental factors.

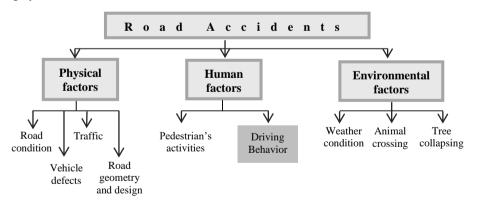


Figure 1 - Factors determine Road Safety

So, this research is focus on the relationship of driving behaviour to road accidents.

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3.1 DRIVING BEHAVIOUR

Driving is an activity which is always attached with the outdoor environment. Drivers always make their driving decisions depends on what they have seen on the outside road environment. As R. Kaplan and Kaplan says in the book 'The experience of nature: a psychological perspective' (as cited in Antonson , Mårdh, Wiklund, & Blomqvist, 2009, P.494), "people often appreciate the visual experience of nature more than that of the built city". It further explains people experiences. It is also found that most of anthropogenic activities are the results of what the human eye perceives from the surrounding landscape.

Many studies have found that the fatigue, drowsiness, vigilance, alertness, activation and arousal are the frequently occurring processes with the visually perceived information from the environment when performing the driving. Therefore, the effective action of driving depends on the individual's visual perception.

3.2 DRIVING BEHAVIOUR AND VISUAL PERCEPTION

The term 'visual perception' is explained as, the ability of the user to gather the information provided to completing the communication exchange. The information should be collected at the proper time, so that the driving decisions can be implement safely and efficiently. Therefore, visual perception of the driver creates a huge impact to the driver behaviour. The safe use of any roadway is depend on visual perception. According to the visual information gathering, we try to understand our surroundings, experience the places and perceives what is happening around our environments.

The visual information collected by the brain create sensible scenes that we can understand and negotiate. As visual information becomes more complex, we may lose some of the sense of order and scenes becomes more difficult to understand. That difficulty may lead to confusion and sometimes hazardous situations.(Schutt, Phillips, & Landphair, 2001)

So, the driving behaviour is depending on the level of perceiving information by the driver. According to the scenes of road landscape provided the driver has to face many severe consequences, such as fatigue, vigilance, activation etc.

3.2.1 Fatigue

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Fatigue, is a general incident which emerges as a function of the driver and environment relationship in the particular driving environment. Fatigue reflects the decreased capacity to perform in driving, along the road environment. Fatigue considered as a major factor in accidents which is responsible for upto 20-30% of road fatalities.

Generally, fatigue can interpreted as the transitory period between awake and sleep, if undisturbed can lead to sleep. (Lal & Craig, 2001). The general causes of fatigue and drowsy are generated by perform driving through monotonous driving environments.

3.2.2 Vigilance

Vigilance, is identified as the ability to maintain sustained attention within the road environment. The characteristics of both the driving task and road environment influence to vigilance. Driving requires sustained vigilance to perform at its best, and a lack of visual, motor or cognitive stimuli can alter the ability to sustain vigilance. Drivers experience Hypovigilance more frequently in monotonous environments, especially when driving on highways.

3.3 DRIVING BEHAVIOUR AND ROAD ENVIRONMENT

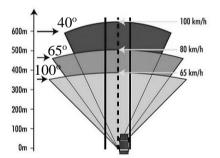


Figure 02 - Speed and field of vision Source: The Role of Road Engineering in Combatting Driver Distraction and Fatigue Road Safety Risks,(2015)

Driving is a visual experience of outside driving environments. The drivers limits their visual experience mainly to the larger spaces and land forms, because the drivers always focus on the narrow band created by the road. But, drivers may interested to expose to a broader visual field even for a brief moments. But the increasing speed reduced the visual field. The movement of the driver creates views, dynamic which gives different experience of the road landscape. At about 65km/h speed

driver can observe about 100^{0} degrees and the focal point is near 400m, if it's increase to 80 km/h about 65^{0} and focal point near 500m. When the speed is 100 km/h the field of vision become narrower to 40^{0} degrees and the focal point go beyond 600m. That clearly demonstrate that when the speed is increased the field of vision of the driver is narrowing, but the driver focusing on to more distance views.

DEVELOPMENT OF METHODOLOGY TO ANALYZE ROAD LANDSCAPE OF ACCIDENT BLACK-SPOTS;

Landscape is mainly a visual experience when travelling by a vehicle. So, the roads and highways should have a visually pleasing environments. The landscape of roadside environment should be considered when designing roads and highways. The main goal of road landscaping is to produce roadways to high safety standards which will also aesthetically integrate with the environment. (Matijošaitienė & Navickaitė, 2012) It creates driving into a pleasurable activity as well as ensuring safety in drivers' perspective. With the speed of the driver is moving, the visual information gained from the road environment is more important and it decide the safety of the roadway. It is found that "an aesthetically pleasing roadway will most likely be safer and that safer roadways are usually more aesthetically pleasing". (Schutt et al. 2001)

The experience of road landscape may affect drivers in many different ways. More natural environments reduce stress. It is apparent that certain open spaces appeal to people and are experienced as relaxing and therefore safe. (Antonson et al., 2009). Addition to that the study indicates, the spatial form of a road or street should give clear visual guidance and signals to drivers regarding suitable speed and driving behaviour. The aim of the aesthetic design in the roadside environment is to maximize the safety and efficiency of the transportation function as well as create a memorable and pleasurable experience to the users.

4. IDENTIFICATION OF BLACK-SPOT - METHODOLOGY

The Southern Expressway, Sri Lanka selected as the case study to research, since it has highest 'Average Data Traffic(ADT)' among current expressways in Sri Lanka. Although it records the highest number of accidents than other two highways. This study have identified two Black-Spots in two directions of the expressway, and suggest a methodology to analyze the characteristics of road landscape through a visual analysis.

In the study, the data collection and analysis has been done with two phases.

Phase 01 - Recorded accident data collection & Analysis on Southern highway

Phase 02 – Field data collection & Analysis

Human Factors	Physical Factors	Environmental
		Factors
Alcohol - 15	Vehicle defects - 293	Bad Weather - 527
Bad Driving- 396	Electrical Problems-30	Animal crossing -408
Fatigue - 316	Stone throw/hit - 127	
Negligence - 146	Other objects - 7	
Overtaking - 168	Road slippery - 14	
Sudden Stopping- 29	Fire - 1	
Speed - 113	Others - 9	
Reverse - 3		
Driving B	Southern	Database EOM & M division- Highway, compiled by author

DHARMASENA. S.R. & EDIRISOORIYA ARACHCHIGE. T.S.

Table 1 - Accidents by cause in southern highway

4.1 PHASE 01 - RECORDED ACCIDENT DATA

Related Accidents

Southern Expressway was the first expressway to the country, which was opened on November 2011. It runs 126 km from Kottawa to Matara with 11 interchanges, connecting Western province and Southern province.

From 2011 November to 2016 February, there were 2602 accidents were recorded, which were caused to eliminate valuable human lives and huge property damage to the country.

In the analysis of recorded accident data, they divided into major three categories, accidents caused by Human Factors, Physical Factors and Environmental Factors.

This study focuses on to analyze the accidents caused by driving behavior. The accidents caused by Bad driving, Fatigue and Negligence consider as the causes for driving behavior related accidents, contribute 32% of total accidents happened in Southern Highway.

Then the driving behavior related accidents on one direction are analyzed according to the interchanges by using a chart below.

DEVELOPMENT OF METHODOLOGY TO ANALYZE ROAD LANDSCAPE OF ACCIDENT BLACK-SPOTS;

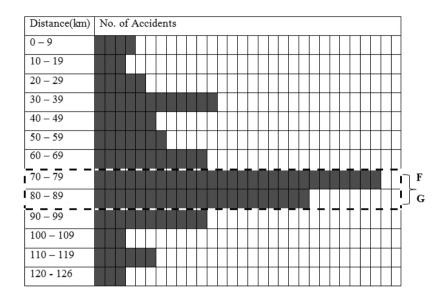
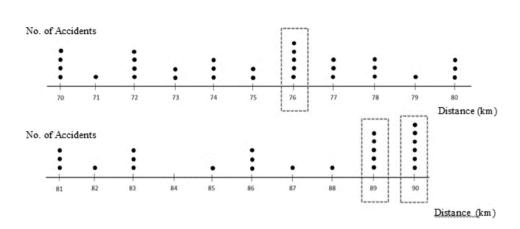


Figure 03 - Black- spot identification chart, most accidents in Colombo to Matara direction (*Source: compiled by author*)

	Distance	Interchange		Distance	Interchange
A	0-6 km	Kottawa- Kahathuduwa	F	68-80 km	Kurungugahahetekm a -Baddegama
B	6-14 km	Kahathuduwa- Gelanigama	G	80-96 km	Baddegama- Pinnaduwa
С	14-35 km	Gelanigama- Dodangoda	н	96-108.4 km	Pinnaduwa-Imaduwa
D	35-46 km	Dodangoda- Welipenna	Ι	108.4- 116.3km	Imaduwa- Kokmaduwa
Е	46-68 km	Welipenna- Kurungugahahetekma	J	116.3-126 km	Kokmaduwa- Godagama

Table 2 - Interchanges in	n southern highway
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From above chart it can be identified that most number of driving behavior related accidents are concentrated between Kurundugahahetekma- Baddegama interchange and Baddegama – Pinnaduwa interchange. So, between those two interchanges, a 'Dot-Density measure' used for identify the accident Black-Spots. Dot density measure is done by placing the recorded accident locations in every kilometer distance by a dot.



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Figure 04 - Dot-Density measure to identify black spots, Colombo to Matara direction (Source: compiled by author)

According to the above chart 76th kilometer and 89th-90th kilometers identified as Accidents Black-Spots due to driving behavior related accidents in Colombo to Matara direction.

4.2 PHASE 02 - FIELD DATA COLLECTION AND ANALYSIS

A driver experiences the road landscape as a movie, or series of photographs changing in a very short time period, because they are moving along a roadway to one direction in higher speeds. When the surrounding road landscape of the driver remains repetitive or without any stimuli, consider as monotonous road landscape. So, the monotony of the road landscape lead the drivers to fatigue and less attentive. It seems the significant methodology developed to identify the driver fatigue with reference to road landscape is almost matters but not seriously thought of. Therefore, this study tries to develop a methodology also to analyze road landscape with referring to driver fatigue.

The field data collection has been done when travelling in a car starting from Kottawa interchange upto Godagama interchange (Matara). The entire driving environment has recorded using a digital camera mounted in front of the driver's seat.

The video recording of the driving stretch then converted to the series of photographs and they used to identify the characteristics of the road landscape. So, the identified Black-Spots above, have been analyzed by using the photographs taken from the live video recording of the driving stretch.

DEVELOPMENT OF METHODOLOGY TO ANALYZE ROAD LANDSCAPE OF ACCIDENT BLACK-SPOTS;

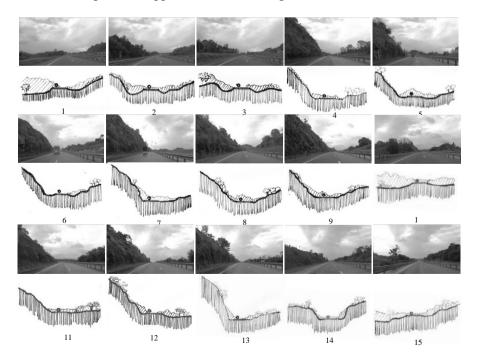


Figure 05 – Sample photograph from the video recording (Source: compiled by author)

These kind of series of photographs will captured by the driver while on driving along an

expressway. The road landscape is not changing very much or keep on repetitive create same series of photographs for a while. That scenario leads drivers to fatigue or many other driving behaviour related issues. So, in a study related to the road landscape and driver fatigue, can use series of photographs to analyse with supporting some other spatial plans, sectional diagrammes and road sections.

The below figure 06 shows that a part of an analysis done as a visual analysis of road landscape with related to driving brehaviour, used series of photographs of road landscape with support of sectional diagrammes, sections etc.

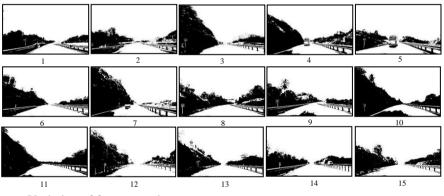


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- Mostly enclosed with the left side rocky surface.
- First 3km stretch create monotonous environment
- Sudden exposure to open low lands
- Next, 3km stretch with enclosed soil slopes
- Low composition of enclosed spaces & open spaces
- Create uncomfortable, monotonous driving experience leads drivers to fatigue.

Figure 06 – Sample of the application of photograph analysis method in identified Black-Spot (Source: compiled by author)

The above analysis indicate that the variation of enclosure effect of the road landscape along the identified Black-Spot in Colombo- Matara direction.



- Variation of forms very less
- Create monotonous visual forms in the landscape
- Causes to fatigue & hypo-vigilance.

Figure 07 – Sample of the application of photograph analysis method in identified Black-Spot (Source: compiled by author)

Another application of photographic analysis of road landscape, used to identify the form variation of the roadside landscape.

5. Conclusion

This paper presented only a sample of two phases of the study, due to the scope and the limitations of the research conference. From this study, it is emphasize that the identified methodology of 'visual analysis of road landscape', can be developed in a more advanced manner to analyze fatigue and other driving

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behaviour related accidents in Black-Spots. Also, it is recommended that the visual analysis of road landscape should be incorporate to the planning, designing and construction stages of the expressways in the country.

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STRIKING A BALANCE BETWEEN THE VISIBILITY OF LANDMARKS AND THE DEMAND FOR DEVELOPMENT: THE CASE OF SRI JAYAWARDANEPURA PARLIAMENT SURROUNDINGS

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Abstract '

Landmarks' which is one of the five elements those contribute to the city image, as first explained by Kevin Lynch, can be manipulated strategically to enhance the visual quality of urban environments. Landmarks are point references and their key physical characteristic is singularity which can be derived by maintaining background contrast. Urban Planners adopt various regulatory measures such as height restrictions and development control guidelines to maintain singularity of landmarks but they are mostly arbitrary and not methodologically derived. They are challenged in situations where the pressures for development is high and the real estate market conditions do not justify such controls. This paper presents a similar situation in Sri Jayawardanepura new capital city of Sri Lanka, where as a policy decision of the government, the prominence of the Parliament complex had to be preserved amidst enormous demand for developments. This paper presents a scientific methodology to handle this situation enabling physical developments to get to the optimum while maintaining the prominence of the Parliament complex. Visibility Analysis, which is an Isovist technique, based on the concept of the Imageability, was adopted to develop a methodology to propose the development types and the height controls in the vicinity of a landmark. Results indicated that such scientific approaches enable to liberate considerable extents of lands for development, which otherwise were restricted on arbitrary controls, as well as some new controls, without which the intended prominence of the landmark features wouldn't have been preserved.

Keywords: Landmark, Development Pressure, Visual Prominence, Visibility Analysis

1. Introduction

Cities, the place where people live is a construction of space of vast scale and in fact it is being constructed or built by people in the means of little modifications done by them for their own reasons over time since the inception of cities. At the same time, cities are perceived and lived by millions of people

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thus there is a two-way interaction in between people and cities. Even though the city experience differs from person to person based on the personal experiences, attachments and memories, yet there is an overall mental image shared by all. (Lynch, 1960) Visual Quality of a city is an important aspect with regard to the mental image of a city, as what is being seen (visual experience) largely contributes to build up a mental image. Legibility, imageability and identity of cities are main components which need to be maintained in order to preserve the visual quality of a certain city environment.

As first explained by Kevin Lynch in 1960, there are five types of physical elements which contribute to maintain legibility, imageability and identity of cities. In that case these five elements; paths, edges, districts, nodes and landmarks can be explained as the main five physical elements which can be manipulated strategically to enhance the visual quality of urban environments. Landmarks, which is one of the five elements are essential features of a city as they have a strong influence in making a city more legible and imageable while preserving its identity and enhancing visual quality. Landmarks, which are point references are not experienced individually but in relation to their surroundings, thus when using landmarks to enhance visual quality of an environment, it is important to manage both the characteristics of the landmark itself and the surrounding elements. At the same time there is a huge impact made by a certain landmark to its surrounding environment as it adds value and character to the surrounding lands in the vicinity.

However, there are multiple actors who individually operate within surrounding lands of such landmarks, making modifications to the environment which may result in conflicts with the expected character and value attached with the particular landmark. In order to avoid such conflicts, urban planners make different planning interventions through regulatory measures such as height restrictions and development control guidelines in the vicinity of city landmarks in order to visually emphasize them in their background contexts. But in many cases these regulatory measures are taken arbitrary as there are no scientific analysis methods to backup and guide these regulatory measures. Therefore, mostly these regulatory measures are challenged in situations where the pressures for development is high and the real estate market conditions do not justify such controls.

This research attempts to study a similar situation in Sri Jayawardanepura new capital city of Sri Lanka, where as a policy decision of the government, the prominence of the Parliament complex which is a significant landmark of the city, had to be preserved amidst enormous demand for developments in surrounding lands. Further the research attempts to develop a scientific

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methodology known as Visibility Analysis in order to handle this situation enabling physical developments to get to the optimum while maintaining the prominence of the Parliament complex as the most prominent landmark. Second chapter of the paper briefs the methodology and the research process. The third chapter present a summary on literature done on this while fourth section illustrates the proposed scientific method with its application to the case of Sri Lanka Parliament at Sri Jayawardanepura Kotte. Final section of the paper presents the findings of the applied method in the particular case.

2. Methodology

This study basically adopts mixed approach of qualitative and quantitative methodology. In the first section of the study, qualitative approach was undertaken with documentary search as the primary method of data collection. It was intended to identify the importance of maintaining Visual Quality of a city and the role of 'Landmarks' in doing that. Further it was explored the characteristics of landmarks and the methods adopted to maintain the prominence of landmarks within an urban setting. As the second part of the literature review, it was studied about the available technical methods to analyse the visible areas, and how to enhance the visual quality in vicinity of a 'landmark'. Then a technical method was derived based on spatial analysis methods to propose the development types and the height controls in the vicinity of a landmark. The proposed technical method was applied to the case of Sri Lanka Parliament at Sri Jayawardanepura Kotte where there is a conflict in between the demand for dense urban development and the need to preserve the prominence of the parliament complex which is a significant landmark of the area. In this regard, a thorough case specific literature survey was conducted to understand the perceived character of the parliament and surrounding area as proposed in its original design and to analyse the existing rules & regulations adopted by Planning Agency, Urban Development Authority to preserve the said character. Further a situation analysis was conducted with relation to the specific case of Parliament of Sri Lanka, in order to identify the existing issues in the practical application of those rules and regulations and their adverse effect to the real estate market in the surrounding lands. As the final stage, the findings of the technical visibility analyses were used to propose a land use & height control model which can be used as a guide to enable physical developments to get to the optimum while maintaining the prominence of the Parliament complex as the most prominent landmark.

3. Literature Review

Visual quality of a certain environment has a direct impact to the city image as the visual experience has a strong influence for the mental image that one may have on a particular city. There are many aspects of visual quality and at the

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same time they have a strong influence in maintaining legibility, imageability and identity of a city. Legibility; the apparent clarity of the cityscape, imagebaility; the quality in a physical object which gives it a high probability of evoking a strong image in any given observer and identity; the identification of an object, which implies its distinction from other things and its recognition as a separable entity (Lynch, 1960) are three main components which can be enhanced along with different aspects of visual quality. As first explained by Kevin Lynch in 1960, there are five main physical elements which contribute to build up the city image. Even though Lynch interpreted these five elements as contents of city image, they can also be manipulated creatively to enhance the visual quality of a certain city environment. Among the five elements; paths, edges, districts, nodes and landmarks, landmarks play a significant role in creating the city image as they strongly influence the visual experience.

Landmarks are a type of point-references which are simply defined physical objects such as buildings, signs, stores or mountains. (Lynch, 1960) Landmarks can be either man-made or natural elements which get their value due to socio-political reasons or for their aesthetic quality or ecological value. The key physical characteristic of a landmark is singularity which means singling out of one element from a host of possibilities. This enables the landmarks to be unique or memorable in the context. The other characteristics of 'landmarks' are that they are easily identifiable, more likely to be chosen as significant, have a clear form and contrasts with the background. The principle factor which brings out singularity in landmarks is the figure – background contrast thus it is one of the primary design concerns of a landmark. (Lynch, 1960)

Maintaining the prominence of landmarks within an urban context which is subjected to a series of continuous changes caused by various agents, is a significant challenge in urban planning. Therefore, several planning regulatory measures such as height restrictions and development control guidelines are imposed by planning regulatory bodies in the vicinity of prominent city landmarks. But the limitation attached with these regulatory measures, is that they are determined arbitrary without any scientific or logical backup. Jie et al (2005) explained that there is no scientific tool which can provide satisfactory accuracy, efficiency, reliability, and validity to analyze and visualize relevant data and therefore, the visual landscape protection premises, analysis and implementations are only based on personal experiences and manual operations, or even guessing and casual drawings.

Freezing of developable space in order to maintain the prominence of city landmarks becomes a critical decision in an urban context, where there is a

significantly high demand for developable space in the real estate market. Therefore, there is a need for a systematic method to analyse the visual contexts and to recommend the optimum levels of developable land extents and heights while maintaining the visual access and prominence of city landmarks.

In this regard, various technical analysis methods have been proposed internationally. Oh (2001) pointed out that there are also scientific systems established for development assessment which aims at achieving predefined subjective criteria like protecting important natural landscape resources. Most of these analysis methods come under the purview of visual context analysis and visibility analysis, view shed analysis and seen – area mapping are some of such analysis methods discussed in literature and in the practice of landscape planners and designers. As Jie (2005) explained, visual qualities and lines of sight have been a part of human activity, settlement building, military defence, hunting and agriculture since prehistory as there are evidence which suggests that ancient civilizations had constructed important edifices with respect to various lines of sight and visual access. Jie (2005) further elaborated that the construction of the city of Rome and early Italian hill-towns has been theorized to have been influenced by established lines of sight, and the development of visual prominent locations and that contemporary archaeological investigations have used various computer-mapping techniques to analyse prehistoric constructions for line-of-sight determinants in the landscape, theorizing that site locations were at least partly based on visibility of other monuments or prominent landscape features (Christopherson and Guertin, 1996; Wheatley, 1995)

Visibility Analysis is a relatively recent undertaking as it has been in the practice for nearly forty years. Kevin Lynch highlighted the importance of view analysis and available methods in terms of "visual absorption", "visual corridor" and "visual intrusion". View Analysis was first introduced by Tandy in 1967 and this research gave rise to the development of a multitude of methods for quantitative analysis of space perception. View analysis is an 'isovist' analysis which measures a volume of space that is visible from a single point in space. Consequently, Benedikt introduced a set of analytic measurements of isovist properties in 1979. As Koltsova (2013) elaborates, quantitative methods for visibility analysis can be roughly divided into the following categories: a) scientific landscape evaluation (LE) provides methods for 'quantitative description of natural landscape visual quality or impact prediction' (these approaches do not consider human perception); b) methods

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such as 'isovist' concentrate on the visibility of an environmental element from a fixed vantage point and neglect the landscape resources (He et al., 2005).

In these visibility analysis applications, information technology (IT) and geographic information system (GIS) support are indispensable (Ervin and Steinitz 2003, Llobera 2003). In the fields of landscape architecture and planning, there is a similar concept called "viewshed" (Turner et al., 2001). In 'viewshed' analysis, it analyses the visibility of an environmental element from a fixed vantage point. According to Felleman (1979), the viewshed is the area of land, all of which is visible by unimpeded line of sight, from a single point, analogous to the spill-point of the watershed. Technically, viewshed calculations are usually performed with GIS software, based on raster (gridded) or triangulated (TIN) terrain surfaces, specified viewer-position(s), and some number of parameters which may include viewer height, and height and opacity of intervening objects or land uses. (Ervin & Steinitz, 2003)

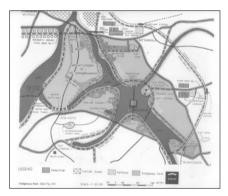
Given the summary of literature reviewed, this paper attempts to combine a few types of visibility analysis methods available as applicable to a specific case study, without being confined to a single analysis method.

4. Visibility Analysis for Sri Lanka Parliament at Sri Jayawardanepura Kotte

The parliament of Sri Lanka is located at Sri Jayewardenepura Kotte, which is designated as the Capital City of Sri Lanka. It is located nearly 16 km East of Colombo, the commercial capital of Sri Lanka. During the period of 15th to 16th century, Kotte flourished as a grand city with a royal ambience, as it was then the capital kingdom of Sri Lanka. Even though soon after independence Colombo was designated as the administrative capital of Sri Lanka, declaration of Sri Jayewardenepura Kotte as the new capital of the island in 1980s with the establishment of new parliament building, enabled Kotte to regain its royal prestige. The design of the Parliament building at Kotte was done by the famous architect, Archt. Deshamanya Geoffrey Bawa. As per the Original design concept of the parliament complex, it emphasizes that the design intends to make the parliament a prominent land mark in the capital city resembling the royal character and Sri Lankan natural landscape. Monumental architecture of the parliament building, along with its surrounding green landscape blended with Diyawanna lake, resembles the said character of a royal garden.

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The design inception of the parliament elaborates that, 'The cultural grove will be crowned with a new Parliament at the center of the lake. It will comprise a building complex of traditional roof styles approached by a North South causeway across the lake. A bridge at the southern end forming a service and security access will link the island with state drive'. (Sri Lanka's New Capital – Sri Jayawardenapura, 1982) Parliament complex is built at an island called Diyawannawa which is in the extent of 5 hectares in Diyawanna oya. With the construction of new Parliament complex at Kotte, the master plan in effect for the area at that time, provided required guidelines to maintain the anticipated character within the area as perceived in the original design. "The designed environment must be built carefully, and its growth controlled and maintained to avoid de generation. This arduous task of building, controlling development maintenance and social welfare should ideally be the responsibility of one administrative authority. It maximum benefit from the possibility of coordinating the work of the several authorities will have to be given careful thought by the government. As the city environment is influenced by the environment of its region it is recommended to exercise development control over the activities in the inner zone of influence also, by the same authority controlling the city. At least a mile wide (1.6 km) belt external to the city boundary is recommended for considerations as the inner zone of influence needing strict development control by the capital administrative." (Sri Lanka's New Capital – Sri Jayawardenapura, 1982)



Even though a buffer zone of 1-mile radius from Parliament complex was initially declared as a special regulation zone with a maximum height restriction of 27 ft., this regulation was later amended due to issues in practice such as some areas falling within the declared zone not having any physical or visual connection with parliament complex due

Figure 01: Design of Parliament at Kotte

to variations in topography and complaints for human right violations due to rigidness of regulations etc. The existing height and development regulations applicable to the area are as follows.

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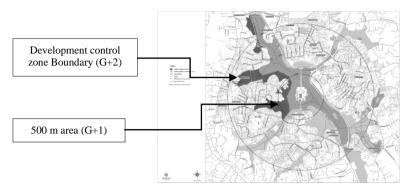


Figure 02: Existing UDA Height Restrictions at Parliament Area

A buffer radiating 500m from Parliament complex is allowed with the maximum height of G +1. A manually demarcated area based on physical features falling within an approximate buffer of 1500m is allowed with the maximum height of G+2. The combination of both these demarcated zones is known as the High Development Control (HDC) Zone.

HDC zone was declared by the Urban Development Authority, which the regulatory body responsible for maintaining the character of the area. However, in the present context, limiting the development space of such a highly valued land has become a challenge and point of critique that needs to be evaluated with a scientific approach. The present land values of the vicinity of the parliament area varies from lkr 1,300,000 to lkr 6,700,000 per perch. Therefore, currently there is a significantly high land demand specially for high rise dense developments. However due to existing regulations in practice, it has made a huge impact to the real estate market within the area, challenging the arbitrary nature of the existing regulations and demanding a more scientific and logical evaluation of the optimum developments that can be allowed in the area. Accordingly following visibility analysis methodology was developed in order to address the above requirement of the case of parliament of Sri Lanka.

Visibility Analysis for Parliament Surrounding Area

1. Selection of Observer Points

Initially a View shed analysis was carried out to find the Parliament visible area. Accordingly, a set of points which are encircling the parliament were selected within the parliament visible area. Then a Line of Sight analysis was conducted to select the points which have a direct view access to the J.N. MUNASINGHE, RANASINGHE. D.A.S.M & DHARSHANI. G.C.

parliament. As a result of the two initial analysis, fourteen number of Observer Points were selected to conduct the Visibility Analysis.

2. Identification of the Maximum Allowable Building Heights (without considering the Topography)

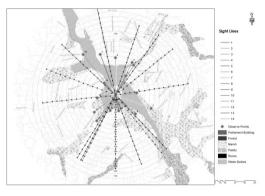


Figure 04: Maximum allowable surface height along line of sights

After selecting the Observer Points, sight lines were created from each and every point to find out the maximum building heights that can be allowed as they are not visible in the background of the parliament when observed from the selected points. The creation of sight lines and measurement of building heights were done using Auto CAD software. As a result of this basic step, a map containing the maximum allowable building heights from Mean Sea Level was produced. In this analysis, the height of the parliament was considered as MSL + 24m and the observed height was considered as MSL + 1.5m.



Figure 03: A sectional view of an observer's line of sight

3. Identification of the Maximum Allowable Building Heights by considering the overlapping View Directions

One of the limitations identified in the second step of the analysis was that a single point can have different maximum building heights when observed from different points. In order to avoid this limitation, a simple correction method was applied where the two side lines of 30 degrees' human visible angle were

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also considered from each and every observer point in order to derive maximum building heights, instead of considering a single line of sight.

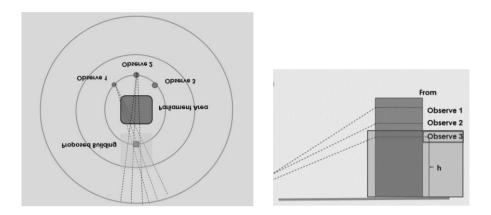


Figure 05: Plan and sectional view of overlapping Lines of Sight

4. Creating a Surface using Maximum Building Heights (without considering the Topography)

A Digital Elevation Model (DEM) was created using Arc GIS software based on the minimum building heights of each point which were derived from the previous analysis. This DEM indicated the maximum allowable surface heights from the Mean Sea Level within the parliament surrounding area.

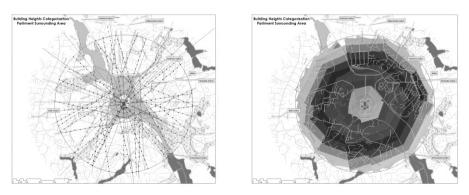


Figure 06 & 07: Maximum allowable surface heights from the Mean Sea Level

5. Identification of the Maximum Allowable Building Heights by considering the Contours

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For the convenient practice, instead of giving the maximum surface heights in terms of MSL, the maximum allowable building heights were found out considering the existing topography levels. As a result, a map indicating the categorized maximum allowable building heights was produced.

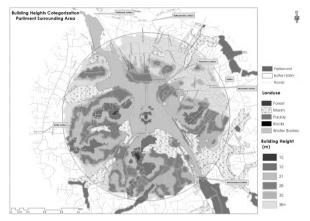


Figure 08: Categorization of Maximum Building Heights

6. Demarcation of parliament special character conservation zone

It was identified that in order to maintain the special character linked with royal ambience and Diyawanna Oya landscape, the height limitations derived in the previous step alone would not be sufficient. Hence, a 100m buffer from Diyawanna Oya was given a special height limitation of 3.5m, in order to preserve the special character and sense of place linked with Diyawanna Oya water space. A View Shed analysis was conducted to identify the critical visible area from the Parliament, and a height limitation of 9m was applied to the said areas based on the existing canopy height. The final map indicating the categorization of Maximum Allowable Building Heights is as follows.

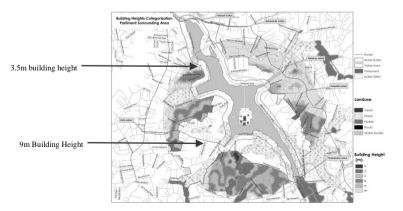


Figure 09: Final Categorization of Maximum Building Heights with Buffer Zones

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5. Results, Discussion & Way Forward

As a result of this study, the optimum building height that can be allowed without effecting the perceived character of the parliament area was derived. Accordingly, it was realized that there is a considerable amount of space which can be released for high dense development, even though they are limited with the maximum building height of G+2 as they are coming under the HDC zone as per the existing regulations in effect. This provides the opportunity to release a considerable amount of highly valued land, which has a high demand for high dense development. Therefore, the proposed Visibility Analysis method is a logical and scientific solution to address the existing conflicts in between the demand for development and the need to preserve the character of the area. At the same time, this study revealed the critical area at the vicinity of parliament complex, which needs special attention with strict height restrictions as they have a direct impact to preserve the special character of the area in terms of visibility aspects.

The proposed Visibility Analysis Method can be adopted to preserve unique visual qualities of environments surrounding prominent city landmarks of ecological, aesthetic and socio-political importance such as mountain view of Ella, Nuwaraeliya & etc., Ethugala of Kurunegala and heritage character of Sri Daladha Maligawa at Kandy. Further to that similar types of analysis methods can be developed in order to provide guidelines to preserve other visibility aspects such as landscape design, permissible uses and activities, architectural character and building colour codes with a more scientific base.

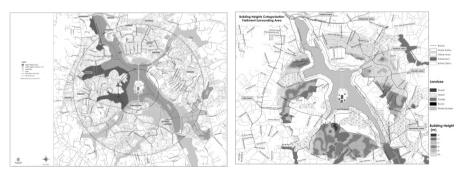


Figure 10: Comparison of Existing and Proposed Building Height Regulations

J.N. MUNASINGHE, RANASINGHE. D.A.S.M & DHARSHANI. G.C.

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EDUCATION FOR BEING: TOWARDS A METHODOLOGY FOR CULTIVATING EMPATHY

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Abstract

There is a call among researchers and educators to cultivate empathy through the education system. They argue that narration and storytelling as a pedagogical tool has a big role to play in the clarification of academic subjects. In this regard, as a focus of this paper, the travel course ENDS 2361 Field Experience I at the Faculty of the Built Environment of Uganda Martyrs University is being discussed. The research method involved an online survey to find out how decisions students took by themselves contributed to the sum of their encounters, while face-to-face sessions focused on a review of the course in as far as its delivery impacted their learning and awareness of the wider context of people, place and the environment. Findings show that students began to associate with interrogating what culture is and its link to local community and later what this might mean when it comes to issues to do with participation and engagement. In addition, students appreciated the team effort in the multiple media and tools used in collectively expressing themselves. The paper therefore delves into how this process impacted the students and how we could build on this to cultivate empathy.

Keywords: Travel, Empathy, Education

1. Introduction

Having changed its name from the Faculty of Building Technology and Architecture, it is now over fifteen years since the Faculty of the Built Environment (FBE) at Uganda Martyrs University was established. The first programmes were the BSc Building Design and Technology and the Bachelor of Architecture, which were later, changed to the Bachelor of Environmental Design and the Master of Architecture (Professional).

Our multidisciplinary curriculum is designed to foster critical and creative thinking, to enable students and graduates to engage with the environmental, social, and aesthetic challenges of the contemporary milieu. Most courses in the Faculty are taught through a problem-based integrated teaching approach, that integrates design with the techniques and practices of construction, structures, materials and building services,

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all within a theoretical and historical context, keeping in mind human needs (social, physiological and cultural). (Uganda Martyrs University Faculty of the Built Environment student handbook and outline of courses 2016 - 2017 pp 1)

The FBE deliberately set out to always be at the forefront of architectural education in the region. The changes were necessary to accommodate an understanding of the profession beyond just *a* building, as some seem to take it; as such, embracing the wider environment and associated context as part of the complexity of contemporary society.

Learning from existing (un)built environments is particularly important in the formation of built environment professionals. Also important, is the role of experiencing different cultures and ways of life (as distinct from architectural objects) as part of the appreciation of the development of (un)built environments. (Uganda Martyrs University, Faculty of the Built Environment student handbook and outline of courses 2016 - 2017 pp 46)

The paper thus, focuses on the importance of encounters through travel in as far as accounts of these can cultivate empathy. This is done through the appreciation of urbanising environments in the context of their people, geographies and development. It is situated within the concept of narrative thinking, and Gerards' and De Bleeckere's (2014) definition that: "it is a design attitude, which stimulates the involvement of the final user." And, given the design component of any architectural programme it is imperative that this context is integrated in the pedagogy.

The importance of travel and the use of narratives are emphasised in the course ENDS 2361 Field Experience I at the Faculty of the Built Environment of Uganda Martyrs University. Nazidizajia, et al (2015) reiterate that researchers have argued that narration and storytelling as a pedagogical tool has a big role to play in the clarification of academic subjects especially considering the successful experience of using the method in other academic disciplines.

2. Rationale

Architecture must grow out of everyday life, it signifies how a person understands nature, other people, and even oneself. At present, part of the population, fortunately the smaller one, neither understand themselves, nor the others around them; they emphasize their own rampant individualism, which rejects or even diverges from the natural environment. (Šafránková, 2006)

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In their paper, Lapadula and Quiroga (2012) for example, identify the importance of cultural heritage and the need to introduce it at an early stage in the teaching and learning of architecture. They argue that while raising awareness about the current state of affairs, cultural heritage necessitates reflection about the context of practice with the view of engendering a deeper understanding of society and the environment. A key consideration is how teaching and learning can be delivered effectively then.

Reflecting on the work of Pierre Bourdieu whose writing on socialisation in education sustains the discourse around how and why education is pursued and the role of educators in this pursuit and; the Jungian epistemological balance, where an opportunity to harness the functions of thinking, feeling, sensing, and imagining both individually (introverted) and collectively (extroverted), this paper sets out to reemphasise key considerations for teaching and learning.

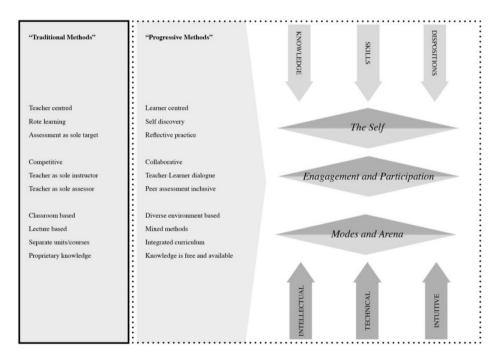


Figure 1: Conceptual framework on broad-based teaching and learning pathways developed further from Biggs and Tang (2011) and Angélil (2003)

Generally, teaching and learning in Higher Education is organized around three themes – Knowledge, Skills and Dispositions. In the context of architectural education the three equivalent themes include the: Intellectual, Technical and

Intuitive. These two dimensions are expounded in Biggs and Tang (2011) and Angélil (2003). See (Figure 1) above.

In evaluating the intentions and outcomes of one course in the curriculum of the Bachelor of Environmental Design programme of the Faculty of the Built Environment the paper offers some insight into how teaching and learning can be enriched in an effort to cultivate empathy.

3. Context, Aim and Objectives

Empathy is an unconscious process in which the individual uses his own body as a template that enables him to 'feel' into other's experience. (Gallese 2001 as cited in Modell 2006)

In a built environment that reveals the distance between education, research and practice and; the evidently weak response to environmental and societal needs, the education process has a role to play in closing the gap (Dabaieh, Lashin & Elbably, 2017; Dessouky, 2016; Farahat, 2011; Olweny, 2015; Salama, 2009/2010). Teaching and learning therefore become strategic fora for influencing future practice. The process though, ought to be mindful of a reality Shuell (1986) shared that, "what the student does is actually more important in determining what is learned than what the teacher does"

Based primarily on the outcomes of an online survey to find out how decisions students took by themselves contributed to the sum of their encounters and face-to-face sessions focused on a review of the course in as far as its delivery impacted their learning and awareness of the wider context of people, place and the environment, the aim of this paper is to work towards developing a methodology for cultivating empathy.

The objectives include:

- 1. To discuss outcomes of a dialogue with the students about their excursions and how this contributes to their view of society;
- 2. To present an analysis of the students' attitude toward key media and tools and how this might contribute to how they apply themselves;
- 3. To discuss a preliminary framework that will reinforce the idea of Empathy Education in the context of architectural education.

4. Methodology

The paper focuses on the course ENDS 2361 Field Experience I that is based around the idea of travel. It is anchored to three things about which students were interrogated: the value that was attached to the excursions; reflections about the media and tools of expression and; an evaluation of the whole

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process including the uploads and online conversations in as far as this will suggest pathways to cultivating empathy on an architecture programme.

The previous editions of this course just focused on the travels followed by a report and an exhibition, while a new addition to the three most recent editions (2014/15, 2015/16 and 2016/17) that are featured in this paper was the emphasis put on sketching, photography and writing and; the use of social media (Instagram and WordPress) to engage a diverse audience.

The research method involved a review of students' feedback via an online survey and a face-to-face session. The online survey focused on finding out how decisions students took by themselves contributed to the sum of their encounters while the face-to-face sessions focused on a review of the course in as far as its delivery impacted their learning and awareness of the wider context of people, place and the environment.

5. Findings and Discussion

...if we want change, we do not need a revolution of systems or institutions: we need a revolution of human relationships. And one of the best ways to bring this about is to develop empathy on a mass scale through the education system. (...) empathy has the power to produce mass social change. Krznarich (2007)

5.1. THE EXCURSIONS

5.1.1. The road less travelled

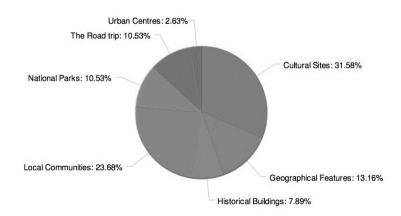


Figure 2: Destinations/sites identified out of interest

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Entry interviews over the years have revealed that students do not travel much. As a strategy to gauge and build interest, this course gives them the independence to select from a list of eight (8) categories (of destinations or sites) where they will be interested in going. Results (Figure 2) above show that students were mostly interested in visiting local communities and cultural sites, affirming the expected interest in new encounters. It also suggests the need for specific enquiries on what would prompt interest in other travel encounters. Perhaps that the idea of lived experiences vis-à-vis what drives interest in new encounters would be a good reference point for cultivating empathy.

5.1.2. Nurturing values

A key observation is that we have tended to restrict ethics (and values) in the practice of architecture to only the dealings with the client (and builder) often neglecting the users, wider community, and the environment. Do we, as architects not have a responsibility to these stakeholders, at a base level? The perception that architecture is primarily about buildings, ignoring inhabitants and what happens between buildings seems to ignore a critical link between people and their environment as a base design challenge.

The indication that students recognise the importance of people and the environment – (Figure 3) is a word cloud of themes that were cited following a survey identifying themes of interest from their excursions – this suggests that the education process perhaps ought to horn this interest at an early stage as Lapadula and Quiroga (2012) suggest, by helping them assign value to the wider context of the social and environment milieu.



Figure 3: Students identifying themes of interest

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5.2. MEDIA AND TOOLS OF EXPRESSION

Each time one views again a great film, re-reads a fine novel, looks repeatedly at a masterpiece of painting, or revisits an architectural classic, the more one discovers. The poetic image takes us to the moment of the first innocent, but immensely potent encounter. A profound piece of architecture is always novel and unexpected, no matter how many times one revisits it, as it lives and reflects life itself. Timeless freshness, a kind of untouchable newness, is a quality of the greatness of artistic images, including those of architecture. (Pallasmaa, 2011)

Narratives and imagery based in world encounters if well composed have the potential to impact the way we view the world. This would perhaps close the gap between what is perceived to be the role of architecture and architectural education and the reality on the ground.

Students seemed to identify more with online platforms (Figure 4) compared to the reflective journals they are accustomed to. This perhaps suggests that as they cultivate their own understanding of society in general there's an opportunity to prompt discourse from multiple angles especially in those where students express keenness. The obvious gap though is in the quality of narratives and imagery and how instructors have to be on hand to improve it.

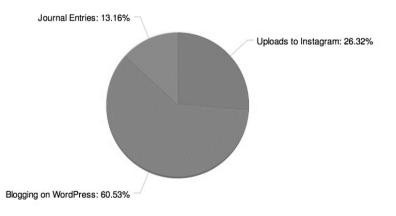


Figure 4: Identifying with preferred tools

5.3. MAPPING FUTURE IMPACT

How then can we rethink the education process to look beyond the prescriptive, and its largely monolithic approach, acknowledging that we have different experience and world-views which frame how we perceive the world and to an extent how we live in it. As architectural education seeks to resolve its origins how can this become a strength for a transformed education that looks at what

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is around us as having value, and from which we can learn, and not something we should ignore? How can diversity be looked at as strength? These questions could appropriately be placed to pre-university educators as well in order to cultivate empathy at an early stage in the education process.

Building on arguments and directions in Juhani Pallasmaa (2011) *The Embodied Image: Imagination and Imagery in Architecture* (Figure 5) is an attempt to begin to demystify this process by engaging the students in self-directed learning that is based around poetic accounts of real time encounters over their excursions.

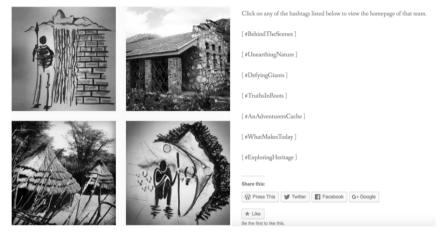


Figure 5: A sample of images and themes as a representation of some of the areas of students' discourse online.

In addition, following a series of conversations (comments and feedback online) under each team's themes (*hashtags*), the students were also engaged in a face-to-face dialogue to prompt some feedback about the course. Overall, from the general attitude (Figure 6) it quickly becomes evident that the students have an idea of what it takes to explore a given area to its potential conclusion – that timing, sampling, an attitude to ask questions (all habits of a good researcher) and generation of ideas are key as part of preparation and the process of engagement. The challenge for the education process is how to nurture reflective practice that is attuned to cultivating empathy.

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Figure 6: Affirming students' awareness of the scope of the process

6. Conclusion

This paper provides some insight into the numerous teaching possibilities for educators in Higher Education to have an impactful education process. With reference to Weidman, Twale and Stein (2000) conceptualisation of the socialisation of students on a professional programme, this paper also recognises that alongside the studio and the traditional methods of delivery, there are possibilities for more diverse teaching and learning tools and methods for a rich education experience.

By discussing the intentions, observations and outcomes of one course at the Faculty of the Built Environment of Uganda Martyrs University the paper has revealed that it is possible to purposefully tweak teaching in a deliberate effort to inspire learning. Key in this process is an understanding of the tripartite classification of teaching and learning in: the self; engagement and participation and; modes and arena in as far as they offer a flexible scope within which to define tasks, scenarios and courses.

In particular, ENDS 2361 Field Experience I reveals that teaching and learning has a lot of potential in contributing to unpacking the process towards cultivating empathy. The paper recognises the key challenge in the belief that you can teach this directly. In reality, it is about what we say and do that can make a difference, engaging students in discovery through an understanding of who they are and what they might rethink of the future.

Ultimately, this study presents a starting point for delineating how teaching and learning can be organised to close the gap between the hitherto rigid classroom

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environment to a discovery based field experience - as a key driver for cultivating empathy.

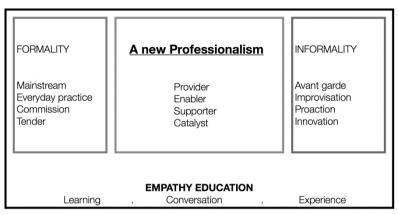


Figure 7: Scoping the contribution EE can make – Developed from Krznarich (2007); Schumacher (2002); Tovivich (2009).

The study reemphasises in (Figure 7) that by investing in learning that prompts conversation and reflection over experiences, transformational architectural education thus becomes one that engages in alternative pedagogies. It engages with research, values and ethics as an inherent part of understanding the human condition. It promotes the radical, pushes the envelope while actively challenging the status quo; it is reflective, critical, and allows students to dream and to solve problems; it learns from the past, to better able to address the challenges of the future, and does not seek to merely replicate the past. Most of all it promotes awareness, personal growth and efforts toward change.

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A COMPARATIVE STUDY OF HOUSING AS A SOCIAL ENTITY: THE CASE OF NAGPUR, INDIA

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Abstract

India is undergoing massive urban development. Currently an irrational focus towards provision of voluminous infrastructure is perceptible. This presents a threatening situation where development is devoid of an essential underlying value system that imparts context responsiveness and hence, sustainability to cities. Smaller cities, relatively insulated from such drastic urban transformation, have been able to retain their people- centric environments through sustenance of a strong socio- cultural continuity, which is manifest in their built environments. In stark contrast to burgeoning metropolises, these foster higher quality of life and saner lifestyles. This study analyses three housing neighborhoods in Nagpur, a grade II Indian city, set in three distinct temporal frames: historic, pre- globalization and post- globalization. The study areas are analyzed through the lens of seminal environment- behavior parameters. Qualitative methodology employs for analysis morphological maps, nonparticipatory observation and photographic documentation. The work constructs an argument for comprehensive urban development embodying socio- cultural and behavioural values of a place as being legitimate parameters and integral to process of development of small cities. This enquiry resolves that to make a city smart and sustainable, efforts at people centricity are imperative along with ICT and other smart technologies of the future.

Keywords: smart cities, socio-cultural sustainability, environment-behaviour parameters, housing patterns, quality of life.

1. Introduction

In the six decades since Indian Independence, metropolitan cities have seen unprecedented growth. Smaller towns with human scale, green cover, lesser traffic and slow pace of life retain an old world charm supported with a saner order. lifestyle. The new world centered around Information and Communication Technology (ICT) measures development by economic progress by voluminous increase in built infrastructure propelling growth even in these small cities. One amongst the many concurrent debates that form the context of this study of small cities is the Smart City initiative for smaller cities of India. (http://www.urbannewsdigest.in & http://www.livemint.com).

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The governmental propaganda as well as debates on TV, newspapers and even miniscule publications, heavily center upon tangible and visible forms of an ideal smart city. The intangible, subtle yet extremely vital ingredient – the socio- cultural sustainability of a city fabric alongside technological and spatial developments is entirely omitted from any acknowledgement. The underlying assumption is that quantifiable development can be adopted in isolation from the intangible constructs within a city and can easily be transposed- as is-across the varied contexts of small Indian cities and signify altruistic good for all concerned. However, the Indian cities, highly regionally specific, are best understood through the multiplicity and simultaneity of the plethora of concurrent layers that form it. To ensure sustainable, inclusive and integrated development, a study of such layers is vital.

Research points out that an inclusive up gradation involves many aspects, important amongst which are Quality of Life (QoL) and holistic sustainability (Islam, 2011). This includes people's lifestyles, their aspirations, preferences and satisfaction with quality of life leading to an overall wellbeing (Marans, 2012). Appreciation and preservation of intrinsic socio-cultural values of the people is an important aspect towards making a city 'smart'. At the altar of technologically driven fantasies for a future city, the significance of the human element as critical in a city's spatial order is over simplified. Hearteningly, a nascent yet potent term, 'a city of wisdom' (Reddy & Singh, 2015) has entered this discourse, although in a miniscule way.

This paper examines the case of a typical grade II city in central India-Nagpur, Maharashtra. A comparative analysis is presented through the study of three housing settlement typologies that exist simultaneously within the many layers of the city and belong to distinctly different temporal and morphological settings. There emerge three unique lifestyle patterns that are a result of these particular local contexts. The paper argues for a comprehensive approach towards designing housing settlements by an examination of the socio-cultural basis of spatial organizations of these housing developments. It focuses on the underlying set of factors that contribute to make a city 'wise'.

2. Methodology of study

The study adopts a qualitative approach with case studies and logical reasoning. Desk study of morphological maps and plans for comparative analysis, non-participatory observation and photo documentation are predominant tools of study. For better comprehension, face-to-face interviews are conducted within the field study.

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The study explores the socio-cultural characteristics and spatial ingredients of the three distinctive housing developments that are representative of three very different types of spatial configurations. They are 'Shukrawari', a neighbourhood of Mahal the old city, 'Deendayal Nagar', a modern neighbourhood and 'Godrej- Anandam World City' a contemporary gated community. A comparative matrix of physical characteristics is drawn up with simultaneous reflection upon the socio-cultural attributes by an assessment of key environ-behaviour parameters (E-B) and characteristics and attitudes underlying the lifestyles of residents in these areas.

3. Indian lifestyle values as underlying concept of old city

The enquiry begins with the investigation of the old city neighbourhood of Mahal- the oldest housing settlement of Nagpur. Like most historic cores of Indian cities, its physical form is born out of ageless wisdom of climate responsiveness, orientation of built form, material and construction techniques, differentiations in expression through facades that operate within wider regional expression and building traditions passed down through the generations based upon an innate understanding of the spatial needs of the community. The settlement displays the potential to serve the physical and spiritual needs of its communities from the single family to the entire community (Steele & Doshi, 1998). The settlement form fosters production of the collective life of the place giving birth to the distinctive lifestyle based on belongingness and ownership and thus, a more unique sense of place. The morphology of old cities is a reflection of the values of its inhabitants (Rapoport, 1969) and the society at large.

By virtue of its morphology, a settlement form born out of the intrinsic behavioural patterns of the community shares a two-way relationship with the inhabitants, allowing an active dialogue, imperative for evolution. The satiated ground conditions that are embodied in such a spatial setting make it a reference point to understand and compare the changes in the evolution observed in the other parts of the city.

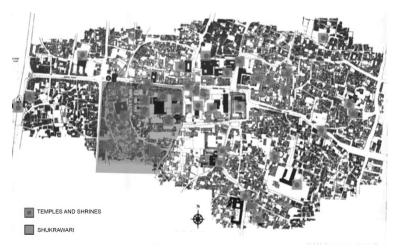
4. Manifestation in Mahal area of the vital parameters of study

The impact of seminal parameters of socio- cultural milieu upon the well being of a community and production of an enhanced collective life is emphasized vigorously in scholarly research and theories of lifestyles. Concepts like social interaction, defensible space, sense of belonging, human scale, privacy and territory and lifestyle are all factors affecting the emotional contentment of the occupants. Built environments soliciting these attributes encourage positive behavioral responses (Kamp, et al. 2003). These are vital for a comprehensive

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and holistic urban development process. The historic city of Athens epitomizes how exalted values of elevate the status and life of a city. Her rich democratic traditions of intellectual interactions were supported with the appropriate spaces that inspired thought and allowed dialogue. Athens exemplified the crucial role of social interactions in flourishing of a civilization. In a parallel cite, the intrinsic spirituality embedded in the Indian ethos is rooted in its social institutions.

The concept of social engagement is at the core of socio-cultural sustainability and becomes the tool that facilitates transmission. A good level of social engagement strengthens two essential components of human inhabitation: psychological wellbeing of humans and the creation of human society. For the first, appropriate social interaction imparts a deep sense of security within the human. Social interaction can ameliorate psychological distress by garnering social support (LaRocco et al 1980). The second component, such engagement between individuals acts as the essential 'social glue' that holds societal structure together. Alexander et al. (1977) refer to the everyday contact between people in public space as an essential 'social glue'. Catalyzing engagement between people and the social space defines the critical challenge in the task of place making (Burte, 2008).



5. Mahal Old City: A Morphological Study

Fig.1. Morphology of *Shukrawari* neighbourhood of *Mahal* old city (*Source: Vidarbha Heritage Society*)

The morphology of Shukrawari (Figure 1) shows winding street patterns that cause the occurrence of many spatial happenings. The '*chowks*', which are intersections of streets, usually marked by a shady tree or a temple shrine as

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landmarks. The 'nukkad' (street corner), the 'chowk', the 'otla' (platform to sit around) and the 'osri' (verandah extension of a house) are elements situated in the hierarchy of spatial situations that allow varied degrees of territoriality and hence diverse patterns of human interaction. These elements, usual and unassuming as they may appear, provide opportunities to meet, discuss, inform, feel connected, find solace in human company with familiarity as the spine of security making for a sense of well- being. As Doshi rightly points out in his article on 'Social Institutions and a Sense of Place', (Ameen. Ed. 1997) that such socio-cultural manifestations provide an understanding of the community's intrinsic needs and must be studied before designing for them.

The spatial organization of Mahal has another set of integral elements that are manifestations of the faith system of the community - the places of worship and religious institutions. These '*mandapa*' spaces (Figure 2) are congregational spaces. Primarily, the community converges in these spaces over '*kirtans*', '*pravachans*' and '*satsangs*'. Kirtans, a form of theatrical folk song with interactive chanting, and Pravachans, discourses on scriptures, are a form of socio-religious activity that is rooted in the '*Bhakti*' movement dating back to the 12th century AD. They are performed by erudite performers and are forms of popular entertainment. *Satsangs* are popular benevolent gatherings.



Fig. 2. Temple with a *mandapa* for congregations..



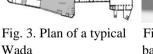




Fig4. An intricate wooden balcony. (Source: Author)

In this manner, these elements nurture participatory activities and meaningful engagements across genders and age groups. As a value system framework, they foster spiritual contentment in the lives of the inhabitants and provide cultural stability, shaping subtlety behavioral patterns of the people. The continuum of these spaces that are intertwined and inseparable from sociocultural and moral values are a unique character of Mahal making it an example of how the value system of a society delineates the lifestyles formed within it.

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One of the most significant outcomes of social interaction is the web of connectedness it fosters in a housing community. Newman's definition of defensible space being a socio-physical phenomenon revolves around a well-knit community as a key agent in ensuing security of their locality (Newman, 1976). Achievement of defensibility is a natural outcome of this socio-cultural set-up.

At the micro- scale of a house- form, the need for security and privacy become primal. Though the practice varies with culture, the larger houses or '*Wadas*' have walls that abut the streets. The transition from the publicness and blurred territorial lines of the streets to the more strictly private domain of a family dwelling is demarcated by a gateway situated in the tall compound walls of the Wada. The plan form of the Wada (Figure 3) is developed around a system of internal courtyards. Specially designated inner courts in the interiors of the plan-form grant womenfolk increased privacy for their domestic activities. 'Construction was not simply additive, its multi-functionality made it basic to a balanced life' Doshi explains. Such an outlook shaped the Indian temperament and the culture at large.

The patriarchal joint family system, albeit its share of disadvantages serves as an excellent support system for the elderly as well as the very young and provides an extended protection to all members in times of need. This societal structure gives precedence to the organization, the family, in this case than the individual. This is in deep contrast to the contemporary practices (Ameen., Ed. 1997, Chadha, 1999). The case of the old city fabric of Mahal is an exemplary lesson in socio- cultural sustainability.

6. The Growing City And Its Evolving Patterns

Post- independence, Development Control Rules (DCRs) were formed that governed the nature of newer growth of the Indian cities. Then onwards two distinct, over- arching phases can be seen urban development in cities: preglobalization and post- globalization. In this study, the subsequent neighbourhoods take up for comparative analysis originate in these two distinguishable time frames. Deendayal Nagar, situated upon a green-field site back then, is pre- globalization that developed on city fringes in the 1980s. It displays orderliness and is largely structured on planning concepts of the time and bylaws. The third, from the post- globalisation era of the 1990s is a gated housing community and is situated in a brownfield setting. The three overlays of Nagpur city that broadly represent the types of housing settlement forms in Nagpur city are distinct in physical manifestations. (Table 1).

Table. 1. Comparative matrix of the three neighbourhoods. (Source: Author)

	Old City Mahal Neighbourhood:	Modern Neighbourhood:	Contemporary Gated Neighbourhood:
	Shukrawari	Deendayal Nagar	Godrej- Anandam World City
Time Period	16th century to the present	1980 to present (pre-globalization)	2000 to present (post globalization)
Developed Under Civic Authorities By	an intrinsic organic development by the community	co-operative societies under city improvement trust	real estate developers under municipal corporation
Physical Setting Of The Housing Settlement	organic development, dense built mass, narrow streets, temples and shrines dotting entire settlement, market along main streets, joint- family houses with courtyards, green cover missing, mixed land use predominant	grid iron layout, regular and hierarchical network of roads, open public utility space with temples and shrines in every neighbourhood, extended single family dwellings, single stand alone units with regulated setbacks, human scaled, substantial green cover, mixed land use intersecting the residential zone	walled enclosure, no relationship with the surrounding urban fabric, substantial well maintained green spaces, adequate parking, combinations of house types, recreational facilities as center of the development, no culture-based typology of built
Visual Setting Of The Settlement	visual and perceptional cultural coherence due to imagery and symbolism as a binding factor despite its dilapidated condition	perceptible visual order, scaled, orderly, bylaw adherence, abundant openness, visual homogeneity despite being low on aesthetical quality	manicured artificial spatial order, visually a coherent whole, total visual dis-link from its urban neighbours, contemporary forms and expressions
Form & Expression Of An Individual House	lost grandeur of building arts and crafts of a bygone era visible, local materials; bricks, stone, timber, cast iron	not much design consistency in the built forms, modern materials: mostly brick and RCC with plaster and cement <i>jallis</i> (perforated panels)	architect designed, theme vocabulary, range of contemporary materials: RCC, steel, glass, aluminum, artificial cladding

7. Analysis Of Observations

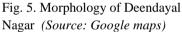
For generations, Indian society has organized itself around the caste system (Adler and Pouwels, 2008), which is further differentiated within the same religion or similar religious faiths. Indian cities have a most distinctive characteristic wherein segregation of areas is observed on the lines of distinguishable culture- based communities. Despite the universalizing intent and effect of regulations and guidelines, each neighbourhood has an inherent cultural flavor/ fervor manifest through different forms of non- verbal communication like symbolism, linguistic familiarity, iconography, folklore and legends, inter personal relationships etc. The second neighbourhood under study, from the pre-globalization era is an example of this tendency. The post globalization times forged forth a newer manner of organising inhabitation- one which was based on economic similarities. The third area of study, Gated Communities belongs to this category.

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8. The New City: A Liberal Re-interpretation of Mother Settlement

The expansion that took place during the pre- globalization period of 1980s, was largely due to the exodus of inhabitants from the congested historic core of Mahal, resettling into newly formed neighbourhoods. The Marathi- speaking Brahmin Community created the area called 'Deendayal Nagar' and continued to nurture and exhibit an acculturation of the old city within planned and organized development. This is in part facilitated by the co-operative society model of these neighbourhoods, which are essentially people centric and focus upon incorporating their needs and aspirations. For example, morphological map shows the several shrines big and small, scattered over the entire area- a distinctive feature of *Mahal* (Figure 5).





The spatial planning of these neighbourhoods mandated open spaces at a local level. Many of these open spaces center around a small temple with a portico, built and maintained by the funding through contributions from the local community. These show similar behavior as elements of urban life as the ones studied in Mahal, the '*dalans*' of the more active ones hosting congregational activities, community classes for yoga and pranayama and other forms of entertainment and cultural knowledge dissipation for the young.



Fig. 6. Visual Character of the 1980-s Neighbourhood



Fig. 7. Plan of a typical house (Source: Author)

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This space also becomes the interface for interaction between the elderly and the other generations in the neighborhood. The '*Bhajani mandal*' is a very interesting activity observed in this colony whereby the group of housewives and elderly women form a group for chorus singing.

Adherence to bylaws has helped the neighbourhood maintain appropriate human scale and spaciousness (Figure 6). The house plan consists of a drawing- cum- dining area that extends into the place where the shrine is situated at the far end (Figure 7). This becomes the quintessential flexi-space. Most residential house- forms in such neighbourhoods are situated as independently plotted residences housing a single extended family, including the grandparents. Nuclear families continue living with and caring for the old; grandparents aid childcare at home, enabling the parents to bridge the gap that modern life creates within family members. Thus the problem of the elderly is mellowed India (Nalini, 1997). A spatial translation of this mechanism is the existence of the 'Aji- Ajoba' (grandmother-grandfather) parks. While the DCRs gave the newly formed nuclear families greater freedom and liberty in lifestyle choices, the community was able to reconcile the apprehended generational and socio- cultural chasm. The study establishes that the characteristics of the parent community such as human scale, perceptible discipline and order, defensibility, privacy, a sense of identity and cohesiveness, were maintained in continuum even in a different physical configuration of the community.

There are some negatives that fall within purview of the study. The continuum stops short of the articulation in visual expression. Mahal displays a percolation of cultural meaning and tradition in its rich display of architectural detailing (Fig.4). Deendayal Nagar presents a case of lack of awareness and inclination towards involvement of local artisans or traditional knowledge systems. Parks, streets and lanes are unkempt and low on maintenance. Amidst all of this, the temple shrines are crisply maintained. Such lack of 'taste' displayed in architectural expression may merely be incapacity to choose outside the framework of traditional forms. (Rapoport, 1969).

9. Development Industry And The Birth Of The Gated Community

The gated community is a recent phenomenon that owes its origins to the developed world. In the developing world, it finds popular manifestation in the urban and sub-urban areas. It is a package deal that flaunts a 'desirous lifestyle' comprising of exclusivity, identity, belongingness, place attachment, comfort and security (Grant, 2005). These manifest as brownfield developments in many cases and appear unmindful and unconscious of the rent created due to its insertion in the midst of an old complex urban fabric, esp. that of an old city

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settlement. In this way they are a sudden and deep dis-link from the on-going urban development (Turgut, 2010). In the late 1990-s, Indian witnessed a mushrooming of such exclusivity based enclaves by developers in many metropolitan cities. They became popular very quickly since they were providing a multitude of facilities that populous Indian cities fail to provide to its teeming citizens (Figure 8).

Anandam World City is one such contemporary enclave. It is planned by a foreign firm and designed by a name architect in a distinctly international vocabulary. The facilities include a mix of apartments with varying carpet areas (Figure 9) and stand-alone villas with a small garden lot. Adequate parking, 24X7 water and electric supply, open spaces with lawns, plantations and cycle and pedestrian pathways are part of the development. This community also shares a clubhouse equip with lifestyle amenities such as gym, swimming pool, outdoor courts and spaces to entertain and socialize. These are communities where economic standing is the basis. It is thus the point of from traditional communities of pre-liberalization departure the neighbourhoods based upon caste, regional cultures or religion (Chacko et al, 2009).

10. Critical Reflections Regarding E-B Parameters

The gated communities are ushering in new socio-cultural norms with focus upon the individual rather than the community. It is a quantum shift from the underlying concept of the historic settlement and its sympathetic later adaptation. The enclaves aggrandize the individual, his privacy, and his personal space. The need for identity is forged from a global palette of forms. Defensibility is built in through walls, gates, Wi-Fi and security devices. Familiarity rather than human bonding seeks sense of belonging. Social interactions are transformed into get-togethers and parties over drinks. The aim at relaxation and enjoyment is unsupported or guided by age-old social institutions. In the quest for an 'International Equity', traditional continuum is not even on the agenda of developers. In this transition, there is possibility of loss of valuable traditions.

The economic basis of the enclave community reflects an upwardly mobile urban citizenry; its negative side reflects loss of spirituality and social bonding. The artificial make-up of the contemporary lifestyle it supports ironically reveals human loneliness in the midst of a populated world.

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Fig. 8. Masterplan of Godrej-Anandam Gated Enclave (*Source: Author*) Fig. 9. Typical Floor Plan of a Residential Tower (*Source: Author*)

11. Conclusion

The paper compares three housing neighbourhoods with origins in different chronological zones but which exist simultaneously in contemporary world from point of view of their morphology and lifestyles they support. QoL parameters that include defensibility, privacy, social interaction, sense of belonging, human scale and lifestyle are studied in each case. It is observed that while each settlement has its own way of expressing these parameters, socio-cultural sustainability as part of traditional continuum is eroding in the recent past.

This study is pertinent from the focus of current smart city initiatives which emphasize voluminous infrastructure; both for housing and for rapid transit systems with ICT enabling. This is fallaciously being implied as making cities with a QoL quotient. The direction of thrust is leading to a rise in gated communities with gratifying existence that aligns with the 'global'. These are being developed as brownfields, even in the historic sectors of the cities. Voices of conservation and heritage groups fall on deaf ears. Without a sociocultural revelation, cities can never be smart.

The ethos of Indian cities still lives in its many simultaneous layers. But it needs awareness and societal desire to acknowledge its pertinence and relevance in the present as well. Select architects borrow liberally from the patterns of old cities in a hope to revive the spirit of the community. Yet, without the vital continuity of live traditions, the soul eludes. These remain only as visually appealing spatial patterns. The quantum shift of priorities from community well being to that of the individual is a change that nostalgic pattern making cannot revive.

Grade II cities support urbanity full of quietude, connectedness, and human scale. These charms need preservation and nurturing in the transformations

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towards smart cities. Age-old cultural mechanisms that engaged, enriched and bonded communities require positive propagation in newer settlements. This is a vital aspect of sustainability. It is important to safeguard age-old devices of human bonding through the lens of spatial planning of our built environments. Kahn (2003) states this concisely when he says that the 'measurable' and the 'unmeasurable', the 'physical' and the 'spiritual' shall resonate even as cities grow and become smart. Socio-cultural sustainability shall be achieved through these vital aspects.

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CHALLENGES ASSOCIATED WITH INTEGRATING GLOBAL POLICIES ON DRR AND CCA IN URBAN DEVELOPMENT: ASIAN PERSPECTIVE

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Abstract

The world's population is increasing rapidly, with more than half living in Asia, mostly in urban areas. Accordingly, it is vital to reduce the current and future vulnerabilities of disasters in Asia as a precaution to save human lives as well as to reduce the damage to the natural and built environment. Increasing change on climate also further surges the vulnerability for disasters. Global policies are important to unify different parts of the world. There are three main global policies that are currently in action in the global context. These are the Sendai Framework for Disaster Risk Reduction, the Sustainable Development Goals and, the Paris Climate Agreement. However, integrating these global policies to the development agendas of Asian countries have become extremely difficult due to many governance, scientific and communication issues. Based on findings of a global analysis conducted as part of a research project entitled ESPREssO funded by the EU horizon 2020 programme, this paper provides a critical review of the existing challenges associated with integrating global policies on DRR and CCA into the Urban Development in Asia. During the first phase of the study, a narrative desk based literature review was conducted and during the second stage an extensive primary data collection was conducted. Key primary data collection methods were semi structured expert interviews, expert focus group discussions and an online questionnaire survey. Findings reveal institutional issues, political willingness, information management are the prominent challenges in Asia to integrate global policies into the urban development.

Keywords: Global Policies, Urban Development, CCA, DRR, Challenges,

1. Introduction

Global demographic trends imply that more people are living in areas vulnerable to sudden-onset natural disasters. Scientists forecast that the frequency and intensity of these disasters are likely to increase as a result of the effects of climate change (Ferris and Petz, 2013). At the same time, it is predicted that the world's population is expected to surpass 9 billion by 2050, with more than half living in Asia, mostly in urban areas (GTZ SUTP, 2010).

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As UNISDR (2012b) describes rapid urbanisation brings more pressure on land and services due to the increased population density, lack of capacities and unclear mandates for DRR at local levels, inadequate resource management, settlements in hazard prone areas, uncoordinated emergency services and decline of ecosystems. Also, unplanned cities and urbanisation can be one of the major challenges to create a disaster resilience built environment in cities (Malalgoda et al., 2013). These trends, coupled with recent, high-profile megadisasters, are raising global awareness of the need to build the capacity of national governments, civil society organisations and international actors to prevent, respond to and recover from natural disasters (Ferris and Petz, 2013). Within this context Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) are key means to reduce the vulnerability of people and assets (both natural and man-made) for disasters. The key aim of DRR is to reduce the damage caused by natural hazards through a culture of prevention. As such, DRR includes the, "Systematic development and application of policies, strategies and practices to avoid (prevention) or limit (mitigation and preparedness) the adverse effects of hazards" (UNSDR, 2010). DRR initiatives have the potential to reduce the negative impact of hazards and would lead to sustainable development (World Bank, 2011). Thus, it is important to reduce and prevent the impact of disasters with the proper adoption of disaster risk reduction strategies. As global climate change rises, the risk of climate related disasters increases. According to IPCC (2012), CCA is the, "Process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities."

Whether it is CCA or DRR, legal, policy frameworks play a key role in tackling their related challenges. Legal and policy approaches act as the backbone for effective CCA and DRR. Palliyaguru et al. (2010) describe how it is extremely important to integrate DRR policies into the development process. As they specify, risk-management policies, relevant guidelines, standards and legal frameworks should be directly integrated into national level strategies. Similarly, Burton et al. (2006) state that CCA must be guided and supported by national policies and strategies and for some countries, these in turn, need to be facilitated through international measures. In this context, the Sendai Framework for DRR (SFDRR), Sustainable Development Goals (SDGs) and the Paris Agreement for Climate Change have become important global agreements. However, integrating these international policies on DRR and CCA into the urban development in Asia has become extremely difficult due to various challenges. Accordingly, this paper reviews the challenges to integrating the global policies on CCA and DRR into the urban development in Asia.

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Section 2 introduces the key global policy context on CCA and DRR in which the key discussion is based.

2. Global Policy Context

Global policies are needed to unify different parts of the world. Although, there are various policies on CCA and DRR, as mentioned above, there are three main global policies that address DRR and CCA which are: the Sendai Framework for Disaster Reduction 2015-30 (SFDRR); the Sustainable Development Goals (SDGs) and the Paris Climate Agreement.

2.1. SENDAI FRAMEWORK FOR DISASTER RISK REDUCTION (SFDRR)

The SFDRR was introduced at the third United Nations World Conference on DRR, held in Sendai, Japan in 2015. This provides a concise, focused, forward-looking and action-oriented, post-2015 framework for DRR. This framework complements and replaces the Hyogo Framework for Action. The framework highlights the importance of disaster governance, stakeholder participation and disaster preparedness against future disasters (UNISDR, 2015). It further emphasises the impact of climate change and its effects on disasters. The SFDRR focuses on a strategy of a multi-hazard approach, covering disaster losses between 2015 and 2030. The aim of the framework is to achieve a substantial reduction in disaster risk and losses in lives, livelihoods and health, and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries. This will be achieved through four priority areas (UNISDR, 2015):

- Priority 1: Understanding disaster risk
- Priority 2: Strengthening disaster risk governance to manage disaster risk
- Priority 3: Investing in DRR for resilience
- Priority 4: Enhancing disaster preparedness for effective response and to 'Build Back Better' in recovery, rehabilitation and reconstruction

Within the aforementioned priority areas, seven global targets have been presented (UNISDR, 2015) which are substantially reduce global disaster mortality by 2030, compared to 2005-2015, substantially reduce the number of affected people globally by 2030, compared to 2005-2015, reduce direct disaster economic loss by 2030, substantially reduce disaster damage to critical infrastructure and disruption of basic services (health and educational facilities) through improving resilience by 2030, substantially increase the number of

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countries with national and local DRR strategies by 2020, substantially enhance international co-operation to developing countries to support their national actions by 2030, substantially increase the availability of, and access to, multi-hazard, early warning systems and disaster risk information and assessments to the people by 2030.

2.2. SUSTAINABLE DEVELOPMENT GOALS (SDGS)

The SDGs, otherwise known as the Global Goals, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. These 17 Goals build on the successes of the Millennium Development Goals, while including new areas such as climate change, economic inequality, innovation, sustainable consumption, peace and justice, among the other priorities. The goals are interconnected, often the key to success; one will involve tackling issues more commonly associated with another. The goals and targets became effective on 1st January, 2016 for a 15-year time period (UNDP, 2016).

The 17 goals emphasise the importance of having a global partnership for successful implementation (UNDP, 2016).

Goal 11 deals with sustainable cities and communities. This is to ensure cities and human settlements are safe, resilient and sustainable. Accordingly, this goal aims to overcome the challenges faced by cities and to support them to continue thriving and growing, while improving resource use and reducing pollution and poverty. It focuses on areas such as adequate, safe and affordable housing and basic services, sustainable transport systems, inclusive and sustainable urbanization, participatory, integrated and sustainable human settlement planning, inclusive and accessible green and public spaces and cultural and natural heritage. It also emphasises the importance of reducing the economic losses of disasters, including water-related disasters, with a focus on protecting the poor in vulnerable situations. It further aims to reduce the environmental impact of cities and improve social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning (UNDP, 2016).

Climate Action is the 13th development goal. The goal aims to mobilise \$100 billion annually by 2020 to address the needs of developing countries and help to mitigate climate-related disasters. It aims to help more vulnerable regions, such as land locked countries and island states, to adapt to climate change. This goal suggests integrating disaster risk measures into national strategies (UNDP, 2016). Similarly, the 13th goal proposes to strengthen resilience and adaptive capacity to climate related hazards and disasters in all countries.

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More importantly, they propose to integrate climate change measures into national policies, strategies and planning. The need to enhance human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning are all highlighted in the goal. They further aim at enhancing capacities among the least developed countries and small island developing countries with more focus on women, youth and local and marginalised communities towards effective climate management. The goal emphasises the support of international financial institutions for developing countries in international, economic decision-making, norm-setting and global, economic governance (UNDP, 2016).

2.2. PARIS AGREEMENT

At the Paris Climate Conference in December 2015, 195 countries adopted the first ever, universal, legally binding, global climate deal. This agreement operates within the United Nations Framework Convention on Climate Change (UNFCCC). This was signed by 197 UNFCCC members and ratified by 126 members as of December 2016. The Paris Agreement will come into force on the 30th day after the date on which at least 55 parties to the Convention [accounting in total for at least an estimated 55% of the total global greenhouse gas emissions (GHG)] have deposited their instruments of ratification, acceptance, approval or accession with the depositary. The first of these thresholds was achieved on 22nd September, 2016 (UNFCCC, 2016).

According to Article 2 of the Agreement, its objectives are: to maintain global average temperatures to below 20C when compared to pre-industrial levels and to limit the temperature rises to 1.50C above pre-industrial levels, to increase the ability of adaptation to climate change, to improve climate resilience and reduce GHG emissions without any threats to food production, make available financial sources for low GHG emissions and climate resilient development.

One of the main features of the Paris Agreement is its 'bottom up' structure. As it emphasises consensus building among members, it accepts voluntary and nationally determined targets. Hence, their climate goals are politically supported rather than legislative requirements. This agreement makes all parties submit to emission reduction plans. Their plans are based on the principle of 'Common but Differentiated Responsibility' due to differences between capacities and duties to climate action among nations. Further, there is no specific treatment between developed and developing nations. According to Article 3 of the Agreement, the contribution of each member should be set individually by considering the principle of ambition, represent a progression

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over time and with a view to achieve the ultimate purpose of the Agreement. These are known as 'Nationally Determined Contributions' (UNFCCC, 2016).

The Agreement contains collective, long-term adaptation goals. According to Article 7 of the Agreement, parties establish the global goal on adaptation towards enhancing adaptive capacity, strengthening resilience and reducing vulnerability. They identify adaptation as a global challenge and developing countries require immediate actions since they are more vulnerable to climate change (UNFCCC, 2016).

3. Methodology

This paper is produced based on the findings of a global review on legal, policy and Science approaches within the frame of CCA and DRR, conducted by a project entitled ESPREssO funded by the EU horizon 2020 programme. The key data collection instruments were desk-based literature review, semistructured expert interviews, focus group discussion and a questionnaire survey. Desk-based literature review supported to identify different types of challenges to integrate global polices into the urban development in Asia and primary data collection was focused to further review the identified challenges as well as to explore any other challenges. Among the total number of interviews, focus groups and the survey, the figures for the Asian review are as follows.

Semi Structured Interviews	Focus Groups	Questionnaire Survey
4 interviews for Asia out of 12	3 focus group discussions in each focus group approx. 5-6	198 responses in total 78 for Asia
	members	

The sample represented academics, practitioners, NGOs, representatives from government bodies and so forth. Once the focus group data and interview data were collected, they were qualitatively analysed by using QSR-NVivo version 11 and thereafter, based on the identified key themes, mind maps were developed to reveal the findings. Questionnaire survey was qualitatively analysed. The survey was mainly designed to rate answers on a Likert scale, which allowed participants to specify their level of agreement on a five-point scale, 1 being 'strongly disagree' and 5 being 'strongly agree'. The collected data was mainly analysed through the Relative Importance Index (RII) method where 'W' is the weightage given to each factor, 'A' is the highest weight and 'N' is the number of respondents. Accordingly, results of the questionnaire

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survey supported to validate the findings which were revealed from the qualitative analysis.

4. Findings

Findings reveal that there are several challenges to integrate global policies on DRR and CCA into the urban development of Asia. However, at the same time, it is revealed that there are positive post 2015 indications which support for the integration of these polices to the urban development in Asia. This section describes each challenge in detail with its positive indications.

4.1. INSTITUTIONAL SET-UP

In most of the Asian countries, CCA and DRR are separate portfolios operated by different ministries. In addition, urban development is mainly within the theme of infrastructure development. As a result, agencies on CCA, DRR and urban development want to work in their space, so there is less room to see these disciplines in an integrated aspect. As a result, there is less room to integrate global CCA and DRR polices for the development agenda. Strengthening the findings revealed from the analysis, Schipper and Pelling (2006) and Sperling and Szekely (2005) state that Climate change related policies and decisions are made by the ministries and organisations related to the environment, whereas disaster management and reduction decisions are made by ministries related to infrastructure development. As revealed from the analysis, theoretically, these agencies should co-operate, but they are competing with each other to achieve certain goals. Perception difference is a reason for this separation as CCA is believed to be more advanced and strong, whereas DRR is considered as non-scientific. As identified by several authors, this is not only an issue for the Asian context, this is more a general issue within globe. As Conway and Schipper (2011) highlight, climate change is considered as an environmental issue rather than an important element of development policies. Development practitioners are reluctant to integrate CCA policies into DRR practices due to an unfavourable perception towards integration (UNISDR, 2012a). They do not identify the role of CCA and DRR in the process of development (UNISDR, 2012a, Sperling and Szekely, 2005). DRR and CCA approaches have originated and developed within two different cultures; for example; DRR is emerged within humanitarian assistance, whereas CCA developed within the scientific community (Mitchell and van Aalst, 2008). This difference in perception among the two communities is identified as a barrier to successful integration. Accordingly, in Asia, urban development is considered as physical development related to infrastructure development. In most of the Asian countries DRR typically sits with emergency response. Longer term DRR is not considered very much. As a

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result of this context there is less space to integrate these key global polices into the urban development of Asia.

However, post-2015, the SFDRR as well as the SDGs are two key tools for Asian countries to widen their thinking on CCA and DRR and on sustainable development. SFDRR enhances the need for integration of CCA into DRR and then to the urban development. Further, SFDRR aims to substantially enhance international co-operation to developing countries to support their national actions by 2030. Goal 11of SDGs advices the nations to promote sustainable development in order to produce sustainable cities and communities. This is to ensure cities and human settlements are safe, resilient and sustainable. Currently, the global and regional communities are trying to force Asian countries to follow SFDRR and SDGs.

4.2. FUNDING ARRANGEMENTS

Funding is a common barrier to the integration of CCA and DRR into the urban development in Asia. There are different funding systems for DRR and CCA at global, regional and national levels, leading to policy and institutional separation (UNISDR and UNDP, 2012).

The donor perspective in Asia is based more on science and evidence based approaches than applied approaches. As a result, CCA gets more funding, as CCA is science based and evidence based. This scenario is common among the global funding bodies which support Asia. DRR has less funding as it is mainly seen from the humanitarian angle, but, not from the development angle. Adding to these preliminary findings, Mitchell and van Aalst (2008) state that generally, funding organisations for climate change may be reluctant to integrate funding with DRR programs.

One of the major issues in Asia is that some major international funds are not suitable for the real needs at ground level. Therefore, in order to access funding, authorities need to follow guidelines which are not the exact requirement. On the other hand, national and international funding, for urban development are mainly focused on infrastructure development or so called physical development. Therefore, there is a tendency to ignore these key global policies, as they are considered as a part of environmental planning which normally lies within the ministry of environment. This challenge is an outcome of the existing institutional set up which is discussed in section 4.1. However, it is important to note that, as per the Paris Agreement on Climate Change, there is an obligation for developed countries to take the responsibility of providing funding to developing countries to address climate change (SPC et al., 2016).

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4.3. POLITICAL SETTING AND AWARNESS

Political will and motivation are of paramount importance in integrating CCA and DRR into the urban development of Asia at the national level. As revealed from the analysis, in Asia, since many Asian countries are still developing, politicians are more keen on physical-economic development than DRR or CCA. Accordingly, disaster management strategies are aimed more towards disaster response than disaster risk reduction. In many cases, communities in Asia expect physical-economic development rather than CCA or DRR. Communities are more keen on new job creation, new infrastructure development and so on. Within this context, there is a lack of political will for integration of these key global policies to the urban development as the integration does not provide immediate short-term benefits to increase their popularity among the community. However, Dupuis (2011) highlights that irrespective of developed or developing countries, low political interest to integrate will remain a key challenge. There is weak political recognition for DRR when compared to CCA (Venton and Trobe, 2008, Mitchell and van Aalst, 2008). In order to create an enabling environment to integrate CCA and DRR, political commitment should be increased by the high-level political authorities (UNISDR, 2010).

Further, the analysis revealed that at the state level in most of the Asian countries, CCA has much more attention than DRR. CCA has more political attention than DRR in Asia as a result of two key global agreements. Since the Paris Agreement is a global agenda, agreed by the head of states, it has become legally binding, whereas the Sendai Framework is mainly within Disaster Management ministries and not necessarily legally binding. Therefore, CCA has received state level attention whereas DRR has only ministry level attention. As a result of this priority areas of the SFDRR are not necessary integrated to the urban development in Asia.

4.4. PLATFORMS FOR DIFFERENT STAKEHOLDER ENGAGEMENT ARE NOT SET UP

Multi-stakeholders and multi-sectoral processes are vital in building common understanding, commitment and consensus (UNISDR, 2009). Furthermore, weak co-ordination between stakeholders, lack of know-how and poor communication between stakeholders, especially between government and local communities are some of the key challenges (UNDP and IUCN, 2012). In Asia, stakeholder management is complex at the state or sub-state level. In some Asian countries, stakeholder responsibilities are not clearly defined. In most of the Asian countries, there are no guidance or policy frameworks for stakeholder management. As a result, there is no proper platform for the CCA experts, DRR experts and Urban development experts to sit together to oversee the urban development as an integrated process which adopts DRR and CCA as

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parts of it. Since there are no common platforms, it is extremely difficult to integrate CCA and DRR global policies to urban development agenda.

However, post-2015, the global agenda has provided a platform for CCA and DRR stakeholders. Before the Sendai Framework, there was a great separation between CCA and DRR stakeholders. For example, CCA stakeholders did not even want to attend DRR conferences. However, now things are changing for the better in Asia as a whole. In addition, politicians in Asia are now keen to attend both CCA and DRR activities after implementing the Sendai Framework.

4.5. COMMUNICATION AND INFORMATION MANAGEMENT

When developing appropriate strategies to respond to or reduce disaster risk and adapt to climate change, sound information is required (Birkmann and Pardoe, 2014). In Asia, there are communication issues within the academic community and practitioners. Mainly, new tools and techniques from academic research are not generally transferred to practice. In most cases, new tools and techniques for CCA and DRR are tried and evaluated only for academic research. They are not transferred to practitioners. When practitioners need to address issues related to CCA and DRR, they have to use the same old tools and techniques and at the same time, since practitioners are not in direct communication with the academic community, new policies, tools and techniques are not communicated to them. Therefore, the tendency is to follow the same practice rather than investing time to look on academic innovations. Therefore, sometimes the concepts on integrated development, sustainable development are not within the subject knowledge of urban development practitioners. Accordingly, there is no way to inform them the importance of integrating these global polices on CCA and DRR into urban development. According to the Adaptation Knowledge Platform (2010), the challenge lies in how information can be interpreted for decision-makers which is essential for long-term planning and to boost understanding of CCA. As such, it is important to improve communication strategies to interpret data and information for decision-makers to conduct long-term planning and knowledge-based solutions(Adaptation knowledge platform, 2010).

4. Conclusion

It was evident that a number of barriers prevent integrating CCA and DRR global policies into the urban development in Asia. 'Poor communication between relevant organisations' emerged as the key barrier while 'unclear roles and responsibilities among these organisations' emerged as the second key barrier. As it stands, climate change policies and decisions are usually made by

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ministries and organizations related to the environment, whereas disaster management and reduction decisions are within different ministerial portfolios. Urban development lies within the scope of infrastructure and physical development where they do not necessary see urban development as an integrated approach which should enhance the socio-economic and environmental lives of or societies while increasing the resilience of the societies for disasters. Furthermore, there are different funding systems for CCA and DRR at global, regional and national levels, leading to policy and institutional separation. It was also evident that there is limited political will among those in the disaster management and environmental communities to integrate CCA and DRR policies to the urban development mandates. One reason for this is lack of understanding of the importance of CCA, DRR. Furthermore, some of the political leaders assume that climate change is not an immediate disaster, and the political will is therefore mainly on physical and economic development. Moreover, as the Paris Agreement is a global agenda agreed by the heads of state, it has become legally binding, whereas the Sendai Framework is mainly within Disaster Management ministries and not necessarily legally binding. Therefore, CCA has received state level attention whereas DRR has only ministry level attention.

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LIGHTING RETROFIT OF CEPT UNIVERSITY: ENHANCING VISUAL COMFORT AND REDUCING ENERGY CONSUMPTION

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Abstract

This study is for a lighting retrofit of CEPT University in India, for reducing energy consumption and enhancing visual comfort. The assessment of the spaces included lighting audits, monitoring of lights, schedule of use, visual comfort surveys and measurement of illuminance levels. Electricity consumption due to lighting is 32% of the total due to night time usage of spaces. Health issues like headache, tired eyes, glare problem and low illuminance level were found which resulted in more than 50% of occupants taking breaks for eye recovery. Studio, classroom, and private office spaces contributed to 85% of the campus lighting energy. A market survey revealed that only a few brands provide photometric files in India. Proposed solutions were simulated in Relux. The existing lighting and proposed solutions were evaluated to meet the national codes. The energy savings due to the proposed retrofit is 21%, 44% and 42% for studio, classroom, and private office. Payback due to retrofit is found to be 9.5, 3.8, 6.8 years for the respective spaces. If all spaces of these 3 space types are retrofitted (67 out of 122 spaces), it would amount to an annual cost saving of INR. 178,670 for a payback of 8 years.

Keywords: Lighting audit; lighting retrofit; lighting simulation; visual comfort, energy efficiency.

1. Introduction

This paper discusses a specific case that demonstrates a methodology and shows the potential for improving visual comfort and achieving energy efficiency. The study focuses on retrofitting of spaces at CEPT University in India, where high illuminance tasks are carried out. For commercial buildings in India, nearly 40% energy savings can be achieved by retrofitting existing fixtures with efficient ballasts, lamps, and reflectors (Kumar et al, 2004).

A few representative spaces, each of different typology and functionality were identified by conducting detailed lighting audit of the entire campus. This included lighting energy consumption calculations, in-field measurements for existing illuminance levels at desk height and measurement of existing surface reflectance values. A detailed visual comfort survey for artificial lighting in these spaces was also carried out. Spaces were then identified for retrofitting of

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light fixtures. Using the observations from the visual comfort survey and the audits, each representative space was analysed to identify specific improvements. New lighting design options were also simulated in Relux. Energy savings and payback period were also calculated to better inform the decisions of the building owner. The design proposal for one of the spaces is discussed in detail in this paper. The decision-making criteria are similar for the other two spaces as well.

2. Methodology

CEPT University contains more than a hundred spaces for administration, teaching, studios, and other support activities like, library, storage, canteen, etc. To identify issues due to lighting and address them, these are categorized based on their type of space and functionality (reading/ writing/ drawing/ computer). The methodology used here is summarized in five steps.

2.1. SELECTION OF REPRESENTATIVE SPACES

During a field survey, each space on campus was classified into one of the 9 space types– classroom, private office, computer room, laboratory, library, meeting room, open office, seminar room and studio. A Phase-I audit to collect data on area (m^2) , type of luminaires, number of luminaires, rated power of lamps (W), Lighting Power Density (LPD) (W/m²), hours of usage (h) was done to calculate the lighting energy consumption (kWh). Representative spaces were selected from 3 space types that had the highest lighting energy consumption. Further detailed data collection of each representative space was done in a Phase-II audit.

2.2. VISUAL COMFORT SURVEY

A visual comfort survey was carried out in each selected representative space to understand the occupants' condition of visual comfort and the problems they faced due to existing lighting conditions. A visual comfort survey questionnaire form was developed based on Hygge et al (1997) and Wei et al (2012). A total of 45 occupants were surveyed, 15 from each space.

2.3. PHASE-II

Illuminance levels for electric lighting were measured on a grid at work plane height. Onset HOBO Dataloggers were installed to record the electric light switching events and build a lighting use schedule. The overall average value provided a percentage value, that represented the *percentage of time usage of lamps in a day*. LPD and lighting energy was calculated using the installed watts and the lighting schedule. Careful documentation of the physical characteristics including surface reflectance values and interior furniture layout of each representative space helped in the construction of lighting simulation models.

2.4. MARKET SURVEY

Consultation with the university campus office, which is in-charge of maintenance and retrofitting helped understand their purchasing preferences and policies. Market survey of preferred lamps was carried out to determine the type of luminaires, availability of photometric data for simulation, and cost of luminaires. Electrical contractors and the campus office provided data on wiring, installation, and labour cost. Some manufactures do not share their photometric files but offer to do the lighting simulations themselves. Design options were developed using fixtures where the photometric files were available.

2.5. DEVELOPMENT OF SOLUTIONS

The survey results and the audits were used to identify visual comfort issues that needed to be addressed in each representative space. These issues include: low illuminance levels and uniformity on the work plane, glare, and low surface reflectance. Solutions were developed such that these issues were addressed along with a focus on energy consumption and code compliance as per National Building Code of India (NBC), Unified Facilities Criteria (UFC) and Energy Conservation Building Code (ECBC). NBC and ECBC provided illuminance, LPD and controls criteria, whereas UFC was used for additional guidance on design. Lighting simulations were carried out to evaluate proposed solutions. Energy savings and payback period were calculated. Incremental costs included costs of luminaires, installation, wiring, labour, controls, and surface finishes.

3. Analysis and findings

The results of Phase-I and II audits and visual comfort surveys are summarized in Table 3. Additional audit findings, survey results, design proposal and simulation results are discussed for the studio space only. Summary of the proposed solution and results are presented for all three spaces in Table 2. The following criteria from various standards and codes were used for evaluating the existing design as well as the design proposals:

- NBC: For offices and studio spaces, minimum illuminance levels at work plane should be 500 lux if surface reflectance is <90% and 300lux if >90%.
- NBC: For classrooms, minimum illuminance levels at work plane should be 300lux if surface reflectance is <90% and 200lux if >90%.
- NBC: For all three space types, minimum to average ratio (or uniformity ratio) of illuminance levels should be >0.7; minimum illuminance levels of surrounding area should be >150lux at work plane height.
- NBC: Unified glare ratio (UGR), should be <19.
- ECBC: LPD should be <11.8 W/m², for private office and classroom, and <15.1 W/m² for studio.
- UFC: Minimum surface reflectance for walls to be 60% and ceiling to be 85%. Along with a task ambient lighting approach, UFC recommends that

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classrooms have a task light mounted on the blackboard and private offices be fitted with desk lamps.

Table 3, Summary of audit findings for all 3 representative spaces (value in the
parentheses are from the code/guide)

Parameter	Sub parameter	Studio	Classroom	Private office
Surface reflectance (as per UFC)	Wall (Exposed brick, white paint)	20%, 75% (60%)	20%, 75% (60%)	20%, 75% (60%)
	Ceiling (exposed concrete, white paint)	40%, No white paint (85%)	No exposed concrete, 75% (85%)	40%, No white paint (85%)
Luminaire	Type of luminaire LPD (as per ECBC) Luminous	Open batten - T5 fluorescent 9.5 W/m ² (15.1 W/m ²) 80 lm/W	Shielded direct luminaire- T5 fluorescent 8.7 W/m ² (15.1 W/m ²) 80 lm/W	Shielded direct luminaire- T5 fluorescent 11 W/m ² (11.8 W/m ²) 80 lm/W
Illuminance level at work plane (as per NBC)	efficacy Minimum Task (lux) Min to Avg ratio	75 lux (500 lux) 0.5 (0.7)	216 lux (300 lux) 0.7 (0.7)	118 lux (500 lux) 0.6 (0.7)
Switch board	Minimum surrounding Accessibilit y	62 lux (150 lux) Not easily accessible	187 lux (150 lux) Not easily accessible	72 lux (150 lux) Easily accessible
Lighting condition	Computer work	13% occupants report too bright	13% occupants report too bright	20% occupants report too bright
	Reading or Writing work	40% of occupants report too dim	13% of occupants report too dim	27% of occupants report too dim
Parameter	Sub parameter	Studio	Classroom	Private office
Lighting condition	Model making or Drawing work	47% of occupants report too dim	-	-

Glare	Direct glare	Reported by	Reported by	Reported by
	from lamp	40% of	13% of	27% of
		occupants	occupants	occupants
	Reflected	Reported by	Reported by	Reported by
	glare	27% of	47% of	33% of
		occupants	occupants	occupants
Health	Tired eyes	Reported by	Reported by	Reported by
	due to	74%, 53%,	73%, 53% of	33%, 27% of
	computer,	74% of	occupants. No	occupants. No
	reading/	occupants	model	model making/
	writing,	_	making/drawing	drawing
	model			-
	making/			
	drawing			
	Break for	Reported by	Reported by	Reported by
	eye	74% of	73% of	53% of
	recovery	occupants	occupants	occupants
	Headache	Reported by	Reported by	Reported by
		33% of	20% of	7% of
		occupants	occupants	occupants
Annual	EUI	42 kWh/m ²	40 kWh/m ²	20 kWh/m ²
energy	Consumptio	4978 kWh	1314 kWh	216 kWh
	n			

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3.1. SELECTION OF REPRESENTATIVE SPACES

Based on observations from Phase-I audit, it was found that studio, classroom, and private offices together contributed to 86% of the overall lighting electricity consumption of the campus and hence were selected for further analysis. For each space type, a representative space was then identified for detailed analysis based on the area of the space, type and position of luminaire, surface reflectance, task area, and furniture layout. The space that had the most common characteristics was chosen as a representative space for each space type.

3.2. VISUAL COMFORT SURVEY (STUDIO)

Concerns reported by the occupants were identified as 'issues' to address from visual comfort surveys when >20% of occupants reported it (LEED, 2017). For computer work, 13% of occupants reported the space as 'too bright'; for reading/writing work, 40% reported 'too dim' and for model making/drawing, 47% reported 'too dim'. The minimum illuminance level in this space is 72 lux which does not meet NBC for any of the tasks mentioned in section 3. The tack boards block the light from the fixtures and reduce illuminance levels and uniformity.

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40% of occupants inhabiting the space face direct glare issues from the luminaire whereas 27% face reflected glare issues. Luminaires without diffusers are the reason for direct glare whereas tack board in each row was found to be the reason for reflected glare.

As shown in Figure 1, 74%, 53% and 53% of occupants reported problems with tired eyes during computer work, reading/writing, and model making/drawing respectively. 74% of occupants reportedly take breaks to recover from tired eyes. This decreases the work efficiency of occupants. Additionally, 33% of occupants suffer from headache issues.

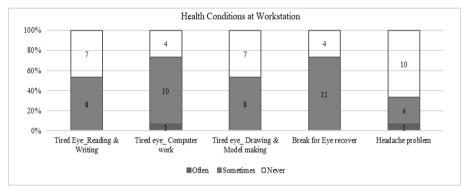


Figure 21, Survey results of health conditions (Studio)

3.3. DETAILED AUDIT (STUDIO)

In the studio, the walls are painted white from the ceiling to 2.7m above floor level (75% reflectance) and the rest is exposed brick-work (20% reflectance). Ceiling is exposed concrete (40% reflectance). UFC recommends minimum surface reflectance for walls to be 60% and ceiling to be 85%. Higher reflectance will improve the luminance ratios within the space and reduce eye strain; this will also improve the Room Cavity Ratio (RCR) which would result in better light distribution.

The luminous efficacy of installed luminaire is 80 lm/W and LPD of the space is 9.5 W/m2 which meets ECBC requirement of 15.1 W/m2 but there is chance to reduce it further, by using lamps with high efficacy (>100lm/W). In this space, open fluorescent batten luminaires throw light in the downward direction only. The lack of illumination on the ceiling increases contrast between the light fixture and its immediate surroundings. The open batten fixture has no elements to cut-off direct glare. The minimum illuminance level for task area and surrounding area in this space is 75 lux and 62 lux respectively. The uniformity ratio for this space is 0.5. These do not comply with the NBC requirements for general drawing space. In this space, only 35% of occupants, positioned near walls have easy access to switchboards for lighting control.

This space is used by occupants on weekdays and weekends from 8 am to 10 pm as shown in Figure 2. During weekdays, the lights are switched on for an average of 50% of the time whereas during weekends, the average is 48%. The annual lighting Energy Use Intensity (EUI) was calculated to be 38.1 kWh/m2.

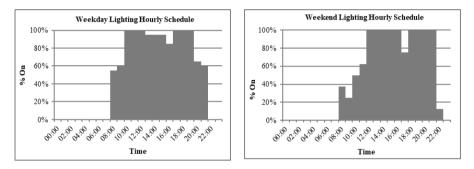


Figure 22, Lighting schedule of operation in studio for weekdays (left) and

3.4. MARKET SURVEY

Conversations with lighting experts, visiting lighting showrooms and additional internet searches showed that Philips, ENDO, Bajaj, GM, Corvi, Jupiter and Oreva were recognized to be the popular lighting brands. Photometric files were not available (either online or on request) for decorative or task lighting in India. For ambient light fixtures, only Philips and Bajaj provided the photometric files of few selected luminaires on request. Some manufactures do not share their photometric files but offer to do the lighting simulations themselves.

For large scale orders the price of luminaire is discounted by 30% to 50% off the MRP of the luminaire depending upon the market and the stock of luminaires. For this project a 40% discount off MRP is assumed.

Market survey led to certain design decisions in this study. Direct/indirect ceiling suspended luminaire by Philips (Model no: SP680P LED34S 6500 PSUSH120 S1) was proposed with dimming controls for private office and classrooms. It was suspended at a height of 0.9m and 1m from the ceiling, in classroom and private office respectively. Direct surface mounted luminaire by Philips (Model no: SM200C LED11S 6500 PSU OD) was proposed for studio. To allow for flexibility, LED desk lamp by Philips (Model no: 61013 Breeze

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LED Desk light) was proposed for private office additionally. Wall mounted luminaire by Jupiter (model no: JI010-16W) was proposed for tack board and blackboard in studio and classroom respectively. This luminaire can be rotated for various angles up to 360 degrees and fitted at accessible distance to the users.

3.5. DEVELOPMENT OF SOLUTIONS

Some common solution approaches for all the spaces were as follows; in-crease the surface reflectance of wall and ceiling to 90%; install direct/indirect luminaire to decrease contrast for visual comfort; make the switchboards accessible to users; provide flexibility to users with dimming controls and task lighting; position the luminaires to achieve NBC requirements for illuminance, uniformity and glare. The proposal for the studio is discussed below in detail.

3.5.1 Proposal for Studio

The existing studio space has been depicted in Figure 3 and Figure 4. Figure 5 and Figure 6 illustrate the proposed case, based on criteria discussed in previous sections. Existing surface reflectance of wall and ceiling were increased to 90%. Two types of luminaires are proposed, 1ft by 1 ft luminaire at false ceiling for ambient lighting and a task light on the tack board which can be rotated by 360°. False ceiling is fixed at 0.6 m below ceiling level. Fan positions are changed to reduce strobe effect from light fixtures. Switch board for the task light is installed at bottom level of each tack board. Grouped switching is provided for ambient light: one switch controls three ambient lights.

Figure 7 shows rendered and isolux images of the proposed design generated in Relux lighting simulation software. The simulations show illuminance level on task area and surrounding area are 315 lux and 197 lux respectively and minimum to average illuminance ratio for task area is 0.7 and 0.76. UGR in this space for any occupant is 10.2. By implementing this design, lighting energy saving of 21% can be achieved. Incremental cost of retrofit and simple payback period is 90,428 INR and 9.5 years.

4. Summary

Summary results of the simulations in Relux, energy calculations, incremental costs and payback are shown in Table 2. The proposed designs for all spaces were able to exceed the minimum illuminance for task and surrounding areas, exceed the minimum to average ratios, and stay within the UGR values required by NBC. Beyond these improvements for visual comfort, energy savings between 21%, to 44% can be achieved with a payback of less than 10 years for each space.

LIGHTING RETROFIT OF CEPT UNIVERSITY:

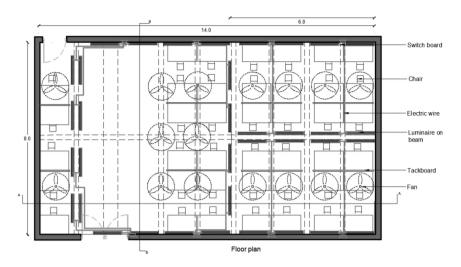


Figure 23, Plan of existing studio

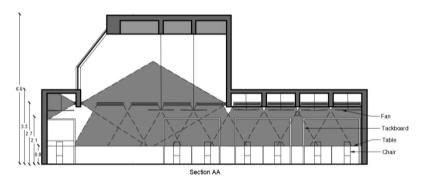


Figure 24, Section AA of existing studio (fixtures are marked in red, and the yellow highlight shows the throw of light)

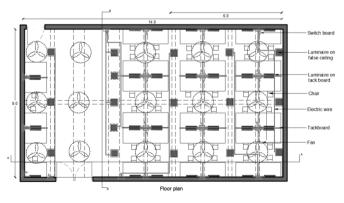


Figure 25, Plan of proposed studio

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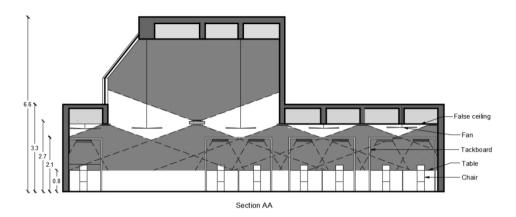


Figure 26 Section AA of proposed studio (fixtures are marked in red, and the yellow highlight shows the throw of light)



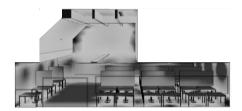


Figure 27, Rendered (left) and isolux (right) image of proposed design for

Table 4 Summary of proposed results (value in the parentheses are from the code/guide)

Parameter	Sub	Studio	Classroom	Private
	parameter			office
Surface	Wall	90% (60%)	90% (60%)	90% (60%)
reflectance	(White			
(as per	paint)			
UFC)	Ceiling	90% (85%)	90% (85%)	90% (85%)
	(White			
	paint)			
Luminaire	Type of	Direct &	Direct/ indirect	Direct/ indirect
	luminaire 1	Direct or	& Direct or	luminaire &
	(Ambient	Indirect	Indirect	Desk lamp
	light) & 2	luminaire	luminaire	
	(Task light)			
	Luminaire	97 lm/W &	105 lm/W &	105 lm/W &
	efficacy of	87.5 lm/W	87.5 lm/W	50 lm/W
	luminaire 1			
	& 2			

	LPD (as	7.2 W/m^2	$4.9 \text{ W/m}^2(15.1)$	6.2 W/m ²
	per ECBC)	(15.1 W/m^2)	W/m^2)	(11.8 W/m^2)
Parameter	Sub parameter	Studio	Classroom	Private office
Switch board	Accessibilit y	Easily accessible	Easily accessible	Easily accessible
Illuminanc e level at	Minimum Task	315 lux (300 lux)	256 lux (200 lux)	302 lux (300 lux)
work plane (as per	Min to Avg ratio	0.76 (0.7)	0.7 (0.7)	$0.63 (0.7)^1$
NBC)	Min. surroundin g	197 lux (150 lux)	202 lux (150 lux)	153 lux (150 lux)
UGR (as per NBC)	Max UGR in space	10.2 (19)	15.7 (19)	13.3 (19)
Energy	EUI	24.9 kWh/m ²	17.8 kWh/m ²	8 kWh/m ²
(Annual)	Consumpti on	2983 kWh	586 kWh	48 kWh
	Savings	1058 kWh, INR 9522, 21%	599kWh, INR 5391, 44%	62 kWh, INR 558, 42%
Incrementa l cost of retrofit in	-			
INR		90428	20337	3768
Simple payback period	-	9.5 years	3.8 years	6.8 years

LIGHTING RETROFIT OF CEPT UNIVERSITY:

Note: One LED desk lamp in office space was proposed as recommended by UFC, and a uniformity ratio of 0.7 can be achieved if the desk lamp is turned off.

5. Conclusion

This lighting retrofit study involves lighting audits, visual comfort surveys, survey of codes and guidelines, market survey for selection of relevant fixtures pertaining to the Indian market, simulations for evaluating the design options, and calculation of energy savings and simple payback.

Visual comfort surveys of the 3 representative spaces show that issues like glare, low illuminance levels, are reported along with health issues such as headache and tired eyes. Due to these, 74%, 73% and 53% of occupants take breaks for eye recovery in studio, classroom and private office.

The Phase II Audit shows the three spaces do not meet the NBC minimum illuminance level requirements whereas only one space (classroom) meets the

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uniformity ratio. Surface reflectance of ceiling and wall in all three spaces are lower than recommended. Switch boards are not easily accessible in all the spaces. Low illuminance, non-uniformity, high contrast between work planes and surrounding surfaces, luminaires that give off direct glare may be the causes of the issues reported by the occupants in the visual comfort survey.

The proposed solutions increased the illuminance levels to meet code requirements and improved uniformity ratio to reduce contrast. The choice of fixtures and their mounting location reduced glare. These performance achievements are expected to address the health issues identified through the visual comfort survey.

The annual EUI for existing studio space is 42 kWh/m² and the proposed solution improved illuminance and uniformity providing annual energy savings of 21%. The existing classroom EUI is 40 kWh/m² and the proposed solution provides energy savings of 44%. The existing private office EUI is 20 kWh/m² and the proposed solution provides energy savings of 42%.

If all 48 private offices, 7 classrooms and 12 studios, which account for 67 out of 122 spaces on campus, were retrofitted as per the proposals here, an annual energy saving of 19,852 kWh could be achieved for a total incremental cost of INR. 14,08,359. This would amount to an annual energy saving of INR. 178,670 with a payback of 8 years.

This study shows that it is possible to achieve a cost-effective, energy efficient lighting solution at CEPT University to address the various issues identified with electric lighting through the visual comfort survey.

6. Acknowledgements

We thank the campus office of CEPT University for providing required drawings and details of lighting vendors. We also appreciate and thank all the occupants for co-operating during the time of survey. Apart from this, we would like to specially thank the faculty members of the M.Tech in Building Energy Performance for providing technical and valuable inputs when needed. Lastly, this study would not have been possible without the support of lighting manufacturers like Philips, Jupiter, ENDO and Bajaj.

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PEDESTRIAN EXPOSURE TO AIRBORNE ULTRAFINE PARTICLES: INVESTIGATING STREET CANYONS IN THE HERITAGE CITY OF KANDY

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Abstract

Traffic emission constitutes the ultrafine particles which play a major role in atmospheric nanoparticles induced health effects on pulmonary, cardiovascular and nervous systems. Thus there is a considerable scientific interest in personal exposure to ultrafine particles and this study presents an experimental investigation of pedestrian exposure to street canyons in mostly populated streets in the heritage city of Kandy. Experimental results explicitly proves majority of the upwind pavements of all Sixteen street canyons are above the overall world standards of mean Particle Number Concentration levels. Thus the findings inform a health risk in the city of Kandy which will instigate a future national dilemma.

Keywords: Ultrafine particles, street canyons, personal exposure, traffic emissions

1. Introduction

With the concentration of fastest growing cities for next 30 years in the developing countries of Asia and Africa, tropical urbanization is an appealing global phenomenon. Intensifying drift in urban sprawl and substandard public transport systems of developing Asian cities promote heavy traffic congestion on roads and the urban environments suffer from poorer outdoor air quality conditions. Thus informs the outdoor air pollution is an emerging catastrophic situation which promotes adverse impacts on health and welfare of urban population concentrated in burgeoning Asian mega cities.

Outdoor air pollution due to particulate matter (PM) and its harmful health effects have being documented by a large and continuously growing number of studies (Hoek et al. 2010). The latest scientific research on the association between PM and negative human health outcomes has been focused on fine (PM2.5) and Ultra Fine Particles (UFPs<100nm) which represents the atmospheric nanoparticles. These particles are more toxic than larger particles and play a major role in PM induced adverse effects on pulmonary, cardiovascular and nervous systems.

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Motor vehicle emissions usually comprise the most significant source of atmospheric nanoparticles and continued growth in number of fossil-fuel based vehicles has caused the greatest health burden in the megacities of developing countries (SDC, 2010). Exposure in urban transport microenvironment close to street is of particular concern because pedestrian's closely associates with the atmosphere of this microenvironments when they are on streets. Moreover exposure and concentration of pollutants of motor vehicle emissions are highly elevated closer to streets than elsewhere.

Street canyon symbolizes the fundamental sectional geometry of a microenvironment in a densely built area of a city. Varying interactions of micro scale urban entities with the micro meteorological processes generates diversified urban atmospheres and promotes plurality in street canyon microclimates (Oke, 1988).

Increasing number of vehicles in cities and motor traffic produces poor air quality in street canyons and represents the mostly polluted zone in an urban area (Santamouris et al. 2001). Air pollution in street canyons are influenced by varying parameters such as its morphology, meteorological conditions and volume of traffic (Gallagher 2016).

Street canyon as the mostly associated urban layer of humans has attracted the greatest attention in the research on urban climates. Impact of canyon geometry on outdoor thermal comfort and energy consumption have been widely addressed an increasing research attention is evident on air pollution in street canyons. Although the scientific progress in urban climate research has assured the current challenge in this field of research is limited attention from rapidly developing countries in tropical climates (Mills, 2014).

Rapidly increasing trend in vehicle ownership is not an exception for Sri Lanka and the composition of the vehicle fleet with high polluting diesel vehicles and predominantly with motorcycles and three-wheelers reinforce vehicular emissions as the main source of outdoor air pollution. With the increasing number of commuting vehicles and considerable slowing down of travel speeds will exaggerate the outdoor air pollution levels in localities closer to major traffic routes.

While recent studies have examined ultrafine particles from traffic in several countries in Asia and developed countries no comparable study has been performed for Sri Lanka. Moreover there is a considerable scientific interest in personal exposure to ultrafine particles. Thus this study experimentally investigated the personal exposure of pedestrians to ultrafine particles in the street canyons of Kandy the second largest city of Sri Lanka which demonstrate the urban streets with larger number of pedestrians.

2. Materials and methods

2.1 EXPERIMENTAL CITY

This study was conducted in the Central Business District (CBD) of Kandy which is primarily a living world heritage city of Sri Lanka declared by UNESCO in the year 1986. CBD is consists of a utilitarian urban fabric integrated into an interconnected street network of the heritage city. Figure 1A and B shows the natural setting and the map of the city center of Kandy respectively. Uniqueness of the city is its geographical location in a center of a valley demarcated by three mountain ranges as shown in Figure 1A. The sacred heritage city composes of the royal palace, lake, the temple of tooth relic of Buddha, chieftains houses (Walawwas) and other settlements (Mandawala, 2009). As shown in Figure 1B, the utilitarian city is robustly integrated into the street network of the heritage city which represents streets with an orientation towards North-South and East-West.

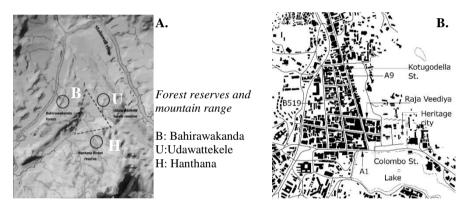


Figure 1, Geographical positioning of city of Kandy, A. Surrounding mountain range, B. Map of Kandy CBD integrating to heritage city

2.2. JUSTIFICATION AS A CRITICAL CASE STUDY CITY

The Kandy CBD is a dense and diversified urban center with a permanent population above 170,000. City of Kandy with 26km2 land areas is evident for the highest population density of the Central province which estimates 6000 persons per km2. Kandy city records 40,000 registered vehicles, a vehicle ownership rate of 255 vehicles per 1000 persons. This is twice that of the national average and continues to increase keeping with the economic growth (Kumarage, 2014). Passenger movement pattern informs 325,000 people enter Kandy CBD during the 12 hour daytime of a weekday of which 46% arrives for employment and education. As shown in Figure 1b, three main roads of A1, A9 and A26 provide the direct entry to Kandy CBD and carry large volumes of traffic. Predominately fossil fuel based transport towards Kandy CBD within a weekday comprises of 5000 trips of buses, 1000 school vans and the traffic

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flow dominated by nearly 45,000 private vehicles. Most of the trips attracted to Kandy CBD end in the city activities. More than half of the people attracted to the city of Kandy are primarily pedestrians. An average, 7500 pedestrians per hour are on Dalada Veediya the densely populated street in the city of Kandy. Thus explicitly justifies its suitability for an experimental investigation of pedestrian exposure to traffic pollution.

2.3. TYPOLOGY OF STREET CANYON GEOMETRIES

Geometrical diversities in canyons are characterized on aspect ratio, street orientation, massing, composition of flanking buildings and canyons integrated with natural surfaces. With the use of an onsite walk through survey and GIS maps a typological profile of 28 street canyons in the Kandy CBD was developed. This typology characterizes street canyons with compact and dispersed massing of buildings oriented towards the two main axes of North-South and East-West streets.

	·	Symmetrical			Asymmetrical
Massing		Aspect ratios (H/W)			
	Orientation	<1	=1	>1	h2/h1<2
Compact Dispersed	N-S	CS	CI	cd	CA ca(NS)
	E-W	cs	ci		
	N-S	DS	DI		DA da(NS)
	E-W	ds	ca(EW		

Table 1. Street	canyon geometries	of experimental	investigation
Table 1. Succe	canyon geometries	or experimental	mvesugation

The aspect ratio represents the ratio of street width to height of the edge building with variations of symmetrical street canyons as <1 (shallow), =1(Intermediate) and >1(deep). Moreover asymmetrical canyons with different building heights and canyons with a water surface and vegetation in a single side were identified. Table 1 shows the morphological characteristics of the symmetrical and asymmetrical street canyons with flanking buildings. Six upper and six lower cases represent canyons in high (180 – 360 vehicles) and low traffic (0-180 vehicles) streets respectively.

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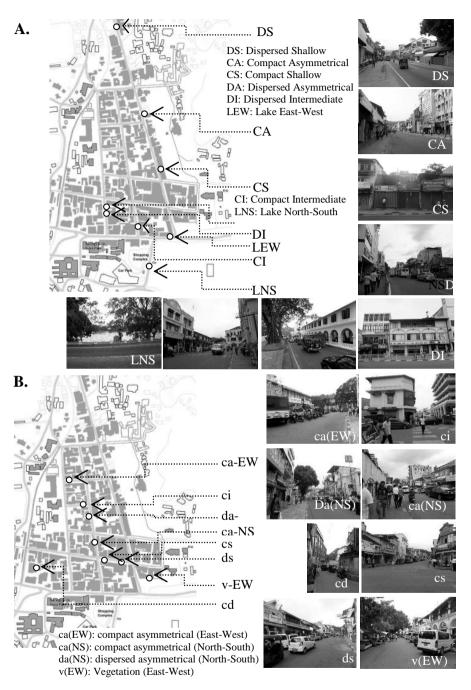


Figure 2, Location and morphological details of experimented street canyons, A. High traffic streets, B. Low traffic streets

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Moreover street canyons integrated with water surface and vegetation was identified. High traffic N-S (LNS) and E-W (LEW) oriented street canyons integrated with water and Low traffic E-W oriented street canyon integrated with vegetation was investigated. This paper presents the pedestrian exposure to atmospheric nanoparticles in 16 canyons which compose of eight each from high and low traffic streets. Figure 2A and B shows the location and morphological characteristics of the low and high traffic street canyons respectively.

2.4. INSTRUMENTATION AND DESIGN OF SAMPLING PROTOCOL

Atmospheric nanoparticles were measured using two newly calibrated portable NanoTracers connected to sampling tubes. This equipment is based on electrical measurement technique which serially generates two independent electrical signals from diffusion-charged airborne particles. These signals determine UFP number concentration (N) and number averaged particle size (dp) of airborne particles in the 10nm<dp<300nm size region (Marra, 2011). Ambient thermal variables such as air temperature (°C), Relative Humidity (%) wind speed (m/s) were measured using the hot-wire anemometer probe.

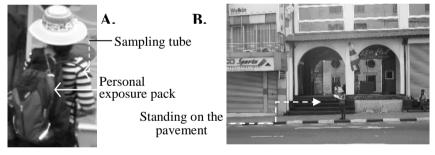


Figure 3, Onsite experimental investigation, A. Personal exposure pack and B. Observer on roadside pavement

Figure 3 shows the sampling strategy involved in pedestrian level exposure monitoring of each canyon. Figure 3A shows the personal exposure monitoring backpack and Figure 3B shows the onsite monitoring mechanism. Exposure measurements of each canyon were recorded by internal loggers of the instruments. The sampling protocol was established to collect data for 10 minutes with an acquisition time of 10s. These loggers were placed in the backpack and the sampling tube and probe was led outside the backpack. Experimental data were collected by two trained members carrying identical backpacks whilst standing at the center of roadside pavements of each canyon. Prior to the sampling program standard zero checks and side by side comparisons for two sets of instruments was performed to assure the quality of data. The roadside measurements were carried out on hot sunny weekdays of 17th and 18th May 2017.

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Concurrent with roadside measurements traffic volume was counted by two observers. Each observer counted number of vehicles passing the point of measurements during the period of sampling. This paper presents the level of ultrafine particle number concentrations in 16 street canyons.

3. Results and Discussion

3.1. PEDESTRIAN LEVEL PARTICLE NUMBER CONCENTRATIONS

A sample of 1920 measured data of ultrafine particle concentrations in upwind and downwind pavements of high and low traffic streets were considered in the analysis. Each street represents eight different street canyon morphologies and the microclimatic analysis of each canyon corresponds to data sample of 120. Samples were collected simultaneously at the center of the pedestrian flow path of both pavements of the street canyon.

3.1.1 Street Canyons in high traffic streets

Figure 4 demonstrates particle number concentrations on upwind and downwind pavements of the high traffic street canyon morphologies.

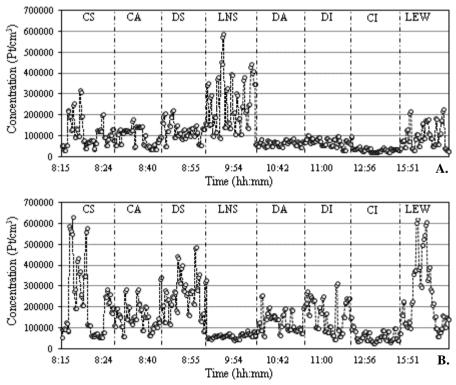


Figure 4,Ultrafine particle number concentrations in high traffic streets, **A**. Pavement of downwind and **B**. Pavement of upwind of high traffic streets.

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Results explicitly confirm a clear variation in PNC of both pavements in the canyon with high concentration levels on the pavements exposed to upwind. Significant difference in measured pavement level concentration indicates the urban canyon effects to the heterogeneity of spatial distribution of pollutants. Upwind pavement of Compact Shallow (CS) and the urban canyon formed by Lake of East West oriented street (LEW) shows the highest PNC levels. Moreover downwind pavement of North South oriented street with Lake shows the highest PNC.

3.1.2 Upwind and Downwind Pavements of street canyons

Descriptive analysis of PNC on upwind and downwind pavements of high traffic streets are presented in Figure 5, A and B respectively. Maximum PNC on upwind pavements varies in the range of 6.3x105 to 9x104 and downwind pavements in the range of 5.9x105 and 4.9x104 particles/cm3. Both street canyons of CS and LEW are apparent for the highest maximum PNC on upwind pavements of the street canyons and the lowest maximum PNC is observed in LNS. However the downwind pavement of LNS is evident for the highest maximum PNC and lowest maximum is observed in DA. A large variation in maximum PNC is evident among both pavements of 08 canyon morphologies.

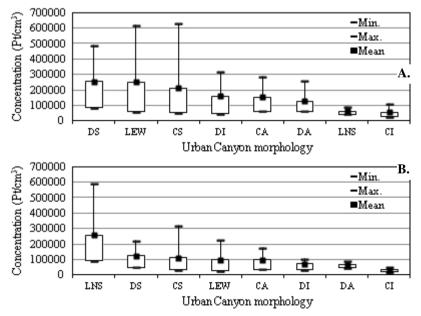


Figure 5, Descriptive analysis of Particle Number Concentrations on the pavements of high traffic street canyons, A. Upwind and B. Downwind

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Difference between highest and lowest maximum PNC on upwind and downwind pavements are 5.4x105 and 5x105 respectively. Descending order from the highest mean PNC on both pavements of the street canyons are demonstrated in the positioning of canyons in Figure 5A and B. Mean PNC on upwind and downwind pavement varies in the range of 2.5x105 to 5.7x104 and 2.6x105 to 3.4x104 respectively.

Thus the differences of mean PNC between upwind pavements are 2.0x105 and downwind pavements are 2.2x105 particles/cm3. Highest mean PNC on upwind pavements are evident in LEW with closer values in DS street canyon. The lowest mean PNC on upwind pavements are demonstrated in CI and closely followed by LNS.

Except for the maximum PNC on downwind pavement of the LNS street canyon a closer variation in mean PNC is observed in other street canyons. Upwind pavements are predominantly polluted than downwind pavements in seven street canyons of high traffic streets. Moreover the percentage increase in mean PNC on upwind pavements with reference to the mean PNC on downwind pavements of the same canyon is within the range of 37% to 60%. Upwind pavements of Compact Asymmetrical (CA) canyon and East-West oriented canyon with Lake (LEW) towards upwind shows the lowest and highest percentage increase in PNC respectively.

Thus the pedestrians in CA canyon are exposed to approximately equal mean PNC on both pavements. However the most polluted pavements with extraordinarily high mean PNC exposure of pedestrians are evident on the pavement along the Lake in both canyons of LEW and LNS. Experimental results explicitly proves Compact Intermediate (CI) canyons along North-South oriented streets contains pavements with the lowest mean PNC concentrations of 5.3x104 and 3.4x104 particles/cm3. Comparison of PNC between varying street canyons is out of the scope of this paper.

Thus the relationship of PNC and vehicle count in high and low street canyons will be presented elsewhere.

3.1.3 Upwind and downwind pavements in low traffic streets

This section presents the measured PNC concentration on both pavements of eight low traffic streets canyons (see Figure 6). The vehicle flow of these canyons is less than 180 vehicles per 10 minutes. Figure 6A and B shows the maximum, mean and minimum PNC on upwind and downwind pavements of the eight street canyons respectively. Maximum PNC on pavements of upwind and downwind varies within the range of 1.8x105 to 4.4x105 and 9.5x104 to

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2.5x104 particles/cm3. The highest maximum upwind and downwind PNC on pavements of high traffic streets are enormously high with atmospheric particle concentrations are 3.4 and 6.2 times higher than the low traffic canyons respectively. Mean PNC concentrations on upwind pavements are within the range of 9.0x104 to 2.9 x104 and 4.8x104 to 2.1x104 particles/cm3 on downwind pavements. All street canyons demonstrate higher PNC on upwind pavements. Moreover a similar pattern of mean PNC variation on two pavements of the street canyons is apparent. The highest and lowest mean PNC of both pavements are shown in the street canyons of ca(NS) and da(NS) respectively. These canyons represent the same street orientation and canyon geometry but differ in the massing of flanking buildings. Thus informs dispersed massing with asymmetrical canyon geometries of low traffic streets are the least polluted and the pedestrians are exposed to mean PNC within the range of 2.1x104 to 2.9x104 particles/cm3.

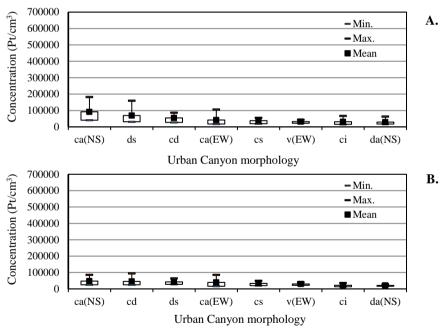


Figure 6, Descriptive analyses of Particle Number Concentrations on the pavements of low traffic street canyons, A. Upwind and B. Downwind

3.2. COMPARISON WITH GLOBAL STANDARDS

This section compares the mean ultrafine Particle number concentrations on the pavements of low and high traffic street canyons in the CBD of Kandy with global standards. In comparison with the measured PNC variability across 40 different roadside locations in cities within and outside Europe mean roadside PNC standards were established for Asia, Europe and overall mean of the representative countries. The Asian mean is based on roadside mean PNC of

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countries such as Singapore, China, Hong Kong, Taiwan and India. Except for Singapore all Asian cities are evident for higher mean PNC levels compares to other cities in Europe, Australia, USA and UK.

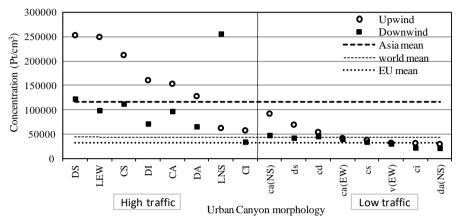


Figure 7, Comparison of mean PNC of street canyons with global standards

The established roadside mean PNC standards for Asia, Europe and overall countries are 1.17x105, 3.15x104 and 4.4x104 respectively. As shown in Figure 7 majority of the upwind pavements of high traffic street canyons are beyond the mean PNC levels of Asia. Out of eight upwind pavements PNC levels of 6 pavements has increased in the range of 31% to 116% from the reference Asian standards.

The most polluted upwind pavement for pedestrians is observed in Dispersed Compact (DS) canyon. However the upwind pavements of CI and LNS shows 47% and 51% decrease of PNC levels respectively. Downwind pavements results a lower PNC level compares to Asian mean with an exemption for pavements in DS and LNS. Percentage decrease in PNC levels of 6 downwind pavements ranges from 4 to 44. In contrary downwind pavement in Dispersed compact canyon has observed for a 119% increase of PNC level in respective to the Asian mean PNC levels. Thus confirms Dispersed Compact canyons are highly polluted and represent unhealthy urban pockets for pedestrians.

In comparison to the canyons of high traffic streets all canyons of low traffic streets are with lower PNC levels and upwind pavements are evident for a percentage decrease of 59 to 82 between all canyons. Experimental results explicitly proves majority of the upwind pavements in all 16 canyons are above the overall world standards. Thus the findings informs the health risks emerging from fossil-fuel based transport and evolving national dilemma which prioritizes the significance of effective transport management protocol for megapolis planning of the country.

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4. Conclusion

This study is an onsite experimental assessment of pedestrian's exposure to atmospheric nanoparticles on upwind and downwind pavements of 16 different street canyons existing in the CBD of Kandy. Results explicitly confirm a clear variation in PNC of both pavements in canyons and higher concentration levels on upwind pavements.

In high traffic streets mean PNC on upwind and downwind pavement varies in the range of 2.5x105 to 5.7x104 and 2.6x105 to 3.4x104 respectively. Out of eight upwind pavements in high traffic streets PNC levels of 6 pavements has increased in the range of 31% to 116% from the reference Asian standards. All canyons of low traffic streets are with lower PNC levels and upwind pavements are evident for a percentage decrease of 59 to 82. Experimental results explicitly proves majority of the upwind pavements in all 16 canyons are above the overall world standards and informs a health risk of cities which will instigate a future national dilemma.

5. Acknowledgements

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A FASHION DESIGN INVOLVEMENT TO UPLIFT THE LOCAL CRAFT OF DUMBARA TEXTILE WEAVING

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Abstract:

An effective craft uplift programme/project has the power of uplifting a whole craft community. In recent years, craft uplift programmes such as, 'design interventions at grassroot level' and 'gamata marketing' (marketing applied to village) caused to change the faces of the crafts and their places in the market. However, unsustainable design interventions due to the negligence of the craft values have directed many crafts to decline. This paper discusses an effective fashion design(FD) involvement taken through fashion as a project to uplift the Sri Lankan indigenous craft of *Dumbara* textile weaving (DTW). Based on empirical data collected at the craft village, the paper presents the uniqueness and the values of DTW, and then discusses the novelty application of the craft carried out within an experimental framework. On-loom pattern creation during the weaving process is suggested as the most suitable design involvement through fashion. The systematic approach is discussed in order to be able to apply in DTW and gain sustainable advantage.

Keywords: Craft upliftment, Dumbara textile Weaving, on-loom patterns, practice-led research, sustainable fashion, design involvement

Introduction

In Sri Lanka, the craft of hand-weaving textiles using hand-spun cotton is centuries old. It has been passing down from generation to generation carrying its values. There are two categories of hand wearers in Sri Lanka as 'Salagama'; the decedents from Indian master weavers whose techniques and skills are inherited to India and 'Berawayo'; the indigenous hand-weavers (Coomaraswami, p. n.d.). At present, different hand-weaving communities are found in various parts of the country. They carry out their hand-weaving practices following their indigenous roots of the craft and there by the woven outcomes have great influence on the values of the craft.

The main indigenous hand-weaving community in Sri Lanka is located in one rural village in Dumbara valley. It is left aside and therefore the indigenous craft has ceased to exist in the competitive market place due to the absence of novelty ideas in matching the needs of the market. As Chandramani Thenuwara states in her book Handwoven Heritage (2012), sustaining distinctive creativity in the modern world requires sensitive understanding of both the craft and making it meaningful moneywise in the modern marketplace. Hence this

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practice-led research is an effort to uplift the Dumbara hand-weaving craft through a fashion design involvement while safeguarding the essence of the craft without distorting its values.

Significance

• Understanding the values of the craft and using them effectively in fashion design to involve in uplifting the craft through a new approach in pattern creation.

• Promoting use of indigenous Dumbara handloom textile in luxury fashion market which can uplift the craft by generating opportunities to the artisans, which results continuing the craft even by the new generation who are moving away from their heritance.

• Promoting ethically and environmentally sustainable designer wear in local fashion market

Methodology

This is a practice-led research in which the designer had experimented in finding a new garment construction method to use the craft's values without distorting them. Designer had experimented with female body measurements to use space between body and the fabric to create innovative fashion silhouettes using the craft with its maximum integrity.

Research tools

Prototyping : Silhouettes are experimented on the dummy to find the relationship between the craft and the female body measurements

Digital photographs: Digital photography is used to understand the behaviour of a woven cloth on the female body Illustrations : Illustrations are used to show the relationship identified between the body measurements and the fabric to be woven Information sources: Books, articles and other reliable literature sources had been used to gather information regarding this indigenous craft

1.0 Dumbara Textile Weaving

1.1 BACKGROUND STUDY

Handloom textile weaving is a craft filled with passion and enthusiasm of the artisan with his or her strength, skill and knowledge. It is a highly time consuming process and in case of Dumbara textiles it is more time consuming than usual due to its intricate design motif creating process which has a strong

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relationship with mathematical knowledge. Interlacing two sets of yarns at right angles to each other, one called the warp which runs lengthwise and the other called the weft running crosswise filling the warp into a fabric .

DTW is different to the common handloom weaving process seen across the country. *Dumbara* weavers use only matt and plain weave to create the ground fabric to support their design motifs. Therefore the loom has only two head shafts which function with by paddling. As their essence and uniqueness is in the motifs they create no variation of weaving techniques are seen in Dumbara. The process of creating each inch of a design motif is hugely time consuming and a complex process which is not easy for a stranger to learn.

1.1.1 Current market situation of the craft

The richness and the characteristics of this indigenous textile weaving tradition has ceased to survive due to the market conditions where craft does not get the right value it deserves. Various trends in market are entrapping consumers so that the distinctive creativities, crafts are moving away from the human world making it more monotonous. With the rising cost of living, it has become very difficult for the weaving families to find labor. Many women who had worked under the master artisans has left the jobs and joined garment industry with the recent establishment of a few garment factories near the village, as they are not sure about the stability of their job as weavers. This is a very severe problem faced by the master weaving families which has made them even to reject orders sometimes.

Not getting the right price for their product is another main problem faced by these indigenous artisans. Buyers tend to compare this weaving with the common hand weaving as they have no idea about the effort and time put in creating each inch of these motifs. This has also caused in simplifying the traditional motifs into less time consuming motifs. Machine made items in market imitating the craft for less prices in the competitive market conditions where price seems to matter more than an appreciation of craft is another severe problem faced by the craft in current situation. Current usage of the craft is mainly on tapestries, bags, table mats, cushion covers, shawls, Sarees etc. Even with these eye catching design motifs, the textile woven using *Dumabara* motifs and techniques is rarely seen in fashion. Main reasons for this are that high time consumption in creating patterns and also motifs tend to come loose if cut into patterns using contemporary garment construction methods. But this project has seen the possibility of using this craft and its techniques effectively in Fashion design.

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Design interventions done to uplift craft sectors can uplift the crafts and at the same time some may harm the true values of the crafts. Therefore it is crucial to understand the core values of the craft before giving it a hand to climb up in the market. "Sustaining distinctive creativity in the modern world requires sensitive understanding of both worlds, nurturing a tradition to make it meaningful moneywise in the fiercely competitive marketplace", says Chandramani Thenuwara (2012) in her book Handwoven heritage. Fortunately, the craft has been passed to the younger generation creating a hope for a better future despite all these difficulties they face; waiting for sensitive modern direction. This project is to give a hand to a craft which has ceased to exist through a fashion design involvement while conserving its values.

1.2 INDIGENOUS WEAVING TECHNIQUES IN DUMBARA

The fabric structure of the these textiles is that of extra weft or supplementary weft patterning in which some weft threads make the unique design motif while other weft threads weave the ground fabric, which is usually matt weave, design picks(threads) are usually woven alternately with the ground picks. Not like in commonly seen handloom machines, these weavers have a loom with only two head shafts and two foot treadles to weave the ground fabric.

1.2.1 Design motifs

The uniqueness of the craft is in these indigenous designs created by the skillful hands of the artisans. The process of motif weaving is described by Chandramani Thenuwara(2012) as,

The design motifs were woven using an indigenous method of retaining the picked up motif to enable the pattern to be reversed. The warp threads needed to form the motif is picked up using a narrow smooth piece of wood, the lath across the width of the warp and then a thin sliver of bamboo is inserted while withdrawing the narrow lath, behind the set of head shafts. Several repeats of the design can be built up in this manner. When a particular weft pick is to be inserted a wide wooden lath or WEAVER'S SWORD is inserted along the required sliver of bamboo while the bamboo sliver is removed. The weaver's sword is then brought forward to rest against the back held shaft and turned upwards thus separating the ends into two sets of thread forming an opening, THE SHED, for the weft pick to be inserted. This is done using a narrow lath in front of the REED. When this lath is withdrawn the pick of weft gets left behind across the width of the warp. The reed then beats this pick into the fabric that is being woven. Two picks of ground fabric are now woven in using the two head shafts and foot treadles. This weft too is inserted by hand.Next, the second motif is reached. Ground picks are woven alternately throughout. Now the reversed design motif is woven in the same manner-ONE REPEAT of the motif is now complete.

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As the initial pick-up procedure to insert the bamboo slivers is time consuming especially when several different motifs are woven across the width of the fabric simultaneously, to cater the today's market needs the design motifs used frequently by the designers have got largely simplified making a threat to their own craft. These geometrical motifs are traditionally designed to match with the rectangular fabrics woven from the loom which are mathematically arranged by the skillful artisans in the needed places. The amazing skill and superb sense of composition and calculations to match with the needed dimensions with which traditional weavers had combined their technically limited design motifs can be been in the museum collections.

2.0 Innovative Garment Construction Process

Hand woven fabric production is a very time consuming process. For DTW even more time is needed. Each inch of fabric is woven with the immense skills and strength of the weaver. The values of material is very high in this aspect. Using conventional methods in creating garments using handloom will cut away many fabric pieces as waste. Therefore it is important to identify methods to utilize the fabric in maximum minimizing its wastage in garment construction.

Also, as explained by Jessica Yen(2016) in one 0f her articles about Zero waste pattern construction she says that (Yen J, 2016),

Roughly 15% of the total fabric used by the fashion industry is wasted, which this is just one of the many ways that fast fashion negatively impacts the environment. To counteract these wasteful practices, a new movement, zero-waste fashion, has sprung up. Zero-waste garments are produced with little or no textile waste. How is this possible? Most patterns that sewists encounter include curved seams and hems, as well as multiple pieces that flare at different angles, making it impossible to create a cutting layout that generates no scraps. Yet an entire cadre of designers, many with their own labels, has embraced this challenge, and is creating distinctive, fashion-forward clothes.

This zero waste garment construction approach is integrated with the possibilities and technicalities of the craft of DTW and it was identified that crating on-loom finished patterns which do not need to be cut into patterns after removing from the loom, is an effective way of getting the maximum outcome of the craft. The selected silhouette creation process is unique to this research. All the silhouettes were to be designed with no pattern cutting and effective and functional placement of design motifs. The weft can be changed or multiple wefts can be used to change the rectangle widths of the same piece on

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the loom. Designer has used this possibility of the hand woven fabric weaving. In this approach fashion design treats the raw materials of fashion, cloth, with integrity.

2.1 FABRIC EXPERIMENTATION

Designer had done, experiments on the female body form to understand the behavior of the material to see how does fabric behave on the body, where the fabric naturally falls and wants to go, how does it fall and to see what happens to the fabric when body moves.



Figure 1: Female body form measurement guide

Places on the female body where fabric holds naturally and concealing requirements revealing etc. were identified through these fabric handling tryouts. Female body measurements and proportions (figure 1) were studied carefully before starting silhouettes creation.

As the idea is to create on-loom finished silhouettes, various draping with rectangular fabric pieces were done on the dummy to see the drape

and behavior of volume between the body and the fabric (figure2).



Figure 2: Fabric behaviour on female body form

Experiments were developed into next stage creating openings along the warp of the experimenting fabrics(Figure3).

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Figure 3: Experimenting silhouettes

Sketching and experimenting happened parallel to each other in the



Figure: 4 Sketching and colour tryouts - Sketchbook pages

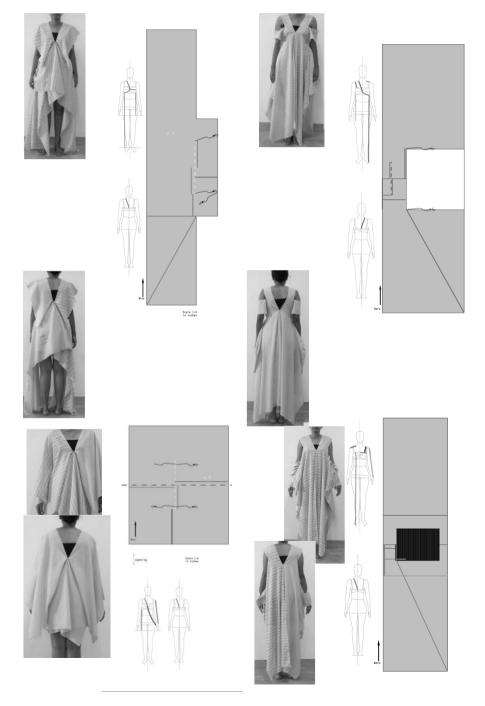
development process (Figure4).

2.2 MATHEMATICAL APPROACH IN THE PROJECT

Identified silhouettes were adjusted to the female body proportions. In here size 12 female figure is used for measurements. Bringing the female body measurements on to pattern which is to be woven as one piece on loom was the unique process. Weft widths, pattern lengths and all the dimensions are mathematically brought onto the rectangular patterns which convert into classy silhouettes when worn on body. The masculine rigid patterns turns into feminine silhouettes on the female body. The place on the body where the fabric weight act needed to be identified to calculate the length of the patterns as the diagonal of the rectangular fabric piece is the lengthiest.

2.2.2 Silhouettes identification

Below figures show how each pattern was created mathematically by placing each body measurement functionally and consciously. Each colour line on the body corresponds to each measurement marked on the illustrated pattern (Figure 5).



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Figure 5: Silhouette creation process : Each colour line on the body corresponds to each measurement marked on the illustrated pattern

2.2.3 Dumbara Design Motif Placements

As mentioned previously the distinctiveness of the Dumbara hand woven textiles is the intricate design motifs which has both functional and aesthetic values. The geometrical motifs can be placed on desired places if it satisfy the needed mathematical requirements of the motif. There are various nature inspired motifs adding different textures on to the ground fabric.

The idea was to place the design motifs effectively on the silhouettes to get the attention on to this distinctive value of the craft. As the motifs are woven along with the weft, the flow of weft needed to be identified. As the identified silhouettes are spacious, the behavior of the weft is not clearly visible at first glance. Therefore lines along the weft side were drawn on the toils and then the prototypes were worn on the female body to analyze the behavior of the weft. The motif placement places were identified on the silhouettes through a picture analysis as shown below. These motif add texture onto the fabric. When the motifs get bigger the feel of it increases and the friction also increases creating a good grip between the skin and the cloth.

Also the motifs add a stiffness onto the fabric. These features were taken into considerations in motif placements. At the same time increasing the visual emphasis of the motifs by placing them on identified eye catching places on the

silhouettes was also done in parallel. For this a picture analysis of trim placement on preferred silhouettes of the target market was done. Images show the motif placement analysis (Figure 6).



Figure 6: Motif placement identification

Below are the final illustrations of the patterns to be crated on loom showing identified pattern placement areas which are shown in lighter shades and use of colours on the patterns. The images in front shows the final looks when worn on body (figure 7).



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Figure 7: Final patterns and Finished dresses

2.3 PRODUCTION PROCESS

Each silhouette took nearly 4 days to complete. Cotton yarns of the counts 80s/2 for the weft ground fabric and 30s/2 was used for the warps. Thickness of the motifs is a characteristic of the craft therefore motifs were done in thick yarns of 20s/2 and 30s/2. At the end of the process the commercial viability of the process was identified by both the artisans and the designer. As explained before all the dimensions of the patterns are consciously calculated using the female body measurements. The pattern placements are done functionally adding grip in between the dress and the skin, adding strength to the identified places, following the referred silhouette lines on the dresses and using less motifs to create more visual aesthetics.

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3. Conclusion

Uplifting the craft can be identified in this research as it has used available skills of the artisans, using available well known techniques used by the artisans, not this being an experimental project in new craft techniques. All the silhouettes had been designed with no pattern cutting and effective and functional placement of design motifs. Designer has used the possibility of using multiple weft at the same time in fabric weaving in creating these unique silhouettes. In this approach fashion design treats the raw materials of fashion, cloth, with integrity.

For a craft to be uplifted it is crucial to understand its core values and applying them in the design process to create new outcomes. Also at the same time it is crucial to make the outcome commercially viable by fulfilling the requirements of a selected target market to continue the production process to generate income for the artisans. The outcome of the research was upto the quality requirements in promoting this indigenous DTW in luxury fashion market which can generate opportunities to the artisans, which results continuing the craft even by the new generation who are moving away from their heritance was a major aim of the project.

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PREFERENCE OF WEATHER PROTECTION DEVICES BY PRIMARY STUDENTS IN SRI LANKA: A CASE STUDY IN RURAL AND URBAN SCHOOLS

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Abstract

Protection of the head, face and skin from sun and rain is of paramount importance especially for primary school children owing to climate change and extreme weather conditions Therefore, children avoiding weather protection devices is a common issue faced by parents. A study was conducted with the objective of understanding the preferences of weather protection devices of Sri Lankan primary school children (ages 5-10 years) of selected rural and urban areas.

The information on Innovativeness in their ideas, Knowledge on ancient weather protection practices, Knowledge on modern technology, Interest in self-protection from weather conditions (rain and sun), and Focus on playfulness were collected. Pictorial expressions on Weather Protection Devices and Preferences were also obtained.

Results showed a gradual increase in relative scores given to the knowledge on ancient practices from grade 1-5. The knowledge of school children in urban areas was comparatively greater on modern practices and applications. However, no differences in the level of innovativeness of ideas could be seen with children in both rural and urban areas.

With age, the interests of children showed a tendency to get closer to that of parents and thus minimize the gap between them in the concept of weather protection. Color, form, texture, interactivity and competition were observed interests.

Keywords: Weather protection, Child Centered Design, Climate Change, Primary School Children

1. Introduction

Since the dawn of mankind on planet earth, it has been evident that they have sought protection from natural weather phenomena, specially the sun and rain. Protection of the head, face and skin is of paramount importance, owing to the irreversible causes by various levels of weather conditions. Overall, weather protection is promoted to ensure to lower the causes and / or to achieve adequate protection by various means. Protection to children among all is recognized as important as they do not realize this need at their age.

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Conventionally, parents and teachers force children to use weather protection equipment such as umbrellas and hats when they are outdoors. However, the children prefer otherwise; they see such devices as something that would distract them from their usual dynamic behavior, and a general tendency to avoid such devices can be seen among children, exposing them continuously to harmful weather scenarios. This is the reason why there is a wide opposition of requirements of the consumer (child) and customer (parent) for weather protection devices. As presented in Figure 1, there is a huge requirement to design appropriate weather protection devices (AWPD) by accommodating the interests of both parents and children while emphasizing the basic need of protection from these weather conditions.

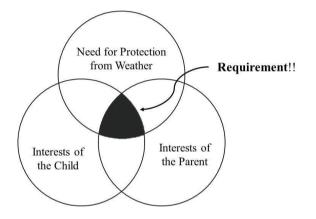


Figure 1: Requirement analysis of protection of children from weather conditions by accommodating the interests of parents and children

1.1 WEATHER PROTECTANTS

Mankind has been using weather protectants since the beginning of civilization using natural means. To suit to weather conditions in tropical, sub-tropical and temperate climates including in desserts and glaziers, communities have been traditionally using appropriate equipment for generations (Blakely, 2006). The causes and repercussions of weather events on humans and animals are not short term but may lead to long term effects inclusive of diseases and side effects. The indirect effects by sun exposures on skin, eyes, memory and behavior in humans are well documented under weather change scenarios.

Some of them are extracted from nature and some are made depending on the availability of materials. Following the inclination of pre-historic man to seek shelter, various forms of housing and accommodation have emerged throughout history, until the need arose for a portable form of shelter. Therefore, different kinds of hoods, hats, umbrellas and body attachments have emerged with the traditional use of leaves, animal skins, tree parts etc. (Plate 1). There are many

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weather protection devices that have been designed since ancient times to cater to these needs of people, young and old alike.



Plate 1: Natural Weather Protection Methods

1.2 WEATHER PROTECTANTS FOR CHILDREN

Generally, weather protection devices for children are those scaled down from adult products and decorated using brighter colours and more appealing shapes for children. Conventionally, hats, umbrellas, protective clothing, protective applicants like sun-screen and attachments are allocated for children when engaging in outdoor activities. But it is a common observation that children find these devices a distraction from their dynamic routines and tend to avoid them whenever possible. Not only do they find these devices a disturbance, but starting from the younger days, they tend to develop certain biased and negative attitudes towards them. Due to their inability to grasp the importance of protection from weather conditions, children who just start schooling (ages 5-10) are the ones most prone to exposure from them. Therefore, with time, changing environments, education, habits, and emerging needs, there has been a great necessity to introduce alternate and novel weather protectants for children.

Among the different groups in communities, young and adult populations will respond in a notable manner to such changes as opposed to children as school and kindergarten children are the most vulnerable to such events with their playful and stubborn behaviors and mindset (Druin, nd). Time bound experiences, age, knowledge, access to share resources, tolerance, ready with equipment etc. shall not be expected with young and children

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1.3 MISCONCEPTIONS ON WEATHER PROTECTIONS

Though, measures against weather events are traditional, there are examples of misconceptions among children that "Umbrellas are for girls". Therefore, children avoiding weather protection devices is a common issue faced by parents (Druin, nd).

1.4 CHILD CENTERED DESIGN (CCD)

When designing products for children, the main interest should be to ensure the usability of the product by the child. It has to be understood that once the children reach a certain development stage, they start making their own decisions though parents can maneuver children of very young ages to act according to their will. According to the WCWTS (2013), when children are first released from the parental care into the outer world and when they start schooling (age 5-6 years), they start identifying the likeliness and differences between objects, and to slowly analyze their belongings with their friends'. Since, they develop certain attitudes towards their belongings and start deciding their preferences, the concept of Child Centered Design (CCD) of products is important.

Accordingly, Druin (nd) has introduced a model to describe stages of including the child in the design process in relation to products for children (Figure 2).

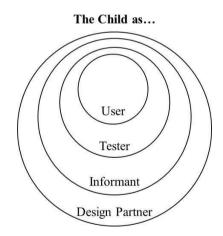


Figure 2: Child Centred Design model by Druin

1.5 CLIMATE CHANGE SCENARIO IN SRI LANKA AND COMMUNITIES

Climate change is one of the most-discussed issues in current global fora besides weather patterns and changes. Across Sri Lanka, climate change

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related weather aberrations and resultant extreme weather events are becoming increasingly common. While this affects the country at large, communities face the worst impacts of this variability. Evidence of climate change in Sri Lanka by analyzing long term (i.e. from 1869 to 2007) monthly data of air temperature and rainfall from seven selected locations i.e. Anuradhapura, Kurunegala, Kandy, Ratnapura, Badulla, Nuwara Eliya and Colombo was shown by De Costa (2008). Interestingly, highly significant linear increasing trends in the mean air temperatures over the entire 140-year period has been evident. The rainfall patterns on the other hand, were seen highly erratic and with uneven distributions of high intensive rains which in turn, seek alternate approaches to face by communities.

Nissanka (2012) while highlighting how weather patterns change across different agro-ecological regions, drifting of seasons, and occurrence of region-specific extreme weather events despite its relatively small aerial extent in Sri Lanka, presented immense importance of developing possible adaptation and mitigation mechanisms to support the communities. Anon. (2016) has analysed and presented how farmers and agricultural workers have been affected due to increased frequency of flood and drought incidence in the last ten years which has caused severe hardship to poor farmers across Sri Lanka.

Many attempts have been made to improve livelihood resilience and ensure water and food security to communities at risk by directly engaging in aspects of science, designing, technology and research. Further, combination of laying a scientific basis for the interventions and implementation of appropriate actions with communities have been achieved for their eventual sustainability. Nevertheless, the attention towards behavioural patterns, shelter, clothing, food and drinking habits, responses to external weather events etc. are scares despite they are important to improve the strategic focus on adaptation to climate change by livelihood.

The main lessons noted are lack of awareness about climate change impacts on livelihood as such, public do not adapt to changed rainfall patterns and seasons appropriately.

1.5 OBJECTIVES OF THE STUDY

With the above understanding of requirement of protection of children from weather conditions, the concept of CCD and highly changing weather events causing irreversible actions in children, it was realised that appropriate and user friendly protective measures be designed especially for school and kindergarten children.

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Therefore, this research was planned with the main objective of understanding the preferences of weather protection devices of Sri Lankan primary school children. The mindsets of the children of primary schools (ages 510 years) were aimed to be understood in order to cater to their needs (the consumers), without conflicting the best interests of their parents and teachers (the customers).

Finally, the outcome of the research aims to be the base for future designs of appropriate weather protection devices for younger children, where the children would actually use them without deceiving their parents into believing that they do, and also comply with all the basic requirements for protection from weather.

2. Methodology

The research was conducted in 3 schools each from Urban and Rural contexts in Sri Lanka, from Colombo, Kandy, Badulla and Anuradhapura districts.

Groups of 10 students each from Grade 1, 3 and 5 were selected from each school. They were interviewed regarding their knowledge and preferences of weather protection devices and recorded in a questionnaire. They were also asked to express their ideas in a pictorial form, with the hope of analyzing their mindsets further. These drawings and answers were analyzed based on five criteria; Innovativeness in their ideas, Knowledge on ancient weather protection practices, Knowledge on modern technology, Interest in self-protection from weather conditions (rain and sun), and Focus on playfulness. The drawings were each marked based on these criteria and analyzed by age (school grade; 1, 3, 5), Background (rural/ urban society) and their exposure to ancient and modern applications.

In parallel, information on attitudes towards weather, and interests for the children's protection from weather was gathered from selected parents and teachers to understand the conflicts of interest with respect to the consumer and customer when purchasing weather protection devices.

A part of qualitative data of the ongoing study were analyzed to determine the mean responses as relative scores and summarized data are presented in this paper.

3. Results and discussion

The results of the knowledge and preferences of weather protection devices by primary school children in the rural and urban areas of Sri Lanka are described below.

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3.1 KNOWLEDGE ON WEATHER PROTECTION DEVICES BY PRIMARY SCHOOL CHILDREN

Knowledge on Ancient Practices:

The results indicated a gradual increase in relative scores given to the knowledge on ancient practices in relation to WPD for school children of 5 - 10 years of age both in rural and urban areas of Sri Lanka (Figure 3). Knowledge levels in grade 1 and 3 were high in rural schools than that of urban schools. However, the children in grade 5 in urban areas showed higher knowledge on ancient practices in relation to weather protection.

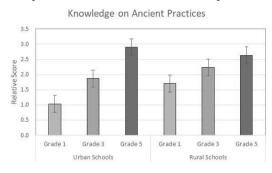


Figure 3: Knowledge on Ancient Practices of WPD

Knowledge on Modern Technology

As shown in Figure 4, the knowledge of school children of 5 - 10 years of age in urban areas was comparatively greater on modern practices and applications. The gradual increase in knowledge levels observed was seen declining with grade 5 students in rural areas probably due to poor access to information sources.

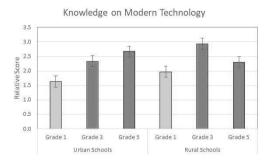


Figure 4: Knowledge on Modern Practices of WPD

Innovative Ideas

A difference in innovative ideas in connection with WPD could not be seen with any of the categories of children (Figure 5).

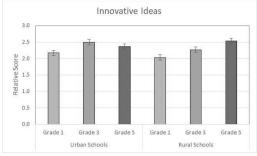


Figure 5: Innovativeness of ideas on WPD

This could be attributed to the knowledge levels observed on ancient practices and modern applications with relevant to WPD. This was supported with the pictorial expressions obtained by the primary school children in rural and urban areas where no remarkable innovative ideas were exhibited in relation of WPD, except an interest in extremely colorful umbrellas (Plate 2).

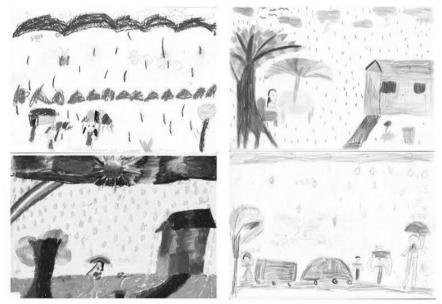


plate 2: selected pictorial expressions on wpd by primary school children

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3.2 PREFERENCES OF WEATHER PROTECTION DEVICES BY PRIMARY SCHOOL CHILDREN

Interest in Protection

A gradual increase in relative scores given to the Interest in self Protection in relation to WPD for school children of 5 - 10 years of age both in rural and urban areas of Sri Lanka was seen (Figure 6). It indirectly indicates the need for WPD being understood by school children with age. However, the trends in interests of children were higher in urban areas.

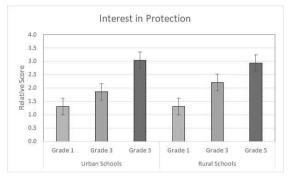


Figure 6: Interest in Protection

Focus on Playfulness

The playfulness among school children of ages 5-10 years was observed to gradually decrease by grade 5 in both regions. This is perhaps due to the increasing competitiveness towards education and examinations by 5th grade. In turn, children tend to get closer to parents and thus minimize the gap in their preferences of WPD.

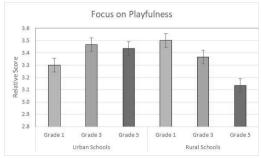


Figure 7: Focus on Playfulness

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3.3 CONCERNS OF PARENTS AND TEACHERS

Parents and teachers were concerned with the full protection of the child's body and head. They preferred WPDs such as umbrellas, raincoats and sunscreen. Their focus was rather on the protection of student, bag, books and shoes, rather than on the outer appearance. They also preferred WPDs with less sharp edges, devices that won't hurt their friends, those that won't distract the students from their work, and devices that won't make the poor friends uncomfortable.

4. Conclusions

Children preferred aspects such as bright colours, creative forms, interactive devices (eg. Drawing where water is bounced off), textured material, devices that can amaze their friends (the wow factor), devices to show off to their friends.

Psychological and design aspects such as color, form, texture, interface, innovation, interactivity and competition were identified as the main considerations/ aspects.

5. Acknowledgements

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FEELING AT HOME. THE ASSESSMENT AS A TOOL TO DESIGN SOCIAL HOUSING

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Abstract

The real city is the one of its inhabitants, and not the one that was planned inside a perimeter. In it, the dwelling is a place of belonging and creates the relationship with the city, representing a strategic axe to overcome poverty and urban substandard conditions. Through assessment, it is possible to extract clues to design new housing proposals or to rehabilitate the existing ones, considering the residential problem in its multiple dimensions, focusing on the needs of the demand and not in the possibilities or the interests of the supply. The evaluation methodology, including physical, economic and social elements, is an important breakthrough since the usual thing is to consider only the economic facts, and even within this, nothing else than the initial cost. Physical, economic and social aspects are analysed separately but with a similar mechanic, to arrive to a final result that relates them, allowing to compare different proposals in an comprehensive way. This paper is a reflection towards planning the settlement - the house - the home, and think on the facts and on the consequences of their transformed environment. And how liveability indicators address to enable families to feel the ownership of their surroundings and of their own home, recognizing them as part of their identity.

Keywords: Social housing; Comprehensive evaluation; technology.

1. Introduction

The results of twenty years of work in the evaluation of Social housing, contribute to demystify assumptions that sometimes are taken for certain without sufficient analysis; to reaffirm conclusions obtained in previous works; to respond to some questions previously raised and to raise new ones.

These conclusions show the importance of evaluating previously and not having to correct later; to acquire and systematize information about what exists and to consider the housing problem in its multiple dimensions, focusing on the needs of demand and not on the possibilities and interests of supply. To do this, there must be different lines of work and different options, also considering the territorial and environmental dimension in the city that is built for all.

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Since the housing problem is one of the main problems facing our country, in the early nineties a research team was formed within the Instituto de la Construcción of the Faculty of Architecture and Urban Design -Universidad de la República (UdelaR), under the leadership of that time Director, Prof. Felicia Gilboa, and designed an evaluation methodology that collects and synthesizes contributions from other researchers and has its greatest originality in addressing the problem of Social Housing within a comprehensive vision.

Since then, the team has carried out numerous evaluation works and accumulated an important experience in the knowledge of different construction technologies used in the country, which seek to reduce costs and production time, to give faster solutions to more people. But many times these technologies have not been sufficiently experienced or have not been properly evaluated, considering only the economic aspects and not the influence on the quality of life of the recipients; the adaptation of production systems, technologies and forms of financing to the social and economic circumstances of each case; and the fuller and more efficient use of social resources.

The present study describes the methodology used, the main characteristics of the items evaluated and a systematization of the results of the years of research and counselling, which show the importance of considering housing in its multiple dimensions.

2. The evaluation as a tool in the process in planning

The concept of evaluation, at the Spanish Royal Academy, is associated with pointing out, estimating, appreciating, calculating the value of something. Thus, the evolution of methods and techniques of evaluation has gone from a predominance of economics, through cost-benefit analysis, to an increasing participation of tools related to sociology, anthropology or even social psychology which expand the sources of information and facilitate the deepening of the behavioural aspects of the final recipient of the architectural product: the user.

Program and policy evaluations are a phenomena that had spread throughout the different public administrations as essential instruments for the rational decision-making of investments: audits, technical controls, performance reports, management reports, cost analysis and benefits or studies, satisfaction have been common practice as a way of knowing the results of activities. The selection of their methodologies and instruments is by no means naive, since it implies a conception of development that gives priority to certain dimensions of this phenomenon over others.

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In recent years there has been a conceptual breakthrough based on the perception of a need for systematization and institutionalization of evaluations and the intention to estimate the effects of interventions on the beneficiaries, in order to increase or qualitatively improve the impact of public policies.

In 1993 the European Community adopted the Project Cycle as a working method, in an effort to systematize its interventions for the development of activities. It builds on the EML Logical Framework Approach, an analytical tool for goal-oriented planning and project management, where evaluation can be understood as one phase of the project cycle and as an activity that influences all others. It is not only an examination at specific moments, but a mechanism for learning from failures and successes, mistakes and successes, and, consequently, to improve planning and management. It is developed in a series of phases: 1. programming: allocation of resources to activities in accordance with established plans and policies 2. identification: recognition of a development problem as an area of possible action and first elaboration of the idea of intervention 3. formulation: detailed preparation of the components of the action according to the EML planning matrix, participation analysis, problems, objectives, risks and alternatives 4. implementation: start-up of activities, in order to achieve the results and the specific objective 5. monitoring, on a continuous basis during the execution to control that the use of resources and the formalization of activities are in accordance with the planned schedule 6. evaluation: analysis of the results and effects of the intervention, in order to learn from the experience. For an intervention to be evaluated, it must have defined objectives; a logic or internal coherence between the elements that compose its design that justifies waiting for the achievement of results; information on the process of implementation of the intervention.

3. Research methodology

"The Evaluation is a tool that contributes to improve the interventions in social housing to the extent that all the involved sectors participate in it, that is applied in a systematic way, and that its conclusions are known and they feed back the future processes." (IC-UdelaR -October 2004)

The methodology formulated and developed by the Evaluation Team of programs and technologies for social housing questions the validity of an alternative housing construction based on the *adequacy to the conditions*: economic adequacy, technical adequacy, social adequacy, cultural adaptation. This concept involves not only a technical judgment, but also the point of view of various actors, including users, whose participation is paramount in the process, especially in defining the

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requirements and evaluation criteria that will most appropriately express those ideas of adequacy. It is a methodology that includes physical, economic and social elements, in which each aspect is analysed separately but with a similar mechanic, so that through a work of synthesis, a final result is reached that encompasses them, allowing to compare different proposals in a comprehensive way after having defined strategic objectives of the evaluation. From the weighting of each of the criteria within the corresponding heading, by global analysis or by comparisons two by two (see *Table 1*) and also the major items with each other, the relative weight of each of them is defined in the evaluation of the whole. Each of the significant criteria is composed of sub-criteria (second order criteria, third order, etcetera), determining the weights between them.

Criterios físicos	SE	S.F	I.	D.	C.T	C.A	F.	E.	I.U	
	VS.	vs.	vs.	vs.	VS.	VS.	vs.	vs.	vs.	
Seguridad estructural		0	0	0	0	0	0	0	0	
Seguridad frente al fuego	1		0.5	0.5	0	0	0	0	0	4.0 2-1
Impermeabilid ad	1	0.5		0.5	0	0	0	0	0	
Durabilidad	1	0.5	0.5		0	0	0	0	0	
Confort térmico	1	1	1	1		0	0.5	0.5	0	
Confort acústico	1	1	1	1	1		1	1	0	
Funcionalidad	1	1	1	1	0.5	0		0.5	0	
Emplazamiento	1	1	1	1	0.5	0	0.5		0	
Integración al entorno	1	1	1	1	1	1	1	1		
Suma	8	6	6	6	3	1	3	3	0	36
Suma ponderada	11.11	8.33	8.33	8.33	4.17	139	417	4.17	0.00	50
Coeficiente	5.56	5.56	5.56	5.55	5.56	5.56	5.56	5.56	5.56	50
Pond eración	16.67	13.89	13.89	13.89	9.72	694	9.72	9.72	5.56	100

Table 1, Two by two comparison (source: evaluation team)

The measurement of each sub-criteria is made from indicators. For each of these indicators, minimums are established with which the proposal will be compared and will allow a classification, first partially by criterion. The relative and absolute weights will enable a partial and final qualification for each criterion and for the aspect. Initially, this model had a quantitative intentionality, aiming to arrive at numerical results that characterize the different aspects and criteria to facilitate to arrive objectively to final conclusions (see *Table 2*). Subsequently, when looking for elements that allowed a finer reading of the results, a qualitative vision was introduced applying the research techniques of the social sciences enriching the analysis. Today, both forms are combined, keeping rigorous in their use, and

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contributing to the study of results and establishment of partial conclusions by Aspect and comprehensive assessment to determine the extent of one aspect over another. It allows, for example, to give a reading of the Program, to make recommendations regarding the objective of the investigation. In all cases, the investigations were based on the study of a random sample, which would allow the measurement of the different physical and social situations and their modification from the intervention of the program. The size of the sample was related to the number of dwellings in the complex, foreseeing a higher percentage of surveys in smaller sets (even 100%).

ASPECTO		PONDER	ACION (%)		Incidencia ponderada			
o GRUPO DE CRITERIOS	CRITERIOS	RELATIVA	ABSOLUTA	CALIFIC.	RELATIVA	ABSOLUTA	CALIF. POR ASPECTO	
22.4086	SEGURIDAD ESTRUCTURAL	16.67	5.6	4.00	0.7	0.22		
	SEDURIDAD FRENTEAL FUEDO	13,89	4.6	3.70	0.5	0.17		
	MPERMEABILIDAD	13,89	4.6	3.68	0.5	0.17		
	DURABILIDAD	13.89	4.6	3.53	0.5	0.16		
	CONFORT TERMICO	9,72	3.2	2.18	02	0.07		
	CONFORTACUETCO	6.94	2.3	2.63	02	0.06		
	FUNCIONALIDAD	9,72	3.2	2.38	02	0.08		
	BUP LAZAN IBITO	9,72	3.2	2.58	02	0.08		
	N TEGRACIÓN AL ENTO RIO	5.56	1.9	2.88	02	0.05		
CALIFICACION FÍSICA								
ECONOMICO 33.30%	NIVERSION TO TAL /m ²	45.0	15 D	0.00	00	0.00		
	COSTO DE MANITEN MIENTO / m²	25.0	8.3	4.39	1.1	0.37		
	MANO DEO BRA/URIrustida	10.0	3.3	4.99	0.5	0.17		
	NSUMOS NACO NALEB	5D	1.7	3.00	02	0.05		
	TIBMPO DEOBRA	15.0	5.0	1.29	02	0.06		
CALIFICACION B	CALIFICACION ECONOMICA							
SOCIAL 33.30%	AUBITO FAULLAR	25.0	8.33	3.70	0.9	0.31		
	AMBITO COMUNITARD	25.0	8.33	2.00	0.5	0.17		
	ASESO RADUENTO TECNICO	25.0	8.33	1.95	0.5	0.16		
	APRO PLACIO N	25.0	8.33	3.00	0.8	0.25		
CALIFICACION SOCIAL								
CALIFICACION FINAL 2.61								

3.1. EVALUATION IN PROJECT-TIME AND POST-OCCUPATION TIME

The methodology proposes two models of evaluation, according to the moment in which it is made: preconstruction or project-time evaluation; or after the execution and occupation of the dwellings (post-occupation evaluation).

In the first case we work on a proposal that has not been implemented yet, based on the executive project for the physical aspect; the detailed budget, for the economic; and the social proposal, formulated according to the population to which the program is directed.

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The post-occupation evaluation is carried out when the appropriation by the users has already been done or is being made, and all the information about the project execution and elements of the physical behaviour is known. It is visualized how the constructed space satisfies or not the needs of the users, its response to the demands in the time and its exposure to the atmospheric, mechanical and use agents. Also the socioeconomic profile of the users, their permanence in the groups, and the appropriation are verified. The economic aspects appear in their true dimension, as there are precise data of investments, labour, times of execution, and other elements.

Both types of evaluation are complemented and provide data to analyse what was constructed, and to project new entrepreneurship, allowing to draw design, use and maintenance guidelines for future constructions and to correct errors in the existing ones.

The methodology includes different tools for collecting data: archival background check; study of collections, reports and data of execution; survey and visual inspection in group visits, in which the residents interact; and the conduct of interviews, both individual and collective, as the main qualitative tool. It interviews program recipients and technicians, both advisors and administration officials, and other qualified informers: representatives of recipient organizations, neighbourhood and / or community referrals, etc.

Secondary sources of information are also consulted, as well as in-depth interviews with community referents, mainly on the issues related to the process and the history of the families targeted by the housing program.

Written and graphic documents are written up on group formation, work process and coexistence. The interdisciplinary analysis of this information is one of the most enriching components of the task, challenging to work together from different perspectives.

But also the user must be a part of the process, from conceptualization to design, and in this one must incorporate the variable of change and transformation, as intrinsic quality of the project, so that it can accept changes as circumstances change and integrate components that can be manipulated, controlled, replaced and transformed independently of the primary structure of a building. Based on the research carried out within the Evaluation Kit of programs and technologies for social housing and professional practices, case studies and the details of their production will be extracted. Based on the conclusions and/or recommendations of the research carried out within the Evaluation Team, the acquired knowledge will be systematized and the various

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contents will be visualized transversally. In the case of professional activity, the methodology previously explained will be extrapolated.

3.2. CASE STUDIES

The methodology was applied, with different objectives and so, in different ways, to the following case studies:

- Direct public promotion Housing Systems (CH) are the result of centralized policies and vertical planning, based on the supply of repetitive and homogeneous models, generally in inadequate locations, in their time with little accessibility to service infrastructure, and ignoring the characteristics of the "demand" that is inserted in these complexes with no possibilities or rights to participate and give an opinion about the dwelling imposed on them. They are part of the so-called "first generation of housing policies", based on supply-side financing programs, consisting of modern housing, grouped into blocks organized by major construction companies and delivered turnkey, following patterns in force in the post-war European reconstruction that overlaps the traditional and nineteenth-century city;
- By the mid-1990s, MVOTMA attempted to solve the housing problems of the lower-income sectors by producing Evolutionary Core Units (NBE) built by turnkey companies. Simultaneously, with similar economic resources, a wide number of cooperative production was carried out by mutual help.

In the framework of the Doctorate in Architecture at the Faculty of Architecture and Urban Design of the University of the Republic (Uruguay), I proposed to work on the role of social housing, considering forms and dynamics of habitability and social heritage in the transformation of the habitat, considering the hypothesis that the construction of the common and the different of the spatial configurations would be determinant in the modes resulting from the appropriation and the use of the dwelling and the urban habitat. So I included another programs to the analysis that was already done by the Team:

- the Plan Lote, which seeks to facilitate the access of families to lots with services in consolidated areas of the city, from the self-construction of individual homes;
- emergency housing that provide in the short term a temporarily solution to the problem of habitability of people, following a catastrophic event that disables their home (in this sense, the practise in Sri Lankan context was of great help);

• and social housing generated in conditions of marginality (spontaneous settlements), in which consolidation processes are generated with punctual improvements.

The casuistic-typological data resulting from the samples surveyed and studied, will be interpreted and elaborated and then infer, project and/or extrapolate a comprehensive study of housing and its habitat

4. The social aspect

The issues that came from the research reflected the incidence of the changes that occurred in the context of the country; the deficiencies in the design and execution of the Programs for a type of population with a great degree of vulnerability, affected negatively in this housing. Post-building work is positively assessed to consolidate the organization and improve coexistence among the group. The different modalities in project management, opened some hypotheses in this regard. The social processes, the capacity of organization, maintenance of the common spaces of the assembly and its links with the environment, seem to have better results in the cooperative mode than in the "hand in hand" delivery. The question that is raised is to what extent it is viable to apply this mode in populations with a greater degree of vulnerability. It would be advisable to implement a program with strong social advice in the stages of group's conformation, during the construction of the houses and mainly in the post-phase.

In many cases, the contribution of social counselling was not recognized, though it was. This could be an element of reflection and apprenticeship to review the work methodology of the technical teams that have worked.

Regarding the typologies, the existence of a personal space is evaluated positively, as well as the perception of the existence of meeting spaces. The degree of satisfaction with respect to housing is high in general, which corresponds, naturally, with a worse previous situation of habitability.

Growth levels had been high. On the other hand, the type of original construction, made with a traditional technology or alternative construction, did not fall into growth rates.

A direct relationship between the income level of the families and the percentage of growth for residential set and family size and overcrowding was found; and a curious opposite relationship between overcrowding and growth. For these reasons it can be expressed that the larger families have induced growth and that the largest income has facilitated the construction.

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Regarding the payment of housing, it does not arise as a concern in the majority of the families of all sets. This is directly linked to the allocation to the housing and its appropriation by the recipients, as generates situations of insecurity regarding tenancy. Therefore, we should assess the responsibilities of the institutional organizations, so that the recuperation of the investment is established and to regulate the legal status in the holding.

5. Global conclusions

If the analysis is carried out on the different aspects, a variable behaviour is observed: the ratings of the physical criteria fall in most cases in postoccupation. The economic scores present important improvements along with declines that are also considerable. In social aspects, it also produces an overall decrease.

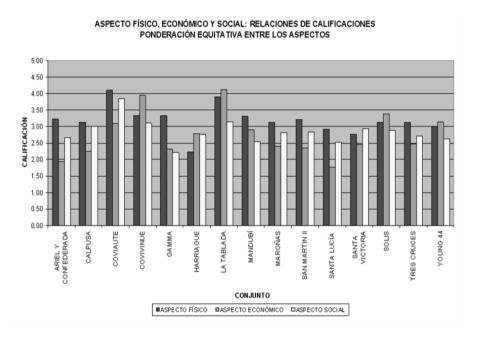
The modification of the evaluation obtained in the physical aspects has important changes between forecasting and reality: the quality of execution; the inaccurate definition of key aspects at the project level that redundant in which it is use inappropriate materials or solutions and the change of conditions of use compared to those provided. The variations in the ratings corresponding to the economic aspects have their explanation in the disparity between the periods of work previewed and utilization of planned labour and the real one. The great difference between one and the other time of the social evaluation is the presence of actual users, which allows to verify effectively the extent to which the proposals achieved the expected results.

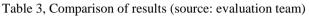
The fact that the larger variations are recorded in rehearsal programs oriented to sectors significantly of very low income, demonstrates that social work is critical. The mobility of families in the homes, which makes many of the population groups, is severely negative: many were now very different from the originals and the difficulties of the financing body to instrument the way of payment-lower costs are not associated with the worst physical behaviour, but they are more influenced by the modalities of management and the efficiency of this, which for a more economical or decisive precarious construction.

There is no clear differentiation between the programs that used innovative or alternative technologies, and those that used the traditional construction, which should be evidenced in the physical qualification and especially in the economy. The results obtained in the program key in hand for each system and construction company are different. It is true that the traditional system has behind itself a "know how to do" for many years and countless studies of each one of its parts so that, to achieve equal performance, the new systems must be studied much more in detail and must have stricter enforcement controls. The BOZZO. L

reason for the different processes that have been given in each case should not only be found in the characteristics socioeconomic groups but in other

variables, the most important process of cooperativization, that is, the construction of the group as a subject and what is specifically associated with it: the organization process. For all comments, see *Table 3*.





6. The quality of habitability

The built environment implies different levels of work-territory, landscape, city, neighbourhood, private space/space public, buildings/support structures, housing unit/separable units, furniture, appliances/objects - in those who reach the most sublime and deepest habit of living. The housing treated as a quantitative problem aimed at providing accommodation to the greatest number of possible families, it included solutions in which the repetition, homogeneity, standardization, functional segregation were used.

XXI century presents new challenges, with the assessment of the housing relationship-public space-uses-mobility. That is why it is essential that the user is integrated to the process from the conceptualization to the design; and how the design incorporates the variables of change and transformation as intrinsic

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qualities of a project of housing, so that it can accept changes according to the circumstances of the user vary; as well as integrate industrial components so that they can be handled, controlled, replaced and transformed independently of the primary structure of a building.

Technology can contribute importantly to optimize production and improvement processes in housing, making the use of resources more efficient. It must be completed with efficient public and private participation, and above all with the recipients' participation, to take into account their priorities and aspirations and enrich the process with its contributions and thus facilitate the appropriation of its habitable space so that it recognizes it as part of your identity.

The evaluation is still a tool that can draw interesting conclusions on these aspects, and so help to improve the interventions in social housing, to the extent that all the sectors involved and participants in it participate, it is systematically applied and its conclusions become public and be an input in the future processes.

This document is a reflection on the planning of the settlement - the home - the home, and think about the facts and the consequences of their transformed environment. And how the indicators of habitability allow to study the degree to which families feel the belonging to their environment and to their own house to recognize them as part of their identity.

I decided to take this meeting as a collaborative space to advance on the development of the doctoral thesis, and incorporate elements into the conceptual framework that could allow me to interpret data and build knowledge from them. Select logical indicators from the incorporation of "new?" indicators for reading and evaluating cases of the corpus of research involves reaching other research sources (Observatories, other research teams) in order to complement them and give a complete reading and description of the adequacies/inadequacies between forms of production and consumption of housing solutions, and also to guide improvements in housing. In this line, can we identify patterns or basic receptive and promoter forms of appropriation and use of housing units and their immediate environment, based on the assessment of the quality of living? What does it make us to feel at home?

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RESULTS CAUSED BY THE EXISTENCE OF DISPOSABLE PRODUCTS: WITH REFERENCE TO PLASTIC STRAWS USED IN SRI LANKA.

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Abstract

Design is for a better world. The stages in the life cycle of disposable products have caused problems to the world. The designer or the inventor of every product should be responsible for each and every direct or indirect consequences caused by the design. Disposable is a concept, which means those products are only for one-time use. There are few main disposable products; those can be identified as straws, cutlery, cups, lunch packs, bottles and bags. Mark C. Stone has introduced modern straws in 1888. which was made out of paper. Straws can be manufactured out of different types of materials such as Glass, Metal, Bamboo, Pasta, Paper, Plastic, etc. According to the usage and functionality straws can categorized as Wide straws, Spoon straws, sanitary straws, and Miniature straws, etc. The objectives are to make a world free of garbage and waste, to acknowledge people, to protect living beings and nature, to prevent disasters and world crises, encourage and provide suitable design solutions to answer existing and future problems. Every product has direct and indirect ways of affecting to the user, society and the world. Caring about those factors and consequences is necessary towards a better world. Study about Straws is the main research sample and the research is based on grounded theory method. The factual data collected from quantitative research method and survey done with observations focusing on Colombo district. The research findings explore that the current usage of straws, the methods and methodologies for a better product, the effect on the society and how it should be updated to the present as well as to the future social contexts.

Keywords: Disposable products, Plastic Straws, Garbage and waste, Designers and inventors, Purpose and appropriate use

1. Introduction

Disposable products are products that are thrown away after one time use. Disposable plastics are the main source of plastic pollution. Consumption of disposable plastics—bags, bottles, straws, utensils, polystyrene cups, film, food packaging and more—has spiralled out of control. These items are used for seconds, hours or days, but their remains last forever.

"50 percent of the plastic we use, we use just once and throw away." (D'Alessandro, 2014). There are tens of thousands of landfills across the globe.

THILAKARATHNA. K.C.M. & RANASINGHE. W.M.N.D.

Buried beneath each one of them, plastic leachate full of toxic chemicals is seeping into groundwater and flowing downstream into lakes and rivers. Even plankton, the tiniest creatures in our oceans, are eating micro plastics and absorbing their toxins. The substance displaces nutritive algae that creatures up the food chain require. Chemicals leached by plastics are in the blood and tissue of nearly all of us. Exposure to them is linked to cancers, birth defects, impaired immunity, endocrine disruption and other ailments. Everything suffers: the health of humans, tourism, recreation, business, animals, fish and birds—because of plastic pollution. The financial damage continuously being inflicted is inestimable. "Not all recycling is equally valuable. True cradle-tocradle recycling is the most valuable because it conserves virgin materials. Plastic recycling is generally not cradle-to-cradle, but just downcycling to fill or fluff or other stuff that does not stem the demand for more virgin material. Most significantly, plastic pollution will not be solved by recycling because it doesn't stop the continual flow of new virgin-material plastic disposable goods every day that enter our environment like a giant oil spill. We need to STOP plastic pollution at the source by phasing out single-use plastics and plastic packaging." (Boyle, 2015)

A straw is a prepared tube used to suck a beverage out of a container. Historians theorize the first straws were cut from dried wheat shafts and they were named accordingly. 'Straws have been used in ancient Mesopotamia, where Sumerians have guzzled beer through straws of gold. In Egypt, long straws have been used to prevent accidental drop of insects. South American natives have used wooden straws for their 'Matey' tea. In 1888, Marvin Stone has invented the paper straw.' (Productions, 2017) He is considered to be the father of modern straw.

With the advent of industrial age, methods were developed to mass produce straws by rolling elongated sheets of wax-coated paper into a cylindrical, hollow tubes. This was accomplished by coiling paraffin-coated paper around a rod-shaped form and then securing the paper with an adhesive. The entire straw was then coated with wax to further water-proof it. The wax coating was important since the straw was paper and would eventually absorb some of the liquid being sucked up it. Thus, inevitably these paper straws became soggy and useless. In the 1960s, paper was largely replaced by plastic which were becoming less expensive and increasingly more sophisticated. The explosion of plastic technology led to techniques to manufacture plastic straws via extrusion. Today, straws are made in a wide variety of shapes, colours, and functions. Colorants can be added to the plastic to give the straws an aesthetically pleasing appearance. However, in the United States, the colorants used must be chosen from a list of pigments approved by the Food and Drug Administration (FDA) for food contact. If the colorants are not food grade, they

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must be tested to make sure they will not leach out of the plastic and into the food or beverage. Additional materials are added to the plastic formula to control the physical properties of the finished straw. Plasticizers (materials which improve the flexibility of the polypropylene) may be added to keep the resin from cracking. Antioxidants are used to reduce harmful interactions between the plastic and the oxygen in the air. Other stabilizers include ultraviolet light filters, which shield the plastic from the effects of sunlight and prevent the radiation from adversely affecting the plastic. Finally, inert fillers may be added to increase the bulk density of the plastic. All these materials must meet appropriate FDA requirements. (Schueller)

"A plastic straw has a lifespan of around 20 minutes, and then it's thrown away," Mark Hall, a Business Waste spokesperson, told the BBC. In more recent history, the United States likely propelled the use of disposable straws. In the early 1900s, when polio and tuberculosis were rampant in the country and people became increasingly afraid of contagious disease from shared glasses, soda fountains began offering drinking straws to prevent contact with the glass. In the mid-1950s, another boost to the straw industry occurred with of cars. Restaurants-spearheaded continued popularization the hv McDonald's-revolutionized the quick meal by replacing washable glassware with low-cost, disposable packaging for meals and drinks on the go. In the 1960s, plastic replaced paper, shifting straws from a renewable to an oil-based, single-use product. (Gourmelon, 2015)

The viral video that inspired organisations to act against straws. "This video shows why plastic trash is detrimental to marine life and why especially plastic straws are one of the most superfluous items made out of plastic, especially if they end up as plastic trash in our oceans. The research team around Christine Figgener (Texas A&M University) found a male Olive Ridley sea turtle during a in-water research trip in Costa Rica. He had a 10-12 cm plastic straw lodged in his nostril, they removed it. say "no" to plastic straws, and any kind of one-time use plastic items!" (CostaRicanSeaTurtles, 2015)

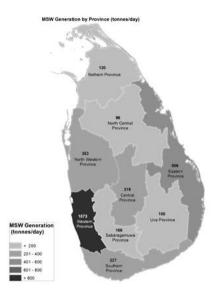
2. Method of Study and Limitations

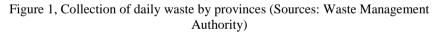
Study about Straws is the main research sample and the research is based on grounded theory method. The factual data collected from quantitative research method and survey done with observations focusing on Colombo district.

The research findings explore that the current usage of straws, the methods and methodologies for a better product, the effect on the society and how it should be updated to the present as well as to the future social contexts.

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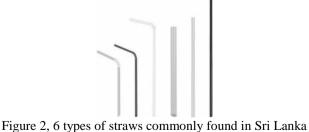
Municipal solid wastes are generated in large quantities creating many social and environmental issues in Sri Lanka. Per capita waste generation in the country ranges between 0.4-0.85 kg and Figure 01 shows the collection of daily waste collection by provinces. The total waste generation is estimated as 6400 tons/day whereas waste collection is only about 3740 tons/day. The Western Province accounts for more than 59% of the country's daily waste generation. In Sri Lanka, the city of Colombo alone generates approximately 1200 tonnes of garbage per day. (Authority, 2016)





3. Research Findings

6 types of straws, which are commonly found in Sri Lanka are as shown below in Figure 2.



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The survey paper was randomly distributed among 59 people. 39% of them were males and 61% were females. 84.7% were at the age of 21-25 years,

RESULTS CAUSED BY THE EXISTENCE OF DISPOSABLE PRODUCTS:

11.9% were at the age of 26-40 and 1.7% each from the age groups 11-20 years and 41-60 years.

From the research sample, 18.6% are having their permanent residences in Colombo. 66.1% are coming to Colombo for their Education. 20.3% are having their work places in Colombo. 15.3% are in Colombo for entertainment. 18.6% are visiting their relations in Colombo. 3.4% are on a trip. 1.7% are on vacation. Below data are according to the survey carried out.

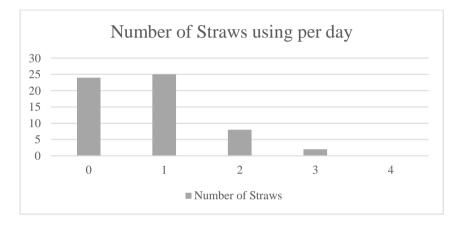
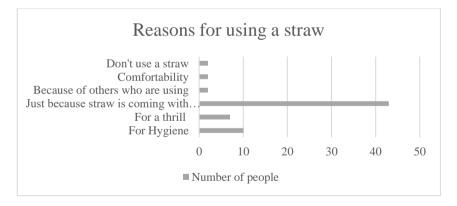
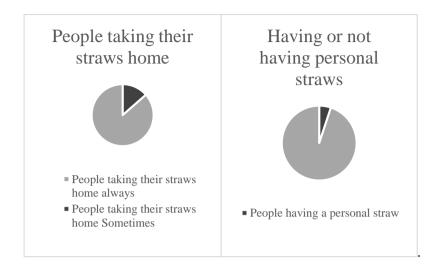


Figure 3, Number of straws used by 59 people



4, Reasons for using a straw by 59 people

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Figure 5 & 6, People taking their disposable plastic straws home and having their personal straws analysed on pie charts

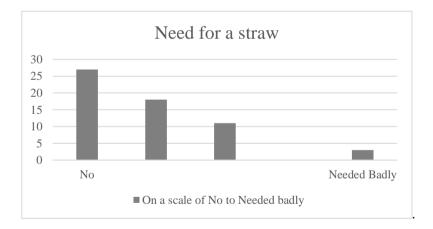


Figure 7, people's need for straw

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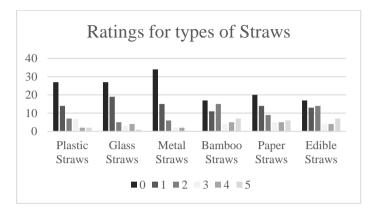
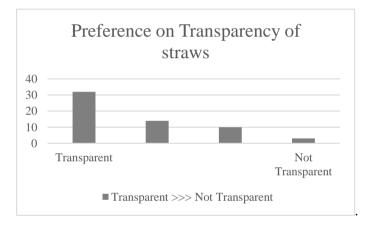
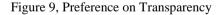


Figure 8, People's preference on different kinds of straws





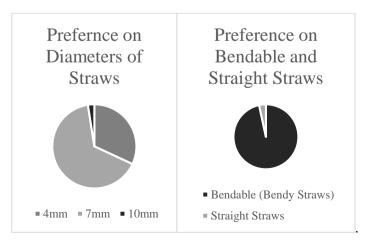


Figure 10 & 11, Preference on Diameter and Bendability of straws



Figure 12, Awareness of the people about the pollution caused by plastic straws

Collection of straws at a location in Colombo District for a week.

Day	PWBS	PGNS	PWNS	PSBS	PBNS	Total	PWBS
Friday (15.09.2017)	145	24	30	-	-	199	Plastic White
Saturday (16.09.2017)	219	33	46	03	-	301	Bendy Straws
Sunday (17.09.2017)	130	05	01	-	-	136	PGNS- Plastic
Tuesday (19.09.2017)	166	12	21	11	05	215	Green Norma
Wednesday (20.09.2017)	322	-	40	13	08	383	Straws PWNS
Thursday (21.09.2017)	201	17	29	15	03	265	Plastic White
Monday (25.09.2017)	191	-	-	-	05	196	Norma Straws PSBS-

Table 1, Details of collected straws

Plastic Small Bendy Straws, PBNS- Plastic Brown Normal Straws

4. Discussion

There are cost of recovering used plastic products (Mader, 1996)

(A) Collection - Integral Collection(MSW)

- Separate Collection (Kerbside, Bring system, etc.) RESULTS CAUSED BY THE EXISTENCE OF DISPOSABLE PRODUCTS

 (B) Separation - Mechanical Sorting - Hand sorting - Fine Separation 		
	•	
(C) Pre-treatment	of Plastics	- Shredding
		- Washing and Drying etc.
		- Agglomeration
(D) Treatment	- Granulation,	Extrusion
	- Feedstock rec	cycling process etc.
	- Combustion	
(E) Credit for reco	overed product	- Polymer material
		-Organic Feedstock
		-Energy (thermal, electric)

So the total recovery cost (TRC) = A+B+C+D-E

There were people neglecting to fill a survey sheet. Some people expected money. People are aware about current issues but do not do anything from their side.

During the collection of straws, people were letting the used bottles to be on the table with the straws. Then some other person has to clean it up and do the work what the other refused. It was an observation on people's attitudes.

5. Conclusion and Recommendations

"In the current 'Game of More', we're told to cheer a growing economy more roads, more malls, more Stuff! Even though our health indicators are worsening, income inequality is growing and polar icecaps are melting. But what if we changed the point of the game? What if the goal of our economy wasn't more, but better – better health, better jobs and a better chance to survive on the planet? Shouldn't that be what winning means?" (Project, 2013)



Figure 13 and 14, use of a straw to drink from a milk packet. THILAKARATHNA. K.C.M. & RANASINGHE. W.M.N.D.

Most of the people stated that they do not need a straw but some desperately needed. Some drinks require a straw for its drinking method. In that case straws have to exist but more effective and environmental friendly way. It is not practically possible to upcycle or effectively recycle plastic straws because of recycling cost and degradation of material.

Awareness programs must be creative and reaching to people in effective ways concerned about current issues and future problems that the world may face. Straws should not be disposable, as they make most of the issues because of that. When they are not disposable, materials including plastics also can be used to make them. But it is better to decrease the use of plastics, since each and every plastics produced make issues to life of living beings and the environment.

Targeting Non-Disposable straw to produce must consider the usability, the materials, ability to clean, ability to carry easily, size, diameter, transparency, durability, cost, manufacturing methods, replacing plastic straws with a design approach. Most of people prefer 7mm diameter straw and bendable straws. It is possible to give what people expect or to make them change according to an appropriate design. It has a design possibility to cater or answer the issues as needed

Non-disposable alternatives for the plastic straw, which are already available. (Alicia, 2016)

- Biodegradable Bamboo Paper Straws by Kikkerland
- Decorative Borosilicate Glass Straws by Glass Dharma
- Hummingbird Bent Glass Straws
- Endurance Bendy Stainless Steel Straws by RSVP
- Reusable Silicone Adjustable Length Straws by GreenPaxx
- Reusable Bamboo Drinking Straws by Zone 365

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WILLINGNESS TO PAY FOR URBAN WATER BODY RECREATIONAL FACILITIES: A CASE STUDY AT DIYATHA UYANA

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Abstract

Revitalization of open water bodies into recreational areas are becoming widely popular in many parts of Sri Lanka. Understanding community perception and expectation on recreational development have important policy and cost-effectiveness implications. This paper explores the public perspectives on development, conservation and value of the open water recreational development at Divatha Uyana and surrounding area. Contingent Valuation Method has been applied to estimate peoples' Willingness To Pay for recreational spaces in the selected area. A total of 300 residents from different socioeconomic backgrounds were selected randomly for the study. Enjoying peace and relaxation, taking children to play and breath clean air were mentioned as most important aspects of open water body areas. More frequent visits occur to enjoy peace and relaxation, breath clean air and enjoy the natural landscape. Almost all the participants were agreed upon conserving open water body areas in urban settings. Willingness to pay was significantly associated with income and occupation status. It yielded a monthly average payment of Rs.446.93 per household for another five years' time. The limited budget was the main reason for not willing to pay. This paper is significant as there is no contingent valuation method study has been carried on water body development in Sri Lanka.

Keywords: Contingent Valuation Method, Open water body development, Valuation of Ecosystem, Willingness to pay

1.0 Introduction

Demand for urban ecosystem services is growing everywhere in the world. Rapid urbanization and change of lifestyles require more public open spaces in cities to fulfil different socio, economic and environmental needs of the city population (Wolch, Byme, & Newell, 2014). Public open spaces provide residents with outdoor recreational activities, contact with nature and enhance the biodiversity in the urban landscape. Ample urban open spaces indicate the livability and the sustainability of the modern cities (Chieura, 2004; Jim & Chen, 2006). In recent years, open water body development and revitalizing have become a popular feature in the urban fabric of Sri Lanka. Properly designed and managed open water body area can facilitate engagement in the neighbourhood and the environment. Planning of open spaces, therefore need careful consideration of needs and aspirations of people.

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Hence acknowledging the importance of public perceptions, planning bodies pay more attention to facilitate designer's perspectives. Further in the legal and planning process in Sri Lanka, public participation is not effectively considered. In order to create effective and sustainable open spaces, it is important to understand perceptions of local people on the development, conservation and their values. The concept of ecosystem services can be used to highlight the importance of preserving and sustainable management of open resources, hence attract the attention of relevant authorities to manage problems in a more efficient and effective manner and implement better policies (Nielsen, Olsen, & Lundhede, 2007). Valuation of ecosystem services by attaching a monitory value to such services is more effective means of highlighting the importance of these natural resources which are being neglected otherwise (Hanemann, 1994).

This study used stated preference approach to assess the willingness to pay (WTP) of users and local people for recently revitalized open water body in Sri Jayawardenarapura Kotte Sri Lanka (political capital of Sri Lanka). The stated preference approach is an economic technique to estimate the monetary value of non-economic goods such as greenery, water bodies, and parks. In this family of research approach, Contingent Valuation Method (CVM) has been increasingly used in valuing environmental goods (Lo & Jim, 2010). Even though more economically valuable natural resources lie in the developing countries, relatively few economic valuation studies have been carried out in this part of the world (Hadker, Sharma, David, & Muraleedharan, 1997a). To the best of our knowledge, no CVM study has been carried on water body recreational development in Sri Lanka. This study is significant as the first study used the CVM to estimate the economic value of the open water body recreational area in Sri Lanka.

This paper organized as follows: section 2 provides a brief literature review of studies that used CVM to access WTP for urban ecosystem facilities. The next section discusses the study location and the research method. The design of the questionnaire is presented in detail in the second section. Results of 300 surveyed questionnaires are organized into four subsections: response rate and socioeconomic characteristics of respondents, importance and challenges of using urban water bodies, conservation of open water bodies and WTP. Next section summarises the study findings and develops the discussion. The conclusion of the paper discusses the applicability of economic valuation methods to value non-market goods in developing countries and future prospects in estimating economic value in environmental goods.

2.0 Literature Review

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Providing high quality urban green spaces have become a key component of urban planning. Rapid urbanization, the rise of income level, changes of lifestyles and concerns on healthy living has increased the demand for urban open space recreational facilities (Berg et al., 2015). Therefore, many studies have emphasized the importance of accessing the monetary value of intangible and non-market benefits of open urban green spaces (Jim & Chen, 2006).

Studies assessing the economic value of natural resources such as ecosystem services, biodiversity and wildlife, cultural goods and waste and resource management have increased with the increased awareness of aesthetic, ecological and environmental and public social functions of these resources (Choi, Ritchie, Papandrea, & Bennett, 2010; Nielsen, Olsen, & Lundhede, 2007; Noonan, 2003; Shang, Che, Yang, & Jiang, 2012; Venkatachalam, 2004). In the past, aesthetic or scenic quality of environmental assets was valued using qualitative methods. Qualitative valuation of the environment is difficult to integrate into the assessment procedure (Tyrvainen & Vaananen, 1998). Such methods have the limitation to provide a universal language to justify the importance of revitalizing and conserving non-market goods.

To address this limitation and to make the planning process systematic, some researchers have suggested applying environmental economic approaches to measure the market value of public goods. By adopting a monetary value to non-market goods provides a standard platform to compare and justify the rationale behind the policy decisions (Jim & Chen, 2006)). Under this approach, CVM has been highlighted as a better way to determine whether the projects are in public interest and whether they need to be continued. The proper cost-benefit analyses can serve as the foundation for planning decisions and investment (Lindsey & Knaap, 1999). Several government agencies have commissioned procedures for using CVM in their regulations. In this backdrop, the importance of assessing the economic value of non-market goods have been increasingly used in many countries (Hadker et al., 1997b; Lindsey & Knaap, 1999, Tyrvainen & Vaananen, 1998)

This literature review has briefly looked at the contingent valuation studies focusing on urban greenery recreational amenities. Mostly, these studies were focused to estimate the economic value of national parks (Bateman & Langford, 1997; Hadker, Sharma, David, & Muraleedharan, 1997b). Estimating non-market benefits of an urban park in Spain, Salazar and Melendez (2007) reported that the mean WTP is considerably higher for people who live closer to the parks. A study from China revealed that the income has a significant association with the WTP (Jim & Chen, 2006). Lo and Jim (2010) reported that Hong Kong residents' willing to pay for urban green spaces is significantly

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associated with age and income. A study from India revealed that despite being a developing country with medium to low-income the participants are WTP to preserve environment amenities (Hadker, Sharma, David, & Muraleedharan, 1997).

It was difficult to find any study conducted to assess the monetary value of open water body development and revitalizing a project. However, assessing the monetary value of water body recreational amenities, help the policymakers and planners to understand public views and also the sustainability of the project. In Sri Lanka, it is very rare to find CVM to solicit monetary values of open water bodies may be due to the lack of concern on using public views in the decision-making process. However, it is worthwhile to gauge information on public perceptions and expectations and also about the monetary value on the emerging trend of developing and revitalizing open water bodies Sri Lanka, because then the planners and policymakers can analyse the demand of people and justify the expenditure. Contingent valuation study on Diyatha Uyana and surroundings are of interest to many people because it is one of the widely used urban water body recreational areas in Sri Lanka.

3.0 Study Area And Methods

3.1 STUDY LOCATION- SRI JAYEWARDENEPURA KOTTE

Sri Jayewardenepura Kotte is the legislative capital of Sri Lanka, located 8km southeast to the commercial capital of Colombo. During the 15th to 16thcentuary, this area used to be the country's kingdom and called as Kotte. Currently, a municipality governs Sri Jayewardenepura Kotte and has developed into an urban area featuring a number of urban characteristics. Sri Jayewardenepura Kotte is a planned city with a number of government building including the Parliament of Sri Lanka and ministerial buildings. Despite the urban development the area still contains lagoons, swamps marshy lands and paddy fields.

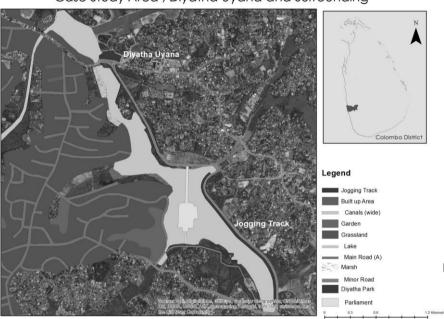
In terms of the demographic characteristics, Sri Jayewardenepura Kotte municipality has a population of 107,925 living in an area of 17 km2. Age distribution of the population shows 70.3% of the population is in 15-64 years age group while 18.3% in 0-14 year age group and 11.4% of the population over 65 of years.

The research site of Diyatha Uyana and surrounding areas are situated in Sri Jayewardenepura Kotte (see Map 1). It was established in 2012 under the guidance and close supervision of Urban Development Authority and the Secretary of Defense. The area sits between the Parliament complex and the Diyawannawa Oya. The marshy land on the banks of Diyawannawa Oya has

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been converted into parks with walking tracks, children's play areas, restaurants and small shops.

Map 1



Case Study Area ; Diyatha Uyana and Surrounding

3.2 SAMPLING METHOD AND DATA ANALYSIS

A total of three hundred people were adopted for the survey. The stratified sampling method was employed to ensure to capture different groups of people. Ten university students were recruited to conduct the survey in August 2017 on Sunday morning and afternoon. A survey was carried out on the site and also at neighbourhood houses. The data were analyzed using SPSS software. Linear regression models were constructed to identify the factors associated with the stated WTP.

3.3 QUESTIONNAIRE DESIGN

The current research used CVM to estimate WTP for preservation and management of the open water body recreational area in Diayatha Uyana and surrounding area. It was a questionnaire-based approach to assess the economic value of non-market goods. CVM provides three different formats when eliciting monetary value: Dichotomous choice, open-ended, and payment card approaches (Venkatachalam, 2004). Previously, both dichotomous choice and open-ended payment card approaches have been commonly used in assessing

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the economic value (Lo & Jim, 2010). However, both methods faced practical limitations. The dichotomous method seeks participants' willingness or not willingness to pay for a given amount by researchers. Even though this question is easy to understand for the participants it requires a large sample size and also it restricts having an actual preferred value of the respondents. The open-ended method provides the better variation of participants' preferred value it requires participants' understanding of bidding system. Payment card approach has been emerged as a hybrid of these two approaches and has been adopted in recent studies (Jim & Chen, 2006).

The current study used payment card approach. The dichotomous approach was less applicable with the resource constraints. The open-ended question method is hard to practice with the citizens of Sri Lanka as most Sri Lankan are not familiar with assigning a monetary value to non-market commodities. To overcome these limitations, payment card approach was adopted which provides participants with a direct prompt and also provide the space for respondents to indicate their preferred amount if they are not satisfied with the given choice.

The design of the questionnaire is important in contingent valuation studies (Tyrvainen & Vaananen, 1998). The questionnaire starts with a brief introduction explaining the aims of the survey. The first section of the questionnaire explored the respondents' level of participation in different activities at Diyatha Uyana and the surrounding area. First, eight groups of questions seek the importance of open water body for the users and non-users in different activities. Next question recorded the frequency of participation in the above eight activities. Final question under the section one explored the challenges when using the open water body.

Section two explored respondents' perceptions of conserving open water bodies. The first question asked whether conservation is important for the users and non-users. Next two sets of debriefing questions were used depending on the response to question 4 (Do you think the conservation of open water body is important to you?). If the answer was yes, they have presented a scaling question with eleven statements to rank the importance of conservation open water bodies. The negative respondents were presented a scaling question nine statement to rank the negative effects of conserving open water bodies.

The WTP questions started with a hypothetical statement mentioning the reduction of public open spaces in the Sri Jayewardenepura Municipal council area. Further it explained the social and environmental problems that can arise from the reduction of open spaces in urban areas. Respondents were recommended to consider their financial circumstances, habits and preferences

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and the environmental features of the area. before filling these questions. The respondents were asked to state their willingness to pay for conservation and development of open water body of a given amount (Rs.1000.00 per month). This amount was selected as an equal average amount of normal monthly fee for a Gymnasium in this area. Then an open-ended question was asked the participants to bid their payment.

After stating their WTP, positive bidders were presented open-ended question to know the motives of their action. Non-positive bidders (Rs 00) were presented another open-ended question to see the rationale behind choosing not to pay for the open water body revitalizing the program.

The questionnaire ends with 12 questions gleaning respondents' socioeconomic characteristics. Such data helped to assertion whether socioeconomic status affects willingness to pay.

4.0 Results

4.1 RESPONSE RATE AND SOCIOECONOMIC CHARACTERISTICS OF RESPONDENTS

A total number of 300 questionnaires were filled by face to face interviews or by the respondents themselves. Socio-economic profile shows that over half of the respondents (62.0%) were in 30-49 of age group (*Table 1*). Fifty-seven percent of respondents have completed their high school education and forty percent have obtained a university or higher degrees. In terms of monthly income, nearly half of the respondents fall within Rs. 50,000-100,000 monthly household income bracket. Fewer respondents indicated over Rs. 300,000 income level. Over one-quarter of participants (27.0%) reported <Rs. 50,000 household income. Over three-quarters of the respondents indicated they are employed full-time or part-time basis.

Socio-economic variables	Categories	Survey %
Age	<30 years	21.3
-	30-49 years	62.0
	>50	16.7
Monthly household income	<rs. 30,000<="" td=""><td>6.0</td></rs.>	6.0
-	Rs.30,000- 49,000	21.3
	Rs.50,000-100,000	48.3
	Rs. 100,000-300,000	22.0
	Rs.>300,000	2.3

Table	1
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Education	Primary school	2.3
	High school	57.3
	University	15.7
	Post Graduate	24.7
Gender	Male	64.3
	Female	35.7
Employment	Full-Time	72.3
	Part Time	6.3
	Unemployed	9.7
	Studying	9.7
	Retired	2.0

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4.2 IMPORTANCE AND CHALLENGES OF USING URBAN WATER BODIES

The survey gathered information on the importance of open water bodies, the frequency of uses and challenges facing by users and non-users. Visits to open water body are induced by different activities. The most important aspect of the open water body is to provide a peace and relaxed atmosphere (*Table 2*). Dwellers of Sri Jayewardenepura are now facing lack of open greenery spaces close to their houses. Therefore, open spaces like Diyatha Uyana and surroundings provide a calming characteristic to the environment. Taking children to play and breathe fresh air was another aspect ranked as important by the participants of the study. Again, the lack of open back garden areas in the neighbourhood and the busy lifestyle of parents limit children's activities. By taking children to open areas increases physical activities as well as social interaction skills of children. Physical exercise and stroll was ranked as the fourth important factor and provides a clear indication of the need for open spaces in high-density urban areas to support residents' physical well-being.

Table 2

Categories	Valid responses %					Score	Rank
	SD	D	N	А	SA		
Exercise or stroll	6.3	1.3	9.3	37.7	45.3	343	4
Breath clean air	1.0	1,0	16.3	45.0	36.7	346	3
Chat or gather with friends	3.0	3.0	18.2	44.1	31.6	292	6
Take children to play group	4.4	0.7	10.1	33.9	51.0	377	2
Biking	44.3	11.1	18.9	14.5	11.1	-186	9
While away time	7.4	4.7	22.8	43.0	22.1	202	8
Enjoy the natural landscape	2.7	4.7	19.0	40.0	33.7	292	5
Add an economic value to the area	6.7	9.4	18.1	35.2	30.5	219	7
Enjoy the peace and relaxation	0.0	1.0	7.4	33.8	57.9	444	1

Why might open water body be important to you?

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SD= Strongly Disagree, D= Disagree, N=Neutral, A= Agree, SA= Strongly Agree Aggregate score is calculated by summing the weights given to =SD= - 2, D= -1, N=0, A=1, SA=2

Enjoy the natural landscape, chat or gather with friends and add an economic value to the area were ranked less important. While away from home was less important probably due to the busy lifestyle. This finding is compatible with Lo and Jim's (2010) study on Hong Kong urban greenery. Lastly, biking was least important. This may indicate the less accessibility of separate biking paths to reach the Diyatha Uyana and surrounding parks and also because of the business of the place.

Most frequent visits were occurred to enjoy the peace and relaxation, breath clean air and to enjoy the natural landscape (*Table 3*). This reflects the users and non-users desire for tranquility in the middle of the busy urban lifestyle.

Categories	Valid responses %				Score	e Rank	
	Never	Rarely	Sometim	Often	-		
			es				
Exercise or stroll	19.7	13.7	29.3	37.3	553	4	
Breath clean air				30.0	588	2	
	4.7	24.0	41.3				
Chat or gather with friends	9.7	27.4	45.5	17.1	507	6	
Take children to play group	21.7	12.7	29.7	35.7	537	5	
Biking	78.6	10	9	2	188	8	
While away time	16	24.3	42.3	17	480	7	
Enjoy the natural landscape	9.3	18.3	48.7	23.3	557	3	
Enjoy the peace and relaxation	4	10.3	43.3	41.3	663	1	

	-
Table	3
rabic	5

How often do you participate in the following activities?

Aggregate score is calculated by summing the weights given to =Never =0, Rarely =1, Sometimes = 2, Often = 3,

The survey gauged information on challenges of using Diyatha Uyana and surrounding area. Inadequate parking and sporting facilities were the most mentioned difficulties facing the participants. The findings of this study can be useful in proposing open water body development in urban areas, as some (23%) mentioned incapability of finding a park close to their residence. Apart from these difficulties, inadequate seating facilities and poor hygiene facilities were also mentioned as challenges in using the area.

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Under the other category, around 38 % of participants have mentioned maintenance issues as obstacles in using Diyatha Uyana. Fewer trees (27%), poor sanitation facilities (19%) and lack of shade (7%) were the most mentioned issues under another category. Public concern about their safety has to take consideration as it was mentioned few times under the other category. Some people indicated their concern on gang behaviours, drug problems as a primary concern for their security.

4.3 CONSERVATION OF OPEN WATER BODY

The survey seeks respondents' attitudes towards conserving open water bodies in urban areas. Almost all the participants (99%) agreed upon conserving open water body areas in their neighbourhood. The motivations behind their attitudes were gauged using eleven debriefing questions (*Table 4*). Place for relaxation or whiling away from home topped the list. This indicates that the people seek more places to relax in the midst of their busy lifestyles. Many respondents were encouraged to save open areas thinking about environmental benefits.

<u></u>	V P D					0	D 1
Category	Valid Re	-				Score	Rank
	Not	Sligh	Somewha	Very	Extremel		
	at all	tly	t		у		
Encourage outdoor activities	2.0	0.7	9.4	42.3	45.0	972	2
Increase property value of the area	3.0	4.9	16.8	45.5	29.1	781	10
Enhance aesthetic quality	2.7	5.3	11.7	40.7	38,3	912	5
Present wild life habitat	15.3	19.0	21.7	22.0	20.7	633	11
Good for public health	3.0	10.7	14.7	45.3	25.3	832	9
Strengthen community sprit	0.7	3.3	14.3	46.0	34.3	922	4
Reduce air pollution	3.3	8.0	18.3	39.3	29.7	844	8
Purify air and environment	0.7	8.3	16.3	39.0	34.3	886	7
Cools the atmosphere	2.0	7.7	13.0	41.0	35.0	890	6
Allow more contact with nature	1.3	5.0	12.7	38.7	41.0	931	3

Table 4

Importance of conservation

WILLINGNESS TO PAY FOR URBAN WATER BODY RECREATIONAL FACILITIES

Place for relaxing or	0.3	3.0	7.0	4.0	54.7	1013	1
whiling away from							
home							

Average scores =- 0=Not at all, 1=Slightly, 2= Somewhat, 3= Very, 4= Extremely Important

5.0 Willingness To Pay

The survey question 7 was targeted to gauge household's WTP to support the development of urban water body and conservation program. First people were asked whether they are willing to pay for a given amount (Rs.1000.00) monthly. About 67 percent (n=201) of respondents showed their support for the program by saying they are WTP a price. There was 33 percent of (n=99) zero bids. Next, asked them to indicate their perceived amount of payment. The mean WTP of households was Rs.446.93 monthly and which will amount Rs. 5,363.16 per year, suggesting that people are willing to pay a notable amount of money to develop and conserve open water bodies.

Multiple linear regression model was applied to estimate factor affecting for respondent's WTP (*Table 5*). All the respondents who did not answer were removed before running the program.

Table 5

Linear regression model for the respondent's willingness to pay for development and conserve of urban water bodies.

		Unstandardized	Coefficients	Standardized Coefficients	t	Sig.
Mode	el	β	Std. Error	В		
1	Constant	-2760.915	1022.412		-2.700	.008
-	Income	244.858	78.926	.239	3.102	.002
	Age	23.024	233.569	.008	.099	.922
	Environmental Group	66.832	76.040	.065	879	.381
	Job	184.061	68.509	.199	2.687	.008
	Gender	257.977	121.875	.162	2.117	.036

Coefficients^a

a. Dependent Variable: WTPMXAMT

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As indicated in *F* test (or global test), the entire model is highly significant at $\alpha = 0.01$ (or 1%) level. Among the other independent variables Income and job are significant at $\alpha = 0.01$ level. The gender variable is also significant at $\alpha = 0.05$ level. For every one-unit change in gender, the log odds of admission (versus non-admission) increases by 0.002. The expected sign for all independent variables chosen are positively contribute towards the WTP values. Variables of age and being a member of an environment group are however not significant.

6.0 Discussion

The survey results suggest people's strong desire in developing and conserving open water bodies in urban areas. This finding can be used to justify the planning decisions and also expenditure used upon developing urban water body recreational areas in cities.

The importance (*Table 2*) and the occurrence of visiting (*Table 3*) open water bodies showed an overlapping ranking indicating people's high desire for having an attachment to the natural environment. The three top ranks for visiting open water bodies were related to acquiring environmental benefits. This may due to the reduction of open places in Sri Jayewardenepura municipal area with the fast urbanisation. With the busy lifestyle and the reduction of open spaces in a neighbourhood may have restricted the attachment with nature and the community and open water bodies have started to re-generate this behaviour. This behaviour pattern is somewhat related to the western people's motivations of visiting open green spaces. However, this is different from the findings from Hong-Kong (Jim & Chen, 2006). The changes of Sri Jayewardene Pura land use show the reduction of water bodies and marshy land. According to 2010 data of land use patterns show that this area consists 10.4% marshy land and 2.1% lakes which are very sensitive to eco-diversity. The survey results in emphasis the need for developing and conserving open spaces in urban areas.

No parking places is a common issue facing the users of urban facilities such as open recreational areas. The increase of car ownership and peaceful environment after the civil war has accelerated people's mobility. The increase of public transportation would reduce the pressure on providing parking spaces. Lack of availability of open spaces seems to be an issue for the participants of the survey. This suggests the need for upgrading public open spaces in urban areas. There can be neighbourhood small potential places which have been neglected because of the more attractive urban recreational areas. Localizing some open recreational areas in neighbourhoods will reduce the pressure on city level places like Diyatha Uyana. Future urban recreational planning can

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use landscape ecological approach to maximize the spatial, social and environmental benefits (Jim & Chen, 2006).

Overall, lack of infrastructure facilities was mentioned as obstacles in using Diyatha Uyana and surrounding recreational area. A requirement of more sporting facilities indicates people's increasing consciousness on health and wellbeing. This reflects the answers given to question one (*Table 2*) and two (*Table 3*). Respondents ranked exercise and stroll at the fourth most important function and also as the fourth in visiting order. With the busy and unhealthy lifestyle urban dwellers are now becoming more aware of the need for physical activities.

6.1 WILLINGNESS TO PAY TO USE OPEN WATER BODY

The findings of this study show the WTP for open water body recreational areas is high among the users and non-users of this study. It is significant for a developing country with people who have limited experience in applying a monetary value to eco-service systems. Currently, there is no entrance fee for open water body recreational areas in the country. Therefore, this research indicates that even people use these facilities for free for years in-return they have a moral feeling to pay for eco-service systems. The mean value of this study is half of the amount usually people pay monthly for an indoor physical exercise centre in Sri Lanka.

This study found that only income had a significant positive influence on willingness to pay. This is more compatible with some studies around the world regardless of the economic development of the country (Jim & Chen, 2006). This indicates that still Sri Lankan people consider recreational and amenity enjoyment as a superior good. The findings revealed that the moral and ethical considerations are not considered in valuing environmental amenities by the participants of this study. In general, it connotes that those who have high income can afford for other services than their basic needs. On the other hand, it indicates that people who can have lower income could exclude from using environmental amenities if an entrance fee was introduced. This should be given more consideration when making policy decisions in future regarding enforcing fees to use natural resources. However, Tyrvainen and Vaanane's (1998) study on the urban forest in Finland revealed that the income does not have any significant impact on people's willingness to pay. This study shows the positive attitudes of people's moral and ethical consideration of the environment. This is a promising indication of protecting ecological systems, and to stop pollution in the country.

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7.0 Conclusion

Sir Lankans have little experience of conducting CV surveys. This needs to be considered when analyzing the data from the current study. The idea of applying a monetary value for the environmental good seems to be unusual for some participants. As a new concept, it took time for the participant to understand the hypothetical situation. Some people might have thought of an actual payment and could have given a lower amount regardless of their actual willingness. Therefore, careful consideration should be given in drafting the survey and should give special emphasis to highlight the hypothetical situation in the survey.

Adopting a monetary value for eco-service systems could provide a justification for policy makers and planners. Development plans can be incorporated into public views and monetary value. By understanding people's motivation and incorporating them into planning decisions in return would attract more support in maintaining and conserving rather neglecting eco-service systems, thinking or criticizing them as a government project.

Finally, the current study provides a green light in conducting more CV studies for valuing not only water body recreational developments in the country but also for the other environmental goods such as forests, biodiversity, ecotourism and water resources. More and more economic valuations on urban open spaces would influence the policy and planning decision in the country. Therefore, it is important to conduct this kind of studies and then the people also would use to adopting an economic value for the environmental goods.

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SOCIAL SUSTAINABILITY THROUGH ORGANIC SUSTENANCE *An interconnection between rural, sub-urban and urban areas*

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Abstract

Sustainability is a complex concept and an interconnected network, impacting an individual to the world. Discussions about sustainability now no longer consider sustainability solely as an environmental concern but also incorporate economic and social dimensions. This paper presents a systems approach for sustainable development through social sustainability, mainly focuses on rural-suburban-urban linkages with the approach of local food to a global solution. The paper incorporates four interconnected layers of this approach, including the understanding of social sustainability, rural-suburban-urban linkages, interconnection of sustainability and food, and the impact of sustainable agriculture on ecological, economic, social and cultural dimensions and a demonstration of the design approach. The context of India and a specific design approach are used to understand the conceptual framework of rural-suburban-urban linkages and social sustainability. The discussed integrated approach could become a responsive tool to solve many critical issues of current and future world and can lead towards a holistic approach to sustainable society.

Keywords: social sustainability, environmental sustainability, economical sustainability, rural-suburban and urban linkages, sustainable agriculture

1. Introduction

In recent years, with rapidly increasing environmental issues, the term "Sustainability" has become a watchword internationally. Sustainability is a complex concept to understand, and its connections are to a wide range of global issues, with its various dimensions of economical, social and environmental sustainability.

Developing countries with enormous biological, economical and cultural diversity and a whole survival as a civilisation are today threatened by inappropriate globalised development. For sustainable cities, we need to address the aspects of social sustainability and design the systems with a new perspective to meet the future global crisis. In a complex system, there are many problems like inclusive growth system, problems of slums, infrastructure, health hazards and other endless problems, which are increasing day by day. By 2050 cities are going to face the problems of sustainable development

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we will face the critical question to feed nine billion people. There is an urgent need to unfold all the interconnected layers of sustainability.

Social sustainability is never explored with a holistic approach to design better cities; it can become a tool for economical sustainability and environmental sustainability and to form sustainable cities. This paper integrates the aspects of

- Sustainable development through social sustainability
- Rural suburban urban linkages for sustainable cities
- Sustainable agriculture the Local food for global solution

The purpose of this study is to understand the connecting network of social sustainability and sustainable agriculture with one of the possible approach of interlinking rural, suburban and urban areas. This proposed approach will positively transform the ecological, economical and socio-cultural dimensions and built environment. The paper addresses that how responsible design approaches aiming for holistic sustainable development can transform the present and future.

2. Sustainability and Social sustainability

We now live in a modern, consumerist and largely urban existence and we consume a huge amount of natural resources every day. Sustainability and sustainable development focus on balancing that fine line between competing needs - our need to move forward technologically and economically, and the needs to protect the environments in which we and others live. Sustainability comprises three layers Environmental sustainability, Economical sustainability and Social sustainability.

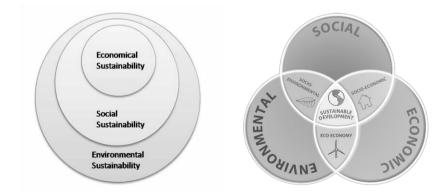


Figure 28: Dimensions of Sustainability

Figure 2: Interconnections of Sustainability

SOCIAL SUSTAINABILITY THROUGH ORGANIC SUSTENANCE

All three layers of sustainability including Economical, Social and Environmental sustainability are interconnected and can't be addressed in isolation. Social and ecological systems are dynamic and connected. They are interdependent and affect each other. Socio-ecological sustainability describes the ability to develop a society that manages the biosphere instead of consuming it.

Social sustainability occurs when the formal and informal processes; systems; structures; and relationships actively support the capacity of current and future generations to create healthy and livable communities. Socially sustainable communities are equitable, diverse, connected and democratic and provide a good quality of life. - according to the Western Australia Council of Social Services (WACOSS)

Social sustainability is largely neglected in mainstream sustainability aspects. Priority has been given to economic and environmental sustainability in the context of planning, housing and communities, where the focus is on renewable resources, low carbon communities and encouraging pro-environmental behaviour in households. As a result, there are very few practical resources that address the question of how to create places that are socially sustainable.

Social sustainability also explains how traditional themes. such equity. as poverty reduction and livelihood, are increasingly been complemented or replaced by more intangible and less measurable concepts such as identity, sense of place and the benefits of 'social networks'.

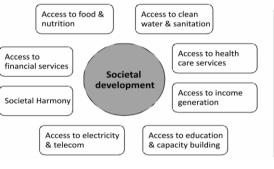


Figure 3: Social Sustainability

Social sustainability addresses how individuals, communities and societies live with each other, to achieve the objectives of development models, which they have chosen for themselves taking also into account the physical boundaries of their places and planet earth as a whole

Social sustainability blends traditional social policy areas and principles such as equity and health, with issues concerning participation, needs, social capital, the economy, the environment, and more recently, with the notions of happiness, well being and quality of life. Social sustainability is a framework that puts people at the heart of cities and recognises that personal wellbeing impacts on and is impacted by, collective wellbeing.

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3. Rural – Suburban and Urban linkages

Urbanization is a dominant demographic trend and an important component of global land transformation. The United Nations predicts that cities will be saturated from the forecast population growth expected over the next four decades. This will impose a tremendous ecological burden both locally and globally. The rate of urbanization is directly correlated with increased production and consumption of goods, services and infrastructure. This leads to greater land consumption, landscape fragmentation, biodiversity loss, the creation of urban heat islands, increasing greenhouse gas emissions and the destruction of sensitive ecosystems. The outcomes are a decrease in human health and well-being among other negative impacts on society, which interact with and are exacerbated by climate change.

Urbanization is more rapid and massive, and affects a greater part of the world than ever before, mainly because of the migration of hundreds of millions of rural folk to the cities. Significant social, economic, and political problems are being created by the huge rural-urban migration. Most workers entering the informal sector are migrants from rural areas unable to find employment in the formal sector. Their motivation is usually to obtain a sufficient income to survive. As many members of the household as possible, including women and children, are involved in income-generating activities, and they often work very long hours. Most inhabits have built themselves in slums and squatter settlements are lacking minimal public services. Millions are homeless, living on the pavements of cities.

3.1 RURAL INDIA

Until a recent past, villagers in India, a family did not easily move to another village or city, but today, the scenario has changed. Migration is obliterating this village attachment, and greater urbanization is creating a profound social, environmental, political and economic dilemma for all segments of society. Rural poverty is bad enough, but its problems are compounded when families leave their rural homes to seek a livelihood in overcrowded city slums, leaving behind their deep-rooted traditions and ties to the extended family and the village seniors. The current growth paradigm is not sustainable, both socially and politically.

3.2 URBAN INDIA

India is the seventh-largest country by geographical area, the second-most populous country with over 1.2 billion people. According to the 2001 Census, the Indian urban population rose from 62.4 mn (17.3%) in 1951 to 286.1 mn in 2001 - 27.8% of the total population. The UN estimates that, if urbanisation continues at the present rate, 46% of the total population (634 mn people) will be in urban areas by 2030. If such an exodus is not checked and corrected, it

will lead to extreme urban decay and strain, and urban sustainability will become a huge utopian vision.

3.3 URBANIZATION PATTERN

Large groups of landless, unskilled, uneducated, illiterate labourers and farmers leave their villages and go to distant large towns or cities like Mumbai, Delhi, Kolkotta and Chennai. They do not go to their neighbouring smaller town centres because these have already reached their saturation point and fail to provide even the minimum services to migrants. The only alternative is the large unknown metropolises seen in movies as glamorous beds of comfort and wealth. Migration causes undue stress to the urban system which has now to deal with pavement dwellings, slums, squalor, disease, crime, and degeneration. The urban system often breaks down due to these stresses. Water, electricity, transportation, education, housing, security and other services fail. Ongoing and increasing demands are moreover made on the local economy which is struggling for sustainability. This causes a major drain on the economy.

Below given chart reflect the entire spectrum of settlements—from small villages to large urban agglomerations for different types of settlements.

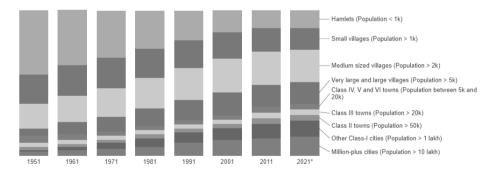


Figure 29: Where India lives: distribution of population by settlement size (source: IIHS, Census)

There is a need to go for professional market research and update the rural people with the required information to lead their products to healthy markets. Without a broad and stable market, micro-enterprises are inadequate, and all the efforts at sustaining villages and preventing migration through this strategy remain unfulfilled. Therefore, a market needs to be explored, identified and created by the people who supply resources to the poor for manufacturing products. In the present context of globalisation, it is particularly important that NGOs and the social institutions take this up because the Indian rural poor are

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mainly illiterate, ill-educated and ill-informed and cannot stand up to the forces of the complex global paradigm.

3.4 SUB-URBAN/ PERI-URBAN INTERFACE OF INDIAN CITIES

The outward expansion of larger metros, gradual changes in land use and occupations have transformed the rural hinterland into semi-urban or 'periurban' areas. These areas are with rural soul in the urban fabric.

Inhabitants of these 'peri-urban' regions are increasingly threatened by a deteriorating quality of life prompted by deforestation, water depletion and pollution as well as by the poor or almost non-existent mechanisms for sewage disposal.

Where the city ends and the rural area begin, mixed land use with rural and urban features coexists in areas surrounding cities. Such areas are particularly vulnerable to environmental damage because of their proximity to the city which could be degrading their land and water resources, for instance, through the dumping of solid and liquid wastes or where population growth has spilled over from the city, and the increased population has strained the carrying capacity of surrounding areas. This makes them no different from the villages of rural India, but unlike these villages, they face a bigger environmental burden stemming from their transitional nature.

3.5 APPROACHES

In the vast area of social sustainability, there is a need to address the area of rural – suburban and urban linkages, to sustain both urban and rural livelihoods and ecosystems. Also, we need to look at the sustainable management of the resources to meet the global food crisis. Sustainable forms of urbanisation require a coherent approach to the rural-urban interface. This interface is a highly dynamic and complex system of land use, constituted by a singular mosaic of ecosystems. The recognition of rural-urban systems and the interdependencies of populations living and working in both areas create new prospects for poverty alleviation in many regions in the developing world. When carefully managed, rural-urban interactions can result in harmonious regional development outcomes.

One of the approaches can be promoting positive two-way interactions and relations between rural and urban areas and how a cooperative or communitybased development can foster economic gains. For example, recycling urban wastewater for rural agriculture is possible, after ensuring that its quality is suitable for crops and human health. A great milestone of such efforts is Amul - the Apex organisation of the Dairy Cooperatives of Gujarat. The Amul brand

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is not only a product but also a movement. It is in one way, the representation of the economic freedom of farmers. It has given farmers the courage to dream. The Amul model has helped India to emerge as the largest milk producer in the world. More than 15 million milk producers pour their milk in 1,44,500 dairy cooperative societies across the country. Their milk is processed in 184 District Co-operative Unions and marketed by 22 State Marketing Federations, ensuring a better life for millions. A milk cooperative promoted economic stability in the rural as well as the surrounding urban regions. Various case studies lead to the idea of local food and global solution, food and biodiversity. This paper covers the different dynamics of the food system and one of the possible approach to local food for a global solution.

4. Interconnection of sustainability and food

Food, water and shelter are our necessities. After air and water, food is an essential resource people require to sustain them. The global food system has become such a governing force shaping the surface of this planet and its ecosystems that we can no longer achieve sustainability without restoring the food system. At the same time, sustainable food systems provide the great possibility for building a sustainable future, a future in which all can lead satisfying lives within the means of the biosphere.

India is a country of possibilities. It is home to incredible history, culture, people, and food but currently facing the challenges of serious health and safety issues, uncontrolled social and economic inequality, and ineffectual government. India has a vibrant technology industry. Businesses from around the world commonly outsource development and customer service operations to India, and domestic and international investors are beginning to take notice of Indian startups. People of Indian origin are also a significant part of the international technology and ecosystem. Furthermore, social entrepreneurship, the use technology to solve civic problems, and the formation of a global community of innovators are gaining momentum as the geographic barriers to communication.

In India Food is more than personal necessities, It is also about culture and, most importantly, about biodiversity. We often do not realise that how flora and fauna around us make up our culture; and interconnection of food diversity, indeed cultural diversity, and is linkage to diversity in the biological world. As an outcome, we do not value this biodiversity that grows on the farm, the forest and the lake and the ocean. Each region of India is diverse in its food habits and food systems. It has its own recipes; cooks with different ingredients and eats differently; and also the world.

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Current global food systems are not enough to meet world's dietary needs. About one billion people are hungry, while two billion people are overweight. India, for example, is experiencing rises in both: since 1995 an additional 65 million people are malnourished, and one in five adults is now overweight. This coexistence of food insecurity and obesity may seem like a paradox, but over- and undernutrition reflect two facets of malnutrition. Underlying both is a common factor: food systems are not driven to deliver optimal human diets but to maximise profits. Report on world health and food systems covers that For people living in poverty, this means either exclusion from development (and consequent food insecurity) or eating low-cost, highly processed foods lacking in nutrition and rich in sugar, salt, and saturated fats (and consequent overweight and obesity).

Much like water, food is vital to human survival, and access to sufficient amounts of healthy and nutritious food varies greatly by region and by socioeconomic level. Worldwide, an estimated one in six people does not get enough food to be healthy. This statistic translates into 40 million deaths each year attributable to hunger or hunger-related diseases. The average poor person spends about 80% of his or her income on food. At the opposite end of the spectrum, many people in developed nations suffer from the effects of an overabundance of too much unhealthy food. In the United States, 30% of adults over the age of 40 are obese. These high obesity rates lead to a variety of serious health problems such as diabetes, high blood pressure, and heart disease.



Figure 4: World Hunger Map

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Beyond the importance of nutrition, food also has economic, social, and environmental dimensions. Efforts at the local, national, and global levels are underway to promote a more sustainable food system, and communities and organisations around the world are producing and distributing food through means that ensure the overall health of communities, support the economy and prevent environmental degradation. The statistics above remind us that there is still a long way to go to achieve a truly sustainable food system around the world.

4.1 FOOD AND HEALTH

Food is the fundamental basis of life, and the quality, quantity and biodiversity of food available are essential to public health. The World Health Organization defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. The health of the population is reflective of the health of the food system. The foundation of a sustainable community-based food system is built on healthy and diverse natural resources. Science proves that healthy soil grows healthy food. Science also proves that eating healthy food nourishes healthy people and healthy people form healthy communities. Therefore, when the soil is unhealthy, it becomes the source of disease in plants, animals and people.

Access to good, fresh, nutritious food is every child's human right. It's easy to agree with this, but the reality is that an astounding 41 million children under the age of five are overweight or obese. Day by day obesity and diet-related chronic disease rates are escalating, while the public's health is further threatened by rising antibiotic resistance; chemicals and pathogens contaminating our food, air, soil and water; depletion of natural resources; and climate change. These threats have enormous human, social, and economic costs that are growing, cumulative, and unequally distributed. These issues are all related to food—what we eat and how it is produced.

4.2 ECONOMIC SUSTAINABILITY AND FOOD SYSTEM

Food is playing a direct economic role. Food production is tightly intertwined with local and global economies. Currently, food is most frequently bought and sold as a commodity.

In the last decade, agribusinesses have made attempts to produce crops that are resistant to diseases, can travel greater distances without spoiling, and produce higher yields through genetically modified food (GM food). The primary benefit of agribusiness and GM food is the ability to produce more food and provide it to people at a lower cost. The result is that much of the world's food is controlled by agribusinesses, which has had serious effects on local

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communities around the world. Areas that were once able to sustain themselves with locally produced food are now dependent on imports. People's access to food is severely limited.

4.3 SOCIAL SUSTAINABILITY AND FOOD SYSTEM

In addition to sustaining our bodies, food sustains our hearts and minds. Across cultures and centuries, food has been central to how we connect with one another. What and how we eat is often heavily influenced by culture, and customs and attitudes relating to food vary greatly from place to place.

Globalization has played an important role in transforming how culture and food interact. As people and ideas travel throughout the world with ever-greater frequency, culture and food follow.

The proliferation of fast food restaurants and products such as McDonald's and Coke and Pepsi Company products (which include Frito-Lay brand chips, Gatorade and Quaker Oats) is a further concern of many who fear that such products will weaken cultural food traditions around the world. Any attempt to create a more sustainable food system will require balancing the benefits of globalisation with the preservation of cultural traditions that promote sustainability.

4.4 ENVIRONMENTAL SUSTAINABILITY & FOOD SYSTEM

A healthy environment is essential to producing sufficient food to sustain the world's population. About 11% of the earth's surface is suitable for agriculture, and 38% of this land has become degraded as a result of poor natural resource management practices. Chemicals used in agriculture – which often run off into rivers, lakes and oceans – and the destruction of rainforests to provide enough land for agriculture and cattle are among the leading contributors to environmental degradation.

Eat right to save the planet. We need to re-invent sustainable agriculture, so that it can meet the needs of millions, but does not cost us the Earth. Think. Eat. Save. That was the theme of the World Environment Day 2013.

4.5 INTERCONNECTED MATRIX

A "Good Food" system is a sustainable community-based food system that focuses on the relationships between farmers, processors, distributors, retailers and eaters.

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There is an emphasis on locally-grown food, economic development, sustainability, resource conservation, health and social equity. When local food production is integrated within a community, food becomes a community asset. As access to locally-grown food increases, food security improves, more fruits and vegetables are consumed, and diet-related chronic diseases decline. A more environmentally sustainable food system would require fewer transportation energy and fossil fuel inputs. In accordance with the community-based discussion above, it would also be climate-appropriate. The time is ripe for public health practitioners to commit to a vision of good food and support a sustainable food system by cultivating a food landscape that supports the health, social and economic well-being of individuals, families, farms and communities. Healthy soil and healthy food can be the next public health achievements.

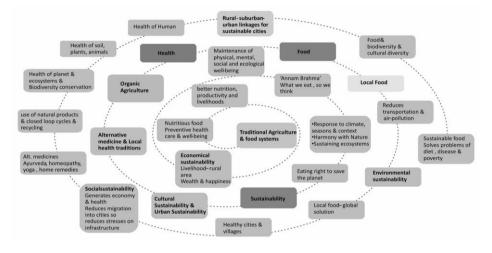


Figure 5: Interconnected matrix of sustainability, food, health and organic agriculture

5. The impact of sustainable agriculture on ecological, economic, social and cultural dimensions Agriculture

A sustainable and resilient food system conserves and renews natural resources, advances social justice and animal welfare builds community wealth and fulfils the food and nutrition needs of all eaters now and in the future. A sustainable system of agriculture and food production will need to balance each aspect of food production to create a self-sustaining system that will provide sufficient food, strengthen the economy, and preserve the environment.

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In recent years, the developed world has sought to make food production and distribution more sustainable. The concept of sustainable agriculture often includes organic farming, locally-sourced food, and fair trade agriculture. Sustainable farms minimize their impact on the environment by creating a self-sustaining ecosystem within the farm. The farmers frequently plant a variety of crops and use strategies like crop rotation, which cause the soil to be naturally refilled with nutrients, and also with the use of organic fertilisers. 'Since the Rio Earth Summit in 1992, a diverse range of scientists, state and non-governmental development bodies and private-sector organisations have taken their lead from the concept of "sustainable agriculture".

Many approaches were originally developed as a means of turning away from conventional agricultural practices and as a countermovement to the Green Revolution. As a result, these approaches place the ecological dimension at the centre of their conception. Newer approaches emphasise the social dimension, and especially poverty reduction. The Task Force on Hunger, set up under the UN Millennium Project, described the priority intervention areas related to the three dimensions of sustainability. All the intervention areas need to be pursued simultaneously:

- Increasing agricultural productivity for food security (economic dimension of sustainable agriculture)
- Restoring and conserving natural resources for food security (ecological dimension)
- Promoting good governance, gender equality and development approaches focused on people and their needs (social dimension).

There is strong competition between these three different dimensions of sustainability. The challenge is to find an optimum balance between them. This takes place by negotiating in a spirit of partnership, to reconcile contradicting interests while shaping complex processes of social reform, transformation and development. The challenge is to respond adequately both to the immediate needs of the population and to the ecological conditions at a specific location and to manage resources in a manner that safeguards them for the future. The goal is to optimise yields (by making optimum use of land and water resources) without causing adverse short-term or long-term impacts on nature, the environment or society.

Sustainable agriculture also builds up community development. By selling goods locally via farmers markets, local food cooperatives and grocery stores, and community supported agriculture, reduction in the pollution associated with transportation, but also community has access to healthy food. Sustainable agriculture needs to be brought back into the development agenda! It is impossible to achieve sustainable development without applying sustainable

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agriculture on a large scale. Sustainable agriculture is a broad concept that covers a number of different approaches. All try in one way or other to achieve environmentally sound, economically profitable, ethically acceptable and socially responsible form of land husbandry. They have much in common with each other, and different people and organisations define them differently, so overlap is not unusual.

 Ecological dimensions Soil fertility Quality and availability of water increased biodiversity No spread of hazardous substances Healthy impact on the landscape ex. relief, vegetation cover, settlement structure Balance between energy & technology Constructive impact on the climate Environmental Sustainability Reduce Transportation Energy Reuse Vacant Land Mitigate Soil Contamination Increase Biodiversity Recycle Waste 	 <i>Economic dimensions</i> improve incomes Provide Business Opportunity Create Jobs Develop Workforce and/or Entrepreneurialism Sustain Farmland Build Local Food Infrastructure lead towards food and income security Farmers to accumulate their working capital The nutritional situation and food availability change if the approach is applied on a large scale compete with other sectors aggregate an economic gain to the national level 	 Social and cultural dimensions rural poor & livelihood or affect social customs, traditions, norms and taboos indigenous knowledge recognised within the approach ensure a more equitable division of labour and distribution of income between men and women; Poor and rich; Young and old; Different ethnic groups and castes broad adoption improve the health situation of the people equitable access to assets, agricultural inputs such as land(secure land-use rights), water, capital (credit), skills and knowledge accessible to the poor technology safe for humans and animals the beneficiaries gain opportunities for empowerment, access to social services, control and decision- making

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6. Design approach

With the understanding of social sustainability, rural-suburban-urban linkages and sustainable food systems as discussed in the paper, a design approach is proposed for the suburban area of Ahmedabad city to explore the possibilities. The design approach demonstrates an intervention in a suburban area, for social sustainability and sustainability in a holistic context. Thaltej, the suburban area, is located in Ahmedabad city. Ahmedabad is the fastest developing city in India. Thaltej is in proximity to the urban city and having village-like settlement pattern. The site consists lakes and a vegetable market. The potential of the site is its strong connection to the city and nearby villages.

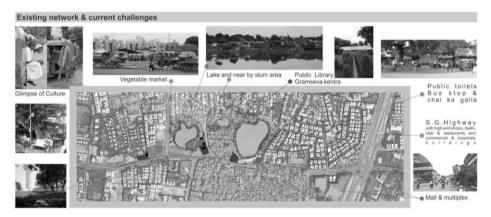
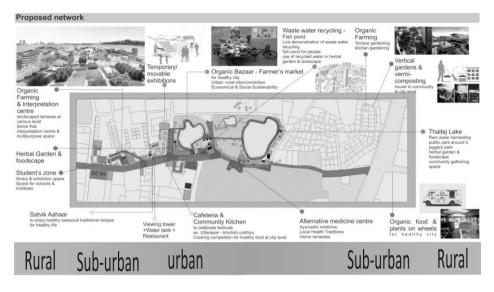


Figure 6: Existing network of suburban area Thaltej, Ahmedabad

Thaltej is one of the fast developing suburban areas of Ahmedabad, where still you can find an urban life of the city with rural soul. The selected site is one kilometre away from S.G.Highway, one of the busiest highway of Ahmedabad connecting to Gandhinagar. The site has two lakes and a vegetable market, which can become a valuable place for community activities in future. The study reviewed the different aspects of current challenges and the possibilities for ecological, economic and socio-cultural developments.

The proposed network consist development of various places, mainly converting unused lake area and other spaces into healthy community places and unorganised market into organic farmers market to connect rural and urban communities. The lake and nearby public land are converted into green spaces of various scale and nature, to address the people from different walk of life. Without any major changes, only with appropriate interconnections of spaces and activities, the whole suburban area will get a new life.



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Figure 7: Proposed network of suburban area Thaltej, Ahmedabad

The intervention of organic farming, herbal garden, cultivating a food landscape and water management of lakes supports the health, and social and economic well-being of individuals, communities and built environment. Gradually this suburban area will turn into a place flourishing with biodiversity and people. By integrating all the domain of sustainability as discussed in the paper, a proposed network of Thaltej area can bring transformation not only to the suburban area but the city and in nearby all villages.

7. Conclusions

The paper proposed a methodology and conceptual framework for the interventions in suburban areas and renewal of the area incorporating the social, economic and environmental dimensions of sustainability. The paper discusses social sustainability and the concept of the sustainable food systems to connect rural, suburban and urban areas. There is a need to re-invent the concept of sustainability as it is not limited to creating energy efficient buildings, reducing carbon footprint, using renewable energy and products, zero-energy and recycling of materials, but to understand the larger domain of sustainability and start with smallest possible responsible actions for better future. For the basic necessity of life and to meet the global crisis, it is crucial to bridge the gap between rural, suburban and urban areas. Inquiry of social sustainability, where the interconnection of rural, suburban and urban areas for social sustainability through organic sustenance can lead towards the holistic approach to sustainable development.

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POETIC ROBUSTNESS IN DETAIL: TOWARDS A TECTONIC CULTURE OF BUILDING

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Abstract

In building production, the term 'detail' is generally used to identify a construction joint, intended to resolve structural, technical and environmental assembly of building systems, elements and materials. An 'architectural detail', on the other hand, is a notion that dwells on formal elucidations and experiences, in addition to the mere pragmatics of building assemblage. Within the local discourse of architecture, how-ever, there is little or no discussion about the ability of architectural details to breed a constructive culture of building, which can resist the failure of the local building output, both formally as well as technically. By referring to seminal literature, building observations, detail analysis and practice-based interviews, this research explores the need to establish a local culture of building that views 'detailing' as a fundamental intention of building construction, thereby responding to both practical and poetic expectations of architectural design. In particular, the study explores the notion of 'tectonic culture' as an embodiment of 'practical poetics' that responds to ideas, customs and principles of a 'way of building' determined by social practices, knowhow and intelligence. Using the idea of 'tectonic culture' as a 'tool' to evaluate how details generate poetry in architecture, this study questions if an alternative position on 'architectural detail' would allow local practitioners a better technical and creative platform to respond to the escalating demand for robust building.

Keywords: Tectonics, Poetry in detail, Robust building culture, Architectural de-sign

1. Introduction

The production and performance of buildings in developing economies such as Sri Lanka are increasingly subjected to sub-standard behaviour in terms of their environmental, technical and aesthetic functioning. Lack of spending capacity, knowledge limitations of the workforce, deficiencies in the application of building systems, weaknesses in regulatory frameworks, and lesser input from professional spheres, etc., can be attributed, among others, as primary reasons for such poor behaviour of the local building stock. One of the most critical outcomes of the combination of aforementioned technical, cultural and economic irregularities is the prevalence of a building culture that devotes little or no regard to proper jointing of building components, both technically as well as aesthetically.



Figure 30 Typical glass and cladded buildings that are coming up in Colombo. (Source: Author)

In the realms of the local architectural profession in general and the academia in particular, there have been very little attempts to acknowledge the possible dual role of 'building details' as both a technical assembly and an aesthetic communicator. This study frames its research hypothesis on the possibility of a 'pragmatic poetics' in the definition of a 'building detail'. In doing so, the study relies on the notion of 'tectonic culture': a culture of building that acknowledges and accommodates the technical and poetic resolution of building systems, materials and assembly as a fundamental role of architectural production. Framing its analysis on the Sri Lankan practice of architecture, the study examines how a reference to the idea of 'tectonic culture' could help establishing a mode of architectural production that contributes to the creation of both the rational and the aesthetic: the pragmatic and the poetic.

2. Poetry in the Detail

Architecture is considered both an art practice as well as a building practice. Frampton and Cava (1995) relate architecture to a problem-solving task concerning the practical application of crafting a building. I.M Pei (1983) and Peter Zumthor (2006) reverberated the above position, claiming that architecture is a pragmatic art in which the core relies in the construction process. However, as Kenneth Frampton (1995) claims, "*much of the today's architecture has become inorganic, technology based, and romanticized*". Instead, Frampton calls for an enlightened approach to evaluate the 21st century architecture in terms of the 'constructional form' of architecture as opposed to relying entirely on its 'spatial form'.

POETIC ROBUSTNESS IN DETAIL:

The emphasis on the constructional process and its pragmatic base, however cannot supersede architecture's possibility of creating poetic connotations of form, space and the detail. The term 'poetics' originates from the Greek verb "poiesis", meaning "to make". Therefore the Poetics of Architecture has its roots in the making of architecture (Antoniades, 1990). John Ruskin goes further and relates the role of an architect to the role of a poet: "the architect must aspire to poetics (makings/buildings) of the first order by being a poet of the first order: the poet who can think strongly, feel strongly and see truly" (Ruskin 1884: 446 as cited by Auret, 2010)

At a theoretical level, 'poetics' is generally understood as a dimension where the abstract meets the reality; if there is a healthy dialogue between the two, then it creates poetics. According to Louis Kahn (1955) order is a realization created by the combination of thought and feeling. In this sense, order becomes poetic.

The critical position that this study is based upon argues that 'architectural details' can be used as an important part of creating this poetics of architecture; that 'details' can contribute to the state of mind, which oscillates between the 'thought' and the 'feeling'. As Zumthor, Pei and others have stressed, if architecture is about implementing a sense of totality and a holistic approach to combine poetry with the pragmatics, then no part of a building composition should be seen as insignificant. From form and space to micro detail, each part needs close inspection and requires lucid thinking. Within such attention to detail, care and meticulousness, a multitude of meanings could be created, out of which some can be aesthetical while others can be constructional.

In such light, there is no reason why a construction joint should not be considered as an opportunity to impart a sense of poetry to architecture. In fact, the poetic potential of the joint is enhanced by the extent of the difference between the two objects or materials that are joined together.

3. The Notion of Detail

The term 'detail' connotes the smallest part of a larger whole that is called architecture. According to Weber (1991), "an architectural Detail is a small piece of the whole, yet it has the power to characterize and define the entire building. Details tell us what a building is; they are fundamental to the life and personality of a space." Zumthor (2006) agrees and adds that the "importance of a detail is that it enables you to read a building as a whole as opposed to

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separate parts. They are not merely decoration and they can establish form and rhythm in the building".

A broader analysis of the term and application of 'architectural detail' reveal multiple objectives and facets of its usage in buildings.

- 1. A 'detail' tells us what the building is narratively composed of; its story of spatial and constructional form. In his seminal paper "The Tell-The-Tale Detail", Frascari (1996) states that the detail represents the function of *"attaching meanings to man-produced objects.*"
- 2. 'Details' can give personality to a space, and express the nature of its maker and user. Richardson (2013), for example, argues that Mies van der Rohe's usage of the term 'God' in the infamous adage "God lies in the Detail" was not intended to be merely metaphorical.
- 3. 'Details' can convey the aspirations, objectives and the attitudes of the architect and architecture. In Zumthor's, Louis Kahn's or Carlos Scarpa's work, every detail has a role to play in the functioning and experience of architecture, and that they reinforce the overall conception of the work.
- 4. 'Details' can convey the ability of the craftsmen, that they are true imprints of the workmanship and work ethics. For Zumthor (2006), details could make one feel respectful for the art of joining, and by extension, to the proficiency of craftsmen.
- 5. Fifthly, 'details' can be the generator of architecture. Carlo Scarpa, for example, had an astute connection with context through the use and reuse of materials in different ways. Nesbitt (1996) simply calls Scarpa "the master of the joint and its relationship to the whole."
- 6. 'Details' represent where the buildings come form: the context. Zumthor (2006) believes buildings should be an important part of the surroundings. Detailing of a building can certainly contribute to furnishing that feeling of contextual belonging, in the way specific materials are used, building systems are assembled, craftsmanship is applied, aging of components being projected, and environmental parameters been addressed.
- 7. Finally, and most critically, 'details' allow buildings to be put together, materials to be jointed, and building components to be assembled. They are the physical connectors that help architects to combine fragmented building parts together, to create a whole that is poetically meaningful and pragmatically rigorous.

As such, 'details' indeed are the devices that generate 'pragmatic poetics' in architecture. They have the capacity to help architects bridging the escalating gap between architecture's dual role as a practice of 'art' and a practice of 'building'.

4. The Notion of 'Tectonics' and the Culture of Building

For many, 'tectonics' is a study of architecture that is derived from ethical and cultural contributions as opposed to mere aesthetics. Kenneth Frampton in his seminal text "Rappel A L'ordre: The Case for the Tectonic" (1995), states that the earliest evidences of a narrative that connotes the two terms 'building' and 'poetry' appears in 'Sappho', a Greek tragi-comedy written by Homer, who was believed by the ancient Greeks to have been the first and greatest of their epic poets. In 'Sappho', Homer writes about a tekton - meaning a carpenter or builder in Greek - who assumes the role of the poet. For Frampton (1995), this is an attempt by Homer to allude carpentry (and building) to the art and poetics of construction. In other words, the generic notion of construction is convoluted as an aspect of poetry. The poetic interplay in the term tekton has given way to the notion of tectonics, the most widely recognized theorem in the discourse of architecture to signify the 'art' of 'construction'.

The idea of 'tectonics' has evolved around three seminal conceptual frameworks. The first is the framework introduced by the German scholar Karl Botticher, based on the binaries of 'Kernform' and 'Kunstform' (Frampton & John Cava, 1995). The second important conception of 'tectonics' can be derived from Gottfried Semper's writings, where he classified building crafts into two fundamental procedures: (1) the tectonic of the frame, in which lightweight, linear components are assembled so as to encompass a spatial matrix, and (2) the stereotomics of the earthwork, wherein mass and volume are conjointly formed through the repetitious piling up of heavyweight elements (Semper, 1989). The third critical position on the idea of 'tectonics' was put forward by Kenneth Frampton himself, as a counterpoint against the increasing scenography of architectural production.

In his 1995 book "Studies in Tectonic Culture", Frampton advocates regrounding of architectural expression in the means of construction and the nature of materials, to overcome the reduction of architecture into scenographic effects. In order to reach a balance between poetic and cognitive applications of architecture, Frampton has suggested two intellectual and practical interpretations for the use of technology and craft respectively: (1) technology as a productive procedure, and (2) craft technique as an anachronistic but renewable capacity. He believes that it is only thorough a tectonic understanding of details that a desired level of production quality can be achieved (Frampton & John Cava, 1995).

Edward Ford (2011) reflected upon Semper's position on layered and monolithic constructions, and argued that architectural detail can be both a representation of construction and a representation of meaning. He further

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claimed 'tectonic' as the articulation of structure, thus acknowledging the narrative that must be generated between the binaries of the parts and the whole, and the vice versa. For the famed Japanese writer Junichiro Tanizaki – illustrated so expertly in his seminal work "In Praise of Shadows" (1933) – 'tectonic' is about material honesty, an exploration of the relationship that must exist between tradition and meaning, and the subsequent spatial characteristics based on the play of light and shadows.

Carlo Scarpa's tectonic approach to detailing has an astute connection with the building's physical context through the reuse of materials in different ways. Being the master of the joint and its relationship to the building's whole, Scarpa's details were meant to acknowledge both the proper transferring of loads on the one hand, and the decorative expressions of architecture on the other hand (Frampton1995). According to Richardson (2013), Scarpa readily employed the use of traditional (cultural) methods of building, but not necessarily to produce a traditional result. He fostered strong working relationships with specialised craftsman, which in turn helped developing his architectural language.

Peter Zumthor, on the other hand, wrote extensively about how architecture can be broken down into parts that generate a whole, and how materials can be joined together to recognize the building's part to whole relationship. For him, joints convey the overall phenomenological meaning as well as its constructional vocabulary; "*joints are not mere decorations, but can establish form and rhythm in the building, as well as integrity and honesty in material to generate an emotional attachment to space*" (Zumthor, 2006). He also claimed that architecture depends on the skill of the craftsmen to realize the final product, and that the real core of architectural work lies in the act of construction (Ibid).

5. Defining a Frame Work for 'Tectonic'

In order to develop a broad-based – and study-specific – framework for 'tectonics', the study follows the writings of 7 most revered critics and practi tioners of the idea of 'tectonics'; the selection of the 7 critiques supports the following logic:

- 1. The three foremost proponents of the idea of 'tectonic': Botticher, Semper and Frampton.
- 2. Two most important critics of architecture who explored the relationship between the function of detailing and its aesthetic representation: Edward Ford and Junichiro Tanizaki.

1. POETIC ROBUSTNESS IN DETAIL:

3. Two of the world's foremost architectural practitioners, from two generations, who pursued an equally-masterful tectonic approach to design: Carlo Scarpa and Peter Zumthor.

Botticher	Semper	Frampton	Ford	Tamizaki	Scarpa	Zumthor
System of parts	Building layers	System of parts	Articulation Of the structure	Play of light and shade	joint: parts to create to a whole	Material honesty / integrity
Construction craft / process	product of human artistic skill	Art of Joining (details)	Detail Representation of construction	traditions and meaning	transfer of loads	making a meaningful whole
	narrative of process	Express method of construction	Layered buildings	material honesty	Spatial expreicne	human skill
		Artistic expression	Meanings Beyond construction		decoration to achieve expression	rhythms
		Material honesty	Parts & whole		Represent traditions	detials to create whole
			Constructional Narrative		Represent Lifestyle	presence - representation
					craftsmanship	emaotional attachemnt
					Act of drafting and Act of making	
	Constructional					
	material play					
	Semanatics / meanings					

Figure 31 framework for tectonics. (Source: Author)

6. Towards a tectonic culture: the critical position

A cross-review of the ideas expressed by these 7 seminal authorities in architecture and construction would reveal common patterns of thoughts and repetitions of views in relation to their interpretation of the term 'tectonic'. Subsequently, the vast range of ideas can be summarized into 3 broader fields, which in turn can be divided into 3 sub-fields respectively.

(1) Constructional tectonics:

This aspect focuses on the notion of 'tectonics' as a means of construction and connotes the ideas of: (a) *collection of parts and layers*, meaning the part to whole relationship, layered vs. monolithic dialect, selection and application of systems of parts, and the articulation of structure and detail, (b) *process*, expressing the method of construction and act of making, and (c) *craft*, alluding to the art of jointing, creative processes of labour and expression of craftsmanship.

(2) Material Play:

This aspect focuses on the notion of 'tectonics' as a material practice and connotes the ideas of: (a) *honesty*, concerning the sincerity, truthfulness and integrity of material selection, assembly and representation, (b) *interplay*, meaning the formal and technical jointing of materials, building components

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and building systems, and (c) *rhythms*, signifying the visual effects – including play of lights and shadows, contrast, geometry, composition, proportion, scale, etc. - generated by particular use of materials and building parts.

(3) Semantics/meaning:

This aspect focuses on the notion of 'tectonics' as a representation of meanings and connotes the ideas of: (a) *narrative of process*, meaning how the processes and phases of construction are signified in the final building outcome, (b) *traditional expression*, concerning the way in which traditional processes, ideas and systems have been appropriated and expressed in the building design, and (c) *symbolic meanings*, attached to the experience of the final product - such as spatial vocabulary and narratives, formal symbolism, specific artistic expressions and explicit intellectual attributes of building.

It is this afore-mentioned theoretical framework – impinged on the triad of constructional, material and semantic, and developed specifically for this study by exploring a broad sample of ideas on the 'tectonic' - that will be used as the intellectual basis to evaluate the case-study investigation, in search of a move towards a tectonic culture in local building practice.

7. Case study and methodology

Since the primary aim of the research was to establish a standpoint on the Sri Lankan architectural practice, the works of three prominent local architects were selected for the case study. These architects more or less represent three different generations of the post-independent architectural practice in Sri Lanka; namely, Anura Ratnavibhushana, Vijitha Basnayake and Hirante Welandawa. The research is based on the assumption that their training and generation gaps may result in different interpretations to the 3 theoretical positions of 'detail' as explained above: *Constructional, Material*, and *Semantic*.

The ensuing case-study investigation was limited to buildings that are simple in program but generous in cultural possibilities. Subsequently, only residential projects by the three selected architects were used as the basis to explore aforementioned theoretical positions, research objectives and intellectual inquiries.

The research methodology followed a four-step process. Firstly, a preliminary literature review was undertaken to identify the socio technical background of the local building practice. Secondly, a more extensive literature survey was embarked on to define the notions of 'architectural detail' and 'tectonic culture'. At the conclusion of this review, a study-specific intellectual position and an analytical framework was established. Thirdly, the afore-mentioned analytical framework cum research position was evaluated through a case-study investigation, which relied mostly on building observations, detail

analysis and practice-based interviews. Finally, an objective review of the case study findings was carried out to validate the initial research objectives.

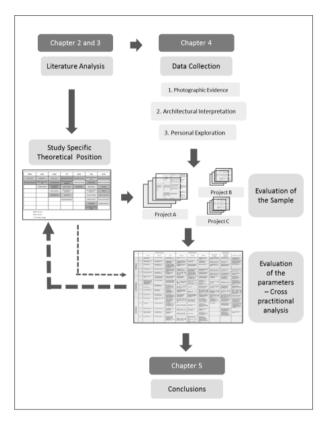


Figure 32 research methodology

An example of the sample data collected on a selected detail is as follows.

MUSTHAQ. A & PATHIRAJA. M

constructional	Material Play	Semantics			
The detail has been done with a proper encodence of the type of the the start and encodence of the type of the start and encodence of the type of the start and duration are spectrated and the start and and a sticker gap constrained and the hand and a sticker gap constrained by the start and constrained and arrandy have the accord to a the predict constrained and arrandy and the start and the start and the start and a start and a start and a start and the constrained by the start and constrained and the start and a start of the start and constrained and a start and used, the detail visitly represents a confid ontone.	Craft	The contactly of the rhythm in hundrally of the chythm in hundrally of the chythm in hundrally of the components and the regulators of the two hundrally of the components and the regulators of the components - the data and referations of the components - the regulator the regulator the regulator the regulator the regulator and referations where the master is much agine and referations between the market distributions rections are not to complexite a structure and rections the receiver are the interval of posting the washer to make the secret longer for the value of the component of the reaction white the book secrets are shorter to and couple with t	Rhythm	The emothers of the handrall has a legicle bind it [If's sharp it will cet the hand-Shave that the handrall is a serve we define. A sub- expression to differentiate from the old. Old is beny but new is light.	Symbolic meaning
This was a dead to be a bear at a the space at a later stage. The space at a later space. The space at a later space. The space space at a later space. The attraction at a later space at a late	Process	Incryptor between the materials is excidented by form and/meaning. The vess of Al and Statistics vestor corresponds to the functions of forcersions; so there is a secondific laterplay. Formally, the interplay means and and and and the second second the second second to the second second second second of the second second second second devices latered and the second secon	Interplay	Non-traditional materials have been used in the detail. However, the way the components have been part to the second of the versual of the second of protected of the versual of the second of the protected of the versual of they are found.	Traditional expression
This detail is made of parts: This detail is made of parts: Bas backets cast in St in Bases, and to possible screes with washers. The materies of the state of parts compared in the state of parts processes. These compares the processes. These compares the processes. The part of the state of the processes. The state of the state of the back of the balance of the state of the back of the balance of the state of the back of the state of the state of the state of the back of the state of the state of the state of the back of the state of the state of the state of the back of the state of the state of the state of the back of the state of t	Layers	The A parts give a soil grip while the Statistes Steel debter and a midential appreace, is general fac- tolistical contentions of the components are made to the soil of the component are made the plaint, verse the bolts and joining mechanism. The deall as here more versely the hill and the metriclify, is expected in it true form. The contraction activation of the component, for example, is expected in true form. The contraction activation of the preformance of the activatify to part of the preformance of the storability large of the preformance of the storability large.	Honesty	The scale, size and form of the comparent wargeven that the scale, size and form of the comparent wave, contacting or working. The doubt levels in an event of the state of the scale scale and the scale contraction and perception, simulation, and darify, and in contraction and perception, the actions and meaning and the process – such as the need for modulative, tark process – such as the need for modulative, as the need for modulative, tark process – such as the need for modulative, tark process – such as the need for modulative, tark process – such as the need for modulative, tark process – such as the need for modulative, tark process – such as the need for modulative, tark process – such as the need for modulative, tark process – such as the need for modulative, tark process – such as the need for modulative as the need for modulative as the need for modulative as the need for m	Narrative of process
		The deall of the handral to the architect's house was selected as it is an counce of the peerty could be created while responding to critical functional and addy requirements in the space.	Detail 2.1		

Figure 33 Sample of Data Collected

8. Conclusion: Local definition of 'tectonic detail'

The following observations and strategies were identified with respect to how the works of the selected local architects have responded to the 9 themes established via the analytical framework. Firstly, layering of details would allow better resolution of joints when more than one component or material have been used in a system. More importantly – and agreeing with Semper's interpretation of 'tectonics' - layered constructions could offer a better 'tectonic' value to a detail than their counterparts: monolithic constructions.

Secondly, there must be a much focused approach to the process of building with a proper understanding and application of the technical know-how. Clarity of erection, logics of construction, adaptability for workmanship standards, tolerance for on-site technical unpredictability, etc., are among key factors that would allow practitioners a basis for process-specific 'tectonic' approach to building production.

Thirdly, acknowledgment of craftsmanship and craft traditions supports a pragmatic and poetic resolution of details. This may impart a certain level of rigour in the technical systems, while benefiting from traditional and cultivated skill bases. A call for the recognition of the craft would also establish a base for a proper understanding and application of materials via tried-and-tested constructional principles and practices.

Fourthly, 'honesty' in material play would encourage materials to be applied in their true form, imparting a 'tectonic' feel to a detail. This would create a technological environment where textures, colors and forms of material are expressed without concealing. This would further allow possibilities to work with the limitations of the material, thereby imparting an understanding of an aesthetic that follows the constructional needs.

Fifthly, an open-minded attitude to the interplay between material and components would allow better jointing possibilities, as well as mitigating technical tensions between layered and monolithic systems, acknowledging the capacity to accommodate exposed connections, and imparting alternative design sensibilities based on, for example, senses of informality, casualness and spontaneity.

Sixthly, thoughtful composition and assembly of tectonic details would allow clarity of construction, application of modularity and flexible repetitiveness, and an appropriation of an aesthetic maintained by a rigorous understanding of material properties on the one hand and their phenomenological interpretations on the other hand.

Seventhly, a process-specific narrative of a tectonic detail could be achieved via the dialectics of technical and poetic binaries: i.e., between layered and

monolithic, functional and constructional, solid and void, heavy and light, craft and industrial, etc.

Eighthly, semantics with respect to traditional expressions could determine both a pragmatic and intellectual construction of a tectonic detail. The concerns here would mainly focus on the particular selection of materials and constructional principles, pursuing traditional detailing methods and typologies, and references to traditional artefacts, narrations and attitudes.

Ninthly, tectonics could offer symbolic meanings to details; these may include semantics related to an experiential quality - i.e, lightness vs. heaviness; the presence of time - i.e, new vs. old; a visual base - i.e, formality vs. spontaneity; and a theoretical approach - i.e, modernity vs, vernacularism.

Tenthly and finally, a proper tectonic detail is not simply responding to pure aesthetics. It is derived as a result of responding to the functional and economic requirements of architecture and then manipulating it so as to not compromise the aesthetics. The key term here is 'robustness': an idea of technological application that can tolerate the building's economic, technical and cultural variations without compromising the expected performance.

The afore-mentioned ten-point design strategy can be used as a point of departure in developing a broader theoretical framework to discuss and evaluate the notion of 'tectonic' with respect to the idea of 'pragmatic poetics' in architectural detail.

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EXPRESSION OF PSYCHOPHYSICAL BOUNDARIES RELATED TO INTERPERSONAL SPACE THROUGH SELECTED TECHNIQUES IN FASHION DESIGNING

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Abstract

Every human being acquires a physical space in his existence from womb to tomb. This physical space is a variable which depends on external parameter; amount of matter the body consists of. The composite planes which this body mass is active could be defined as the active space around body which is, on the body and outside the body. Over this physical space each and every person owns their psychological space. This subjective space which is often affected by the parameters such as Age, gender and cultural norms is visualized as a "bubble "by Anthropologists. A rela- tionship is being built between interpersonal space and the active space on human body which is margined by a wearable. Transformational fashion is used in as the technique in the visualization of the discussed relationship. Avant-garde which is a method of experimenting and expressing a concept in fashion designing is used for this project as the method of exceution. Objective of this line of Avant-garde, is to forward a method of expressing psychophysical boundaries of interpersonal space expe- rienced by an individual via compounding theories in fashion designing and modifi- cation methods of space to create an environment which cares about the need of self- expression of an individual.

Keywords: Interpersonal space, Psychophysical boundaries, Avant Garde, Space on body, fashion designing

2. Introduction

Interpersonal space is a physical space created by a presence of a be- ing in relevance to his outside. It is studied under Proxemics, the hu- man use of space. Social interactions, behavioural patterns and com- munication are being studied in relation to interpersonal space. Edward T hall, defined Proxemics to be the interrelated observations and theories of human use of space as a specialized elaboration of culture. Inter interpersonal communication is effected by use of space by each person communicating. Rather depending on one's physical presence, this invisible space is composed of a varying margin which depends upon different factors. These factors are highly attached with the context the considered person s within. The context is composed of several parameters which are age, geographical location, social and cultural

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norms. In a predefined state of these parameters the in- terpersonal space acquired by an individual can take a fixed volume. While interpersonal space is based upon ones physical presence along with a physiological margin, the space that is outlined outside the body through a wearable can be defined space on body. These two derivations of space are interrelated by the research through selected techniques in fashion designing.

The experiment work done, depicts a series of selected and fixed states of interpersonal space defined under a set of fixed parameters through design elements. Design elements such as colour shape and texture with given interpretations that matches the context of the se- lected individual are used in this visual and functional expressions. This method could be implied on any defined situation under the same considered parameters within the research.

3. Limitations and scope of research

3.1 In sri lanka any research or experiments about the interpersonal space are not conducted yet, which is in a proffessional or academically usefull level. Therefore to exectute the design ideas in this project the statistiacal research experiments and the outcomes by Edward T. Hall in year 1963 as mentioned in his book The Hidden Dimension.

3.2.The perceptions of design elements such as colour and shapes are selected accordingly to the context chosen in the above mentioned experiments by Edward T. Hall.

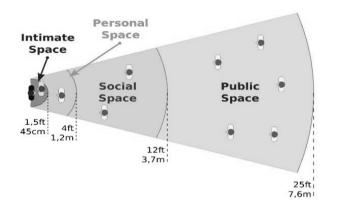
3.3. Hence the individual considered in the experiments are considered and unvariable and only his or her interpersonal space is considered, the interpersonal space of the second party or the outside participant is neglected to avoid complications.

4. Interpersonal space

The relative distances maintained by individuals during a face to face communication action, is known to be interpersonal space. (T.Hall, 1963 octomber) Hall defines four vertical distances starting from the standing point of the individual. These are

- 1. Intimate distance
- 2. personal distance
- 3. social distance
- 4. public distance

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These distances are depicted as radii of circles with a co-centre where there is the individual.

Though these are depicted as vertical distances, they represent a three dimensional volume as the individual holds both vertical and horizontal dimensions. So the volume covered by these circles is visualized in the re-search at its initial unprocessed stage.

The closet to the individual's body, intimate distance is the space used in actions embracing whispering or touching. It has a higher tendency n physical contact in this space. Personal distance is the space maintained with friends or family. Social distance is for interactions among acquaintances. Public distance is used in public speaking. Personal space is defined as the space from the individual's body to personal distance. Each distance is divided into two phases as close phase and far phase.

Personal space is considered belonging to the individual it is made around. Any forced entering to this space may cause the individual to feel fear, an- ger, anxiety and discomfort. (Hall, 1966). Allowence shown by the individual for an outsider to come to the personal space can be indicated as the relationship between the individual and the outsider. It express the intimacy and the familiarity they share. But andy forced conditions such as a limited space for a group of individuals such as an crowded room wouldcause each individual to torelate any intrutions to their personal space. In such situation background volume act as a deciding factor.

In coming to conclusions about above interpersonal space by Edward T. Hall his subjects were selected including following characters, non contact, middle class, healthy adults, native americans, intellectuals and contained both men and women.

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And he clearly states that the finding are unique to the selected group of subjects which is an outcome of their contexts. Hence the findings do not stand for united states of America as a whole, but confined only to the selected group of subjects.

4.1. VISUALIZATION OF INTERPERSONAL SPACE

In visualizing the characteristics of this highly subjective invisible dimension a few methods had to be selected. A from the parameters that Edward T. Hall discusses in his book, the ones that could be included in the method transformational fashion is considered in visualization process. Edward T. Hall mentions biometric concepts of measuring this dimension. Those are as listed below.

4.1.1 Kinaesthetic factors: The closeness of touching by the subjects or their different gestures of touching, physical contact and body part posi- tioning. (Hall, 1966)

4.1.2 Haptic code: The methods that the participants touch each other, ca-

ressing, holding, spot touching, prolonged touching, pressing against, accidental brushing or not touching at all. (Hall, 1966)

4.1.3. Visual code: The amount of eye contact by the subjects is consid-

ered in this code. (Hall, 1966)

4.1.4 Thermal code: the perception of heat by each subject is studied here in the manners of conducted heat, radiant heat, detected heat and ab- sence of heat. (Hall, 1966)

4.1.5. Olfactory code: The degree of order detected by the subjects is measured here. (Hall, 1966)

4.1.6. Voice loudness: The effort made by the participanats in verbal communication is measured at this code. The categories are silent, very soft, soft, normal, normal+, loud and very loud. (Hall, 1966)

Out of these biometric concepts kinaesthetic code, haptic code, visu- al and thermal code is used considering the highest possibility of them of inclusion in an Avant Garde in a tangible way.

Thereby the outcomes of Halls four experiments are summarized ac- cordingly highlighting these features. These are selected due to the reason of having a variation and for being convenient in depiction. Every Avant Garde might not contain all of these factors at once and the visualization takes both a positive aspect in some stages and a negative aspect in others.

5. Psychophysical boundaries

The outcomes of the experiments of Edward T. Hall are taken as Psychophysical boundaries of the individual participated in the experiments. The reactions shown by them are stimulated acts through the situation that they were subjected to. Regarding these psychophysical boundaries the following set of characteristics was selected to be visualized through the Avant Garde making them the objectives of the final design executions. In the considera- tion psychophysical boundaries related to both close phase and far phase are included.

1. Intimate distance: Skin and muscles communicate. High possibility of physical contact. Pelvis thighs and head can be brought in to play. Arms can encircle. Reception of radiant heat is stepped up. (Hall,1966)

2. Personal distance: The three dimensional quality of objects is partic- ularly pronounced. Surface textures are very prominent. Physical domination is prominent. The subjects cannot easily touch each oth-er. Fine details are easily seen. Gaze is limited to the face. No heat is receipted.

3. Social distance: Skin textures are still visible. No perception of warmth. The participants are at the state uninvolved.

4. Public distance: Can take evasive or defensive actions. Roundness of the body is lost and seen to be flat. Facial expressions and eye movements are undetected. The word 'formal style' can be used. (Hall, 1966)

The above summarized Psychophysical boundaries are expressed through the line of Avant Garde in relation to space on body.

6. Space on body

Human body always acquires a space of its own. The shape of this space is defined by the shape of the naked body. The naked ape has evolved to a level that he uses a second skin to cover his naked body. This man made skin or covering known as clothes is worn on the body sometimes with complete contact or sometimes with space in between. The naked human body and this second skin always contain some space in between. This space can take different volumes and different shapes along the body. Hence it is created by the presence of a the human body and the clothing layer or the second skin.

The relationship of this space with interpersonal space is that the both arouse by the presence of a human body. The space on body is marginated by the human body and the wearable, while the interpersonal space is marginated by

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human body and pshycological factors. They both discusses the dimnsion space in relative to the human body.

This space marginated by the wearable is taken dirrectly proportional to the interpersonal space in this project as a method of visualizing the invisible dimension of interpersonal space. The extent of the space on body is designed by the avant gardes in a way that it persue the extent of interpersonal spaces. This persuation is not achieved numerically but through the techniques of fashion designed, precisely volume creation, embelishments and colour selection.

7. Transformational fashion and Avant Garde

As the methodology, in this project the design executions were achieved through series of experiments and studio work carried out. The concept of transformation fashion applied on Avant Gardes is tested. Transformational fashion allows the wearer to create different looks by the same outfit in different situations. Avant Gardes are a well known for concept visualization in fashion field. It combines the main objectives of the concept in to a wearable piece. As the concept discussed here, interpersonal space is highly subjec- tive, transformational fashion is used for executions as it portray several dif- ferent looks from the same garment.

8. Design executions

The design executions for the four types of interpersonal space are sketched upon a female body due to the requirements of the academic background it was conducted. But the characteristics that are used in the designs are inde- pendent from gender and can be applied upon a male figure as well. Hence the process used for designing is initiated through sketching and experimen- tation. Several alterations took place at the production stage in the intension of achieving design objectives. This line of Avant Grades depicts interper- sonal space of the selected group of subjects as a gradient of space on body created by the second skin.

8.1. EXECUTION 01

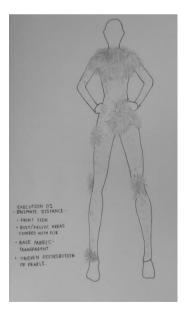
The Intimate space: The stated psychophysical boundaries in the section are achieved through this design. The space on kept nearly or almost zeros marking the starting point of the gradient. The silhouette is body hugging. Limbs and head are at its most free state to make movements. The muscle movements are as they are in the naked body allowing them to communicate. The second skin

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is embellished with different sizes of white pearls. The thermal code is achieved through special use of fur fabrics.

Justification of the silhouette: the silhouette duplicates the origi-nal silhouette of the body allowing it to be free and do a range of movements as in intimate space. The neck is free allowing widerange of head movements. This follows the look of a ballerina suit or a leotard which makes body movements ideally easy. (The importance of a proffesional ballet leotard, 2017)

- Justification of materials: The fur fabric is used to achieve the thermal code that is associated with radiant heat. Persuasion of a comfortable heated body and warmth is given by this. The main fabric selected is transparent PVC fabric which allows the body to be seen. This shows the understanding between the two sub- jects. (Mahe, 2011)
- Justification of embellishments: Pearls are used as a reflection of purity, integrity, loyalty and familiarity between the outsider and the individual. (Monarch13, 2014)
- Justification of the colour/colours: The light blue colour is cho- sen to reflect the trust and confidence that is shown by the indi- vidual in allowing the outsider into the intimate space. (Bourn, 2011)



Design Execution 01 Front



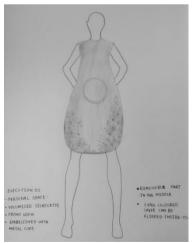
Design Execution 01 Back view

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8.2. EXECUTION 02

The personal space: The design is in a distinctive spherical form empha-sising the 3d form of the structure. The hands are kept free but lower limb movements are restricted to some degree. As the subjects cannot have touched each other with hands effortlessly in situation, the lower volume is increased so that an extra effort is to be taken in touching each other.

- Justification of the silhouette: The silhouette with added volume gives an idea about the increase of the interpersonal space main- tained. The embellished second skin is elevated from the body surface resembling increased personal space.
- Justification of the material: The use of padding in the Avant Garde is creating volume between the body and the second skin. The Rexin material creates the voluminous structure easily than other fabrics. Hence the padding added works as an insulator de- picting the thermal code of person space; no heat. (Linkway, 2014)
- Justification of the embellishment: The embellishments of metal cups and coloured beads act as a hint of the connection between the two subjects. The cups are rigid yet contain a fascinating de- tail; so is the connection.
- Justification of colours: use of cyan colour indicates being protective over the individual's territory and self centered. (Neidliger, 2014)



Design execution 02 Front view



Design execution 03 Back view

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8.3. EXECUTION 03

Social space: The silhouette is a development of the silhouette of the person- al space. The texture and the structure are changed by a transformation. The structure becomes pointy over the spherical shape, adding more distance to the silhouette. Hence the space on body is also increased preceding the gra- dient. Justification of the silhouette: the silhouette is made pointy to add more volume from the point to the body. The cones resemble the re- pellent nature of the individual and outsider. The cones restrict the head movements and hide the face up to some degree

- Justification of the materials: A stretchy fabric is used in Oder to pop up the cones easily in transformation. The cones are filled with padding as insulation and boning. (Linkway, 2014)
- Justification of the embellishments: The embellishments are the
- cones which pop out of the surface when transformed.
- Justification for colors: The dark brown color resembles dull and uninteresting nature that the Relationship between the individual and the outsider is unclear. (Colourpshycologymeaning,2017)



Design execution 03 Both the front and the back views are similar

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8.4. EXECUTION 04

Public space: This is very rigid and static design. The shape is changed in to a rigid structure deviating from the spherical shapes maintained in the former stages.

- Justification of the silhouette: The silhouette is rigid and composed of straight edges, this hides the human silhoutte which reflect nature of the relationship that the subjects share.
- Justification of the material: Structural PVC fabric is used to achieve the structure of the Avant Garde.
- Justification of the embelishments: no heavy embelishments are used in this as minute details tend to blur at this distance. only the rough texture of the selected material acts as an embelishment.
- justification of colour: Dark grey is used as the colour hides the exact shape of the silhoutte. Hence grey is considered the colour of formalty.



Design execution 04 Both the front and the back

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9. Conclusion

The research was carried out as a project of expression pshycophysical boundaries of interpersonal space through selected technique of fashion designing. The hidden dimension by Edward T. Hall where he has recorded the set of phycophysical boundaries related to a group selected subjects is taken as the main source of the project. His findings are being visualized in a logical manner through a line of Avant Gardes that uses transformational fashion. The design elements used in the executions are from the similar context of the reserch finding which makes a link between the research and its executions. As interpersonal space is highly subjective, it has to be continuosly experimented to produce a conclusion on an individuals interpersonal space. the same set of experiments the Edward T. hall has used in his book can be applied to any desired context. Hence the method of using fashion designing techniques could be used the visualize the reserch outcomes. The relationship formulated by this project is applicable for any of the research finding regarding interpersonal space of any context as it matters only upon the presence of an active human body and a wearable.

As expression is a basic right held by every human being, understanding each others social territories and comfortable zones can led into better communication system. through this project it creates foregrounds to create that are consous and designs that care about individual, by that the community and the planet.

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INFLUENCE OF EXPERIENTIAL LEARNING ON EDUCATION OF CONSTRUCTION STUDENTS IN SOUTH AFRICA

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Abstract

South Africa's education sector comprises various individuals, all with different backgrounds, and this sometimes creates challenges when it comes to the teaching and learning processes, especially in construction education. This research assessed the impact of experiential training on construction education in South Africa. The study used a survey research design. Data were collected by the use of a structured questionnaire aimed at 130 respondents purposively selected among the students who were registered for Construction Management (CM), Quantity Surveying (QS), Civil Engineering and Building Science at a South African higher education institution. Out of the 130 copies of the questionnaire, only 101 were usable and therefore analysed for the study using descriptive statistics. The findings from the survey indicate that most of the respondents were of the view that collaborative learning is effective. Also, the findings of the study suggest that majority of the students are aware that they are working with people from different cultural backgrounds with experiential training running between a period of six months and 12 months. Regarding the influence of experiential training on education of students of construction programmes, the finding shows that experiential training has an influence "in encouraging students to find greater meaning in their studies"; "in providing students with exposure to the real world of work"; "encourages students to develop a greater sense of responsibility"; "encourages students to place more reliance on their judgement"; "in creating students who are readily employable"; and "gives students access to possible funding sources in that order. The study concludes that experiential training influences education of construction students in South Africa.

Keywords: Construction students; education; experiential training, South Africa.

1. Introduction

Education is a method in which training, teaching and learning take place, mostly at a school or university to improve knowledge and to develop skills (Oxford Advanced Learners' Dictionary, 2015). Education in construction is one of the contributing variables to the construction industry since it involves

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the process of teaching, training and learning about construction, infrastructure, structures and roads, amongst others. The construction industry is one of the biggest industries in the world and contributes greatly to the economy of any country. It is responsible for all the construction and conservation of infrastructure and structures (Owolabi & Olatunii, 2014). Furthermore, it is an industry that plays a substantial part in a country's economy, irrespective of the country's level of development; it also plays a significant role in the transformation of the physical terrain of any nation in its march toward greater civilization and economic independence (Owolabi & Olatunji, 2014). The importance of the industry is not only due to the fact that it is responsible for the infrastructure and buildings from which nearly every other sector depends on but also to the fact that it is a large sector in its own right (OECD, 2008). It is necessary to emphasise that construction education is done through various learning institutions which include colleges, universities and universities of technology. Likewise, the learning institutions are the key centres for developing and fostering the necessary manpower needed to run the construction industry (Ayarkwa et al., 2011).

It is worthy of note that graduates of university construction programmes have been in high demand by contractors in all types of construction, including commercial, residential, highway and heavy construction (Ahn et al., 2012). Traditionally, construction education has been implemented in a way that there is a clear demarcation between the industry and the education sector where discipline-based education and basic skills have been provided to students by universities while their training to become professionals is done by the industry (Park et al., 2003; Gann, 2000). According to Hynds and Smith (2001), universities collaborate with companies for the opportunity to provide students with exposure to the real world of work and this is done through research and student and/or faculty internships for students to have access to possible funding sources, to work on tangible industry-related research, and to have industry practitioners provide input on academic curricula. Also, companies collaborate with universities to gain access to programme graduates, to obtain a window on science and technology, and to gain access to university facilities (Hynds & Smith, 2001).

To succeed in today's complex, dynamic, interconnected, and global world, construction professionals and graduates require competencies such as a firm technical foundation of construction skills, an awareness of ethical issues, good problem-solving skills, leadership abilities, an understanding of safety issues, and collaborative skills: these are considered to be some of the key competencies of construction graduates (Ahn *et al.*, 2012). Importantly, these skills cannot be only obtained in the classroom, but through industry placement

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of students, which then made experiential training a key form of training for students of construction programmes as reinforced by the study of Hardie and Love (2012). However, it is unclear whether or not collaborative learning is effective for students of construction programmes in South Africa. Are these students working together with people from different backgrounds? For how long are the students exposed to experiential training? How has experiential training influenced their education? These questions are yet to be answered in any scientific work of carefully designed inquiry. It is on this basis that the study is poised to examine the influence of experiential training on education of students of construction programmes with evidence from a South African higher education.

2. Review of Related Literature

2.1. AN OVERVIEW OF CONSTRUCTION EDUCATION

Education is defined as the process of teaching or learning in an environment such as a school or college, or the knowledge that you get from this (Cambridge Advanced Learners' Dictionary, 2005). It is also referred to as the process where teaching, training and learning takes place in order to expand knowledge and develop skills. Several elements such as the attitudes of various people, peer behaviour, money, and cultural expectations, among others, are covered under education as it does not only cover what we generally think of as we progress through school and college (Kainuwa & Yusuf, 2013). Education introduces people to new ideas and new things in a way that can be beneficial to them.

Similarly, construction education involves the process of teaching, training and learning about construction, infrastructure, structures and roads and this is done through various learning institutions which include colleges, universities and universities of technology. Likewise, the learning institutions are the key centres for developing and fostering the necessary manpower needed to run the industry (Ayarkwa *et al.*, 2011). Haupt (2003) also adds that while higher education institutions maintain their commitment to high academic standards, they also need to be committed to responding to the needs of industry, both in course content and research. One of the ways to obtain a career in the built environment is working through measures such as apprenticeships and training (Grytnes *et.al.* 2017). To produce 'preferred' graduates, tertiary education institutions need to obtain feedback from professional bodies and other industry stakeholders on course curricula in order to ensure that their graduates will meet the changing needs of the industry (Wong *et. al.*, 2007). Better coordination between the training institutions and industry would enable

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institutions to plan curricula which would meet the needs and expectations of employers more broadly, facilitate access to work experience for students, assist lecturers to upgrade their practical knowledge, and provide students with realistic expectations about their chosen field and the working environment (Haupt, 2003). Therefore, it is crucial for construction education programmes to develop and strengthen these competencies, including both pure construction skills such as estimating, scheduling, project management, cost management, and construction materials and equipment utilization, as well as more general skills such as leadership, cultural dynamics, communication skills, team skills, ethics, critical thinking, and problem solving (Ahn *et al.*, 2012).

According to Avis *et al.* (2002), upon graduating in the construction sector, graduates have to be equipped with essential attributes such as practical experience for them to be thoroughly familiar with the workings and complexities of the industry. Again, they have to be familiar with the tools and techniques for planning, scheduling and controlling construction operations, and be able to work in teams (Ayarkwa *et al.*, 2011). Construction is a complex and fragmented sector which covers varied activities which comprise designing and planning, construction, civil engineering, maintenance and refurbishments (Grytnes *et al.*, 2017).

One of the concerns that employers and workers in this industry have is the inability of the industry to attract workers and also having no way of investing in training them. This results in serious effects on the productivity as well as the quality of construction products and also on the ability of contractors to satisfy the needs of their clients (International Labour Organization [ILO], 2001). Wolf (2017) outlines that the right group of young people has to be targeted in order to take up field positions, especially in cases where they have just come out of high school. Moreover, Grytnes *et al.* (2017) is of the view that the construction industry has demonstrated itself as a world leader with plenty to offer young people with diverse talents and interests; however, one of its biggest tasks is enthusing schoolchildren about working in construction. Unfortunately, the majority of people have the perception that the construction industry is vocational or trade-based and has a set of ethical guidelines that are ineffective and is often an irritation and inconvenience to their lives (Mulligan & Knutson, 1999).

The International Labour Organization (ILO) (2001) holds that the issue of the work in the construction industry having such a poor image is generally a result of the type of work done in the industry which is often labelled as dirty, difficult and dangerous. Many learners do not regard construction and engineering professions as first career choices and this is because of the industry's image and the lack of the attractiveness of the industry in recent

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years. The Construction Industry Development Board (CIDB) (2007) specifies that some of the stressing elements in the contracting sector are the physical demands, the long working hours, the remote sites and the nomadic lifestyle within the industry and these result in only a few young people regarding it as a career choice (CIDB, 2007). In order to target the right group of youngsters for construction work, candidates should be identified early in high school early: these should be people who have a presence at community colleges, who have a sincere interest in construction due to the fact that they have held more than a few jobs in the sector and youngsters who have a work ethic that has been strongly established.

2.2. EXPERIENTIAL LEARNING FOR CONSTRUCTION STUDENTS

Experiential learning is defined as a period whereby instruction and relevant practical experience that relates specifically to the selected programme of study are integrated. It occurs when a personally responsible participant cognitively, affectively, and behaviourally processes knowledge, skills, and/or attitudes in a learning situation characterized by a high level of active involvement (Genty, 1990; Hoover & Whitehead, 1975). According to the Nelson Mandela Metropolitan University (NMMU) Prospectus (2015), the professionals of any discipline require work experience that is appropriate prior to effectively practising their chosen career. The experience illustrates that the incorporation of theory and in-service/experiential learning creates diplomats who are more mature and readily employable. Similarly, this work experience encourages students to develop a greater sense of responsibility, place more reliance on their judgement, and find greater meaning in their studies (NMMU Prospectus, 2015). However, Haupt (2003) states that the separation between practical and academic work creates a division in the mind of students rather than relating the theory to the application that reinforces the basic concepts taught in the classroom.

According to Henry (1989), experiential learning methods include, in no particular order of relevance, independent learning, problem solving, project work, personal development, prior learning, work, social change, community placement and is non-traditional and is based on activities. Moreover, during the experiential learning period, the student is expected to secure employment/ placement in an approved company. However, universities in some countries assist students to obtain appropriate experiential learning placements at approved companies but the responsibility rests on the student to secure such placement (The University of Johannesburg Faculty of Engineering and Built Environment Rules and Regulations, 2015). After completing each level of the experiential learning, the students need to ensure that they hand in all the

documented evidence of their having finished their experiential learning, this should be done according to the submission dates stipulated by the faculty (The University of Johannesburg Faculty of Engineering and Built Environment Rules and Regulations, 2015).

Obtaining companies to work for in order to complete experiential learning is somewhat of a concern for most engineering and built environment students who do not receive financial aid from bursaries since those who study through bursaries might not face the same challenge since the companies providing funding offer training as well. The mediums through which construction education students can find companies, organisations or places where they can go for their experiential training include learning opportunities that are work integrated, bursaries, internships, presentations by companies, career fairs and through graduate placements (NMMU Prospectus, 2015). Experiential learning encourages and promotes the students' interaction with professionals in their chosen career and is also good for the development of team spirit. Moreover, the NMMU Prospectus (2015) further adds that during the time when students are undergoing their experiential learning, they become exposed to people from diverse spheres of life and therefore develop a greater confidence when working as part of a team

3. Methodology

In this study, a survey research design was used. Respondents for the study were students who registered for Construction related programmes like Construction Management (CM), Quantity Surveying (QS), Civil Engineering and Building Science at a South African higher education institution. Data were collected by the use of a structured questionnaire aimed at 130 respondents purposively selected among the students who were registered for Construction related programmes as mentioned above. Out of 130 copies of questionnaire administered, 102 were returned, but one of them was discarded due to incomplete information. Therefore, only 101 were usable, representing a response rate of 78 per cent that was deemed viable for statistical analysis for this study. Data were analysed using the mean item score (MIS) to derive straight-forward totals and rank the variables. MIS was computed using the following formula:

$$\text{MIS} = \frac{1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}{\Sigma N}$$

where;

 n_1 = the number of respondents for 'not at all influential';

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 n_2 = the number of respondents for 'slightly influential'; n_3 = the number of respondents for 'somewhat influential'; n_4 = the number of respondents for 'very influential'; n_5 = the number of respondents for 'extremely influential'; N = the total number of respondents

4. Results and Discussion of Findings

4.1. BACKGROUND INFORMATION OF THE RESPONDENTS

In order to provide insights into the results of this study, respondents background information are first analysed. The results from the 101 questionnaires that are usable revealed that the majority of the respondents were male with a percentage of 62 per cent while only 38 per cent were female. Also, when asked about their age, 56 per cent of the respondents indicated that they are between the ages of 21 and 25 years of age, 31 per cent of the respondents are within the 26-30 age group, 11 per cent of the respondents are between the ages of 31-35, 1 per cent of the respondents are between the ages of 36-40, followed by 1 per cent who are 41 years and older and none of the respondents were younger than 21 years. Results relating to the ethnicity of the respondents indicates that majority of the respondents were African with a percentage of 90 per cent, followed by whites at 6 per cent, Indian or Asian at 3 per cent and 1 per cent were coloured. Further results revealed that 84 percent of the respondents are single and this was the highest in this category, 12 per cent are married, 4 per cent are co-habiting and none of the respondents were divorced or widowed. Additionally, the findings showed that 90 per cent of the respondents were South African and the remaining 10 per cent non-South African.

Of the overall respondents, 82 per cent are currently registered for a B. Tech. degree while 18 per cent of them are registered for third year in Building science. The respondents currently registered for the B.Tech. degree are registered for various courses: 46 per cent of them are registered for Quantity Surveying, 28 per cent for Construction Management and 10 per cent for Civil Engineering and the 17 per cent represents those registered for third-year Building Science. Furthermore, when asked who is funding their university fees, the result revealed that 34 per cent of the respondents said that they are responsible for their own fees, 30 per cent of the respondents are studying through a bursary, 23 per cent of the respondents' fees are paid by their parents, 5 per cent of the respondents are studying through scholarships and 3 per cent are making use of study loans.

4.2. EXPERIENTIAL LEARNING AND CONSTRUCTION EDUCATION OF STUDENTS

As part of experiential learning of students, they must be able to work in groups. As such, when the respondents were asked about the regularity of taking part in group work, the findings revealed that 27 per cent of the respondents work in groups two to three times a week, 18 per cent of the respondents do so twice a week, 28 per cent do so once a week, 6 per cent do so once a month, 15 per cent do so once in two months, 2 per cent do so once in three months and the remaining 5 per cent of the respondents never do group work. Again, when the respondents were asked about the effectiveness of collaborative learning, the finding suggests that 81 per cent of the respondents said that collaborative learning is effective while 10 per cent said that collaborative learning is not effective and the remaining 9 per cent were not sure. When the respondents were asked about their knowledge of working with people from different cultural backgrounds, the finding revealed that 90 per cent work with people who are from a different cultural background from theirs; 5 per cent had no knowledge of working with people from a different cultural background from them and the remaining 5 per cent said they were not sure. Additionally, when the respondents were asked how long their experiential training took, the result indicates that 51 per cent did their experiential training over a period of six (6) months; 38 per cent said their experiential training lasted for a period of 12 months and 11 per cent said theirs lasted less than six (6) months.

Regarding the influence of experiential learning on education of students of construction programmes, the respondents were asked about the influence that experiential training has. The findings, as shown in Table 1, suggest that the respondents ranked the fact that experiential training has an influence "in encouraging students to find greater meaning in their studies" first and this had an MIS of 3.97; ranked second was that experiential learning has an influence "in providing students with exposure to the real world of work" and this variable had an MIS score of 3.96; ranked third was that it "encourages students to develop a greater sense of responsibility" and this had an MIS score of 3.78; and ranked fourth was that it "encourages students to place more reliance on their judgement" and this had an MIS ranking of 3.55. Ranked fifth was that experiential training has an influence "in creating students who are readily employable" and this factor had an MIS score of 3.47 and they ranked the fact that it "gives students access to possible funding sources" last in sixth place with an MIS score of 3.27.

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	MIS	RANK
In encouraging students to find greater meaning in their studies	3.97	1
In providing student exposure to the real world of work	3.96	2
In encouraging students to develop a greater sense of responsibility	3.78	3
In encouraging students to place more reliance on their judgement	3.55	4
In creating students who are readily employable	3.47	5
In giving students access to possible funding		
sources	3.27	6

Table 1, Influence of experiential learning on construction education of students

4.3. DISCUSSION OF FINDINGS

In some cultures, group dynamics are developed in a more systematic and sustained manner, with greater value placed on interdependence and collaboration than on individual performance (ECTE, 2005). The study findings revealed that 81 per cent of the respondents say collaborative learning is effective while 10 per cent of the respondents said collaborative learning is not effective and the remaining 9 per cent were not sure. The study findings further revealed that experiential training plays a role in encouraging students to find greater meaning in their studies, in providing students with exposure to the real world of work, in encouraging students to develop a greater sense of responsibility, in encouraging students to place more reliance on their judgement, in creating students who are readily employable and in giving students access to possible funding sources. The findings were similar to what the Nelson Mandela Metropolitan University (NMMU) (2015) Prospectus outlined, namely that the experiential learning experience illustrates that the incorporation of theory and in-service/experiential learning creates diplomats who are more mature and readily employable.

Similarly, this work experience encourages students to develop a greater sense of responsibility, place more reliance on their judgement, and find greater meaning in their studies. However, the findings were not in agreement with the study conducted by Haupt (2003) which revealed that the separation between practical and academic work creates a division in the mind of students rather than relating the theory to the application that reinforces the basic concepts taught in the classroom. However, Hynds and Smith (2001) also state that the

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relationships with the industry are essential to programmes of post-secondary education in construction. Moreover, the NMMU Prospectus (2015) further adds that during the time when students are undergoing their experiential learning, they become exposed to people from diverse spheres of life and therefore develop greater confidence when working as part of a team.

5. Conclusion

This study sought to find the impact of experiential learning on construction education in South Africa. From the findings relating to the demographic aspect of the study, it can be concluded that construction education is studied by people of various cultural groups: Africans, whites, Indians or Asians and coloureds, which indicates that all the ethnic groups were represented in the study. Also, the findings indicate that construction students are registered for courses in Quantity Surveying, Construction Management, Civil Engineering and Building Science. It can also be concluded that the majority of the respondents were young people who are from different cultural backgrounds. The findings also revealed that majority of the respondents take part in collaborative learning once a week or two to three times a week or more. Additionally, most of the respondents were of the view that collaborative learning is effective. Furthermore, majority of the students are aware that they are working with people from different cultural backgrounds. It can also be concluded that for construction related programmes, students did their experiential learning between a period of six months and 12 months. It is also evident from the study that experiential training has an influence in encouraging students to find greater meaning in their studies and in providing students with exposure to the real world of work. Further, it encourages students to develop a greater sense of responsibility and to place more reliance on their own judgement. Above all, experiential learning has an influence in creating students who are readily employable and it gives them access to possible funding sources.

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IMPACT OF THE COSTUMES ON THE THEATRICAL STYLE, IN A HOLISTIC SENSORIAL PLATFORM

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Abstract

The purpose of this study is to find out how and in what ways do costumes impact on the theatrical style in the play, in a holistic sensorial platform. The research is done based on the Comprehensive Design project done by the author, which was 'Designing Costumes for an Experimental Play'. The play "The Irresistible Rise of Mr. *Signno*" is an experimental theatre practice done by the theatre practitioner Indika Ferdinando. Following practice based research methodology, this research will discuss the impact of costumes on the theatrical style by designing costumes for the above mentioned experimental theatre practice. In the play the director's aim is to bring back the concept of holism in ritual theater, into the contemporary theatre. Upon completion of the research, it was found out that costumes are a key player, and it has and strong impact on the theater style in a holistic platform. The research was made possible by a Senate Research Committee Grant, University of Moratuwa, Sri Lanka under the grant number SRC/ST/2017/16.

Keywords: costumes, theatrical styles, holistic sensorial platform, cross model perception, kinesthetic empathy

1. Introduction

A theatrical venture, such as a drama or a play can be described as a conversation with the society through art work. In the Sri Lankan context today, the practitioners tend to develop our own style inspired from ritual theater, as it is considered as the birth of Sri Lankan theatre. In the Sinhalese ritual theater, there are multiple of qualities that contains the approach to a holistic sensorial platform. The director tries to apply it in search of a novel theatre movement that incorporates with holism. Holism could be explained as the whole of all the elements. Any of these theatrical practices and all the elements in them depend on two main factors, which are its theatrical style, and director's interpretation to the play. A theatrical style is the nature of the play. In the theatre, costumes play an important role as a major visual element. Studying the impact of costumes in a holistic platform is a challenge. Also in a holistic platform, both the audience and the performers are considered as experiencers. In Indika's play, the audience is called as attendees as they are also a part of the performance. The research is aimed to find out how and in

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what ways do costumes impact on the theatrical style in a holistic sensorial platform, and the research will be done assuming the costumes have a major impact on the theatrical style.

2. Introduction To The Play "The Iresistble Rise Of Mr. Signno"

The irresistible rise of Mr. *Signno*, is an experimental play done by the wellknown theatre practitioner Indika Ferdinando. The play could be introduced as a modern allegory with rationalistic forms. Through this art work, his intention is to identify what constitutes in holistic sensorial experience in Sinhalese rituals and to explore ways of applying it into contemporary theatre practice. The director uses the word "ritualistic parable" to name this piece of art work instead of calling it a drama, or a play. The word parable, is when a particular message, lesson is delivered to the viewer through an art work. The plot talks about an everlasting matter and the whole of it in this parable is really a cross between traditional and the contemporary.

3. Holistic Experince

The term "holism" is described by Jan Smuts (1926), as "tendency in nature to form wholes that are greater than the sum of the parts through creative evolution"-in his book "holism and evolution". Considering the theatre, the spirit of the theater lays in the relationship between the audience and the production. Considering the holistic sensorial platform that the play was presented in, the experience delivered to the spectators was somewhat extended to a standard beyond the usual theatre experience. In the theatrical context, the concept of holism is tried to be achieved by addressing the six senses which are eye, ear, nose, tongue, body and mind. According to the concept of holism, none of the key elements are working as individuals, instead they tend to work as a whole. To point out few examples to clarify the concept, Once Signno's bride sings the western nursery rhyme 'London Bridge is falling down' to the beat of Sinhala traditional drumming, the spectators might be wondering whether it is an innovation or sacrilege, but sure it was addressing more than two senses. Each and every sensation was bonded with an experience that created a conversation with mind. Another trick that was used in this parable was spraying smells into the air to intense the experience in each scene. Also when in a hospital scene, spraying pine scented disinfectant in to the air, and when the villain performing his miracles, throwing mustard seeds overhead could be pointed as very clever in engendering multisensory theater experience to the attendees. As the director of the play, Indika Ferdinando (2015) has

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mentioned, this work could be called as hybridization as the medium of vocal communication being English while the ritualistic facets were Sri Lankan. This work seeks to deliver a single experience as a multisensory experience, and that is a holistic experience.

Music is another element that supports in heightening the holistic experience. In the Signno Parable however, following the foundation concept which is infusing tradition in to contemporary, both western and ritual musical instruments were used. This could be further explained by the term 'cognitive neuroscience'. 'Use of one object to generate sensory identification between perceiver and the performer'. From drum beats to the anklets worn by the performers, number of objects has been used to penetrate the sensations to the attendees. Those have been helped in various ways in engaging with the performance through body and mind both. This could also be explained by the term 'kinesthetic empathy'. Empathy is the ability of one person to understand another. It is the attempt to experience somebody else's inner life. This is again proving how the holistic sensation is delivered to the attendees without just making they watch and hear a performance. Cross model perception was another term to explain the plot which means 'the perception that involves interaction between two or more different sensory modalities' all the sensations interact in perception of other sensations. For an example, vision and hearing interact in speech perception and when drum beats producing both sound and sensation. Even when the actors are wearing anklets, according to the performance the sensation is felt by the movements they perform in that particular scene.

4. Background Research On Rituals

Even though the research base is holism, each element in the research base was individually observed to take the approach to the background research. The director had taken inspirations from two rituals which were "gammaduwa" and "daha ata sanniya". "gammaduwa" is a low country exorcism which is for gods. The central figure of this ritual is Goddess Pattini. (Pattini- the goddess who symbolizes fertility, health and purity as a woman) and "Dahaata Sanniya" is a low country exorcism which is for demons. "Dahaata Sanniya", an exorcism plays an important role among all the exorcism rituals in low country region and their traditions performed on behalf of the demon Sanni and his assistants that are responsible for spreading infirmity among the native man. Eighteen types of infirmities symbolize eighteen demons." As said by Abeysinghe MMK (2013).

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4.1. VISUAL ELEMENTS

4.1.1 Costumes

All the performers wear a base costume of black long trouser, which is body hugging. On that they wear various jackets, draped clothes (*helaya, kachchiya, hagala, waist bands, pachchawadama*) according to the character. Mostly they are embellished with hand stitching and embroidery, or attachments.



Figure 1, basic ritual attire

bead works, embroidery and attachments have been used as embellishments.

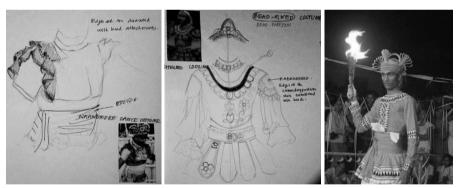


Figure 3, bead works, embroidery and attachments

The silhouettes do not vary from one to another so much. It prevails a uniqueness and common attire throughout the whole ritual.

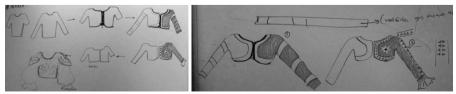


Figure 4, silhouettes of jackets

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Costumes contain a huge range of different patterns, originated and evaluated from the very basic pattern segment which is a line of triangles. By differentiating the placements, the way how they divide the body, colours and with other little variations, they have achieved a whole range of different and elegant patterns in their costumes.



Figure 5, patterns and pattern placements

4.1.2 Colours

Different amounts and combinations of colours are being used to symbolize different characters and personalities. red, white, yellow, black, blue, gold and silver are the main colours that are being used in ritual costumes in low country. white Symbolizing purity, red impurity, black devils, yellow health, and blue was rarely used when in need of highlighting a character and gold silver to symbolize power and stability.

4.1.3 Lighting

For lighting they use fire torches, *ath pandam* (hand fire torches), *pol pandam* (fire torches made by coconut leaves) apart from the basic requirements of lighting, in the rituals it is also used for attraction and visual pleasing, as well as widening the space of performers. The performers play with an additional space that goes beyond their personal space.

4.1.4 Movements

Low, medium or fast movements according to the situation and drum beats both rigid and circulation movements. Mostly the upper body is moving than the lower body. Postures are different to up country movements.

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Figure 6, movements in the rituals

4.2. AUDITORY ELEMENTS

There are basically three types of beats as low, medium and fast which changes according to the situation. The two types of musical instruments that are being used are, *Beraya* (drum) (*Yak beraya/Mihingu beraya*) and jingle bells.

4.3. OLAFACTORY ELEMENTS

The ritual environment is created by burning traditional fragrances like frankincense. Apart from that, the smells of the burning flames, fire torches, even the oil lamps help creating the ritual sensation in the context.

4.4. GUSTATORY ELEMENTS

Both the viewers and players get served by traditional Sinhalese sweets such as *kewum, asmee* and *kokis,*

4.5. TACTILE ELEMENTS

As the viewers and players both are a part of the performance, they interact in many ways. Since there are no stage boundaries, the viewers can sometimes physically touch the players as well. Also the viewers feel the sensations of the fire when performers dance with fire torches they interact in tactile base.

5. Methodology

Methodology of this research would be practice based research as the research objective has been tried to found out through practice which was the comprehensive design project done by the author on designing costumes for the play "*Signno*". The impact of the costumes on the theatrical style in holistic sensorial platform will be discussed with reference to the costumes done for the "*Signno* "play.

5.1. DESIGNING COSTUMES FOR THE "IRRESISTIBLE RISE OF MR. SIGNNO" PLAY IN A HOLISTIC PLATFORM.

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When designing the costumes, the two main factors to be considered were the style of the play and the director's interpretation to the play. Other main factor was, in a holistic platform, both the wearer who is the performer, and the attendees are experiencing the costumes. Both of those parties had to be taken into consideration when designing the costumes. Also costumes were not acting as an isolated element in this context, but it was a part of the whole of the work. The other elements those were described above, were having impact on each other, and designing the costumes to be a part of that holism was the challenge. The concept for the costume designing was "straying away from conformity, in search of holism".

There are three main needs that had to be achieved when designing the costumes, which are getting the ritual attire, following the qualities of the theatre styles and how do costumes work in the holistic platform interacting with other elements. The concept of holism could be incorporated in the play by two ways. By addressing all the senses of the performers and attendees, and by heightening the overall sensation of the theatre experience. To provide a multisensory experience by costumes, they had to be able to address all the senses of the attendees and performers. The visual elements such as colours, lighting, patterns, movements, were all considered in designing the costumes. The materials were selected considering the impact of lighting on it, and the colours of it. Also the visual illusions created by the combination of patterns and lights with the movements done with fire torches in hand, were able to provide a strong multisensory experience to both attendees and performers. As there was no stage boundary, there were multiple ways of interaction between performers and attendees. Apart from the fragrances sprayed and burned in the air, the costumes were also aromatized with traditional scents such as frankincense. Also the textures of the materials, embellishments were felt by both the performer and attendee. Even the sound of moving clothes with the fast movements can be heard and felt by the attendees and the free lengths of the costumes were designed considering those movements. The embellishments and pattern placements were done considering the effects of lighting and the movements. Likewise, as all the elements had an impact on each other, the costumes were designed putting weight on getting the best out in a holistic platform.

Sri Lankan audience can effortlessly and unconsciously identify the ritual attire even by the applications of its tiny details. This knowledge that comes from experience has been used in this work when taking the design approach to the costumes. This could be described by sensory anthropology, which means 'studying culture via senses or vice versa'. When considering the experience delivered to the attendees, there are basically two types for them to grab the message. One is by the sensations given to them by the performance and the

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other one is by the experience of them, by what they know. All the actors wearing "*pachchawadama*" was one of the applications taken from rituals. "*pachchawadama*" which is the red piece of cloth wrapped around the waist, helps the actors to perform fast movements in the rituals keeping their body straight. Also These costumes contain a huge range of different patterns, originated and evaluated from the very basic pattern segment which is a line of triangles. The above mentioned pattern segment was also applied in various ways for the costumes in the parable.

Since all the costumes had to be developed on the base costume, the costume for ensemble (the background actors who participates throughout the play as different characters.) had to be designed first. In this parable there were several facets to be considered other than characteristics of each character. Movements, lighting, music were the main factors. As the ensemble participated throughout the play as different representors, their costume had to be less distracting, characterless and identity less. And also comfortable and practical when performing fast movements. Also the colours had to be visible and suitable for the lighting that was used in the premises. Since the ensemble was supposed to be characterless and identity less, beige colour was used for their costume considering non distractive impact when being visible in the night light. In here, costumes, movements and lighting all the three elements work together making visual illusion which contains a holistic experience to both performers and attendees.



Figure 8, mood board, final costume for ensemble

Also the definitions given for the colours, patterns and placements in both ritual context and folklore were used accordingly when designing costumes. For an example, as the only defined female character in this play is the princesses' character, the inspiration from the ritual was derived from the character of goddess *pattini*, as she is the only female character that highlights as a female character that is given a value as a female and being worshiped and appreciated for her woman hood. All the other female characters were used to produce humour. Likewise, for the most outstanding character in the play who

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is 'the death' (*vasavarthi maara*), the inspiration taken from rituals was the character of '*naga raksha*', as both of these characters were mythical and given an irreplaceable original place in the context. For the other main characters also, the same method was used when designing the costume.

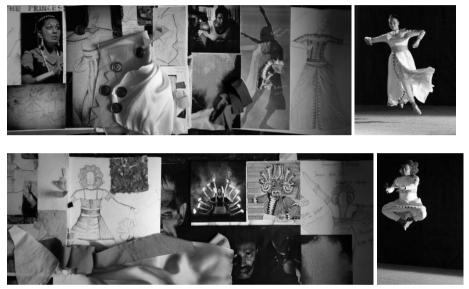


Figure 9, mood board for the princess's character Figure 10, final costume of the princess Figure 11, mood board for "*maara*" (the death) Figure 12, final costume for "*maara*" (the death)

Apart from the main style which is the Sinhala ritual attire, the director says the parable contains qualities of Brechtian epic theatre, Samuel becket's absurd theatre style, and expressionism as well. As in the epic theatre and absurd style, the costumes were minimalistic, and highly symbolic. Even for the main characters the prominence was given through minimalistic embellishments and adornments. The main focus was to convey the idea to the attendees, keeping the ritual attire. By using symbolic colours the relevant messages were conveyed to the attendees. As in the expressionism movement, the costumes were highly expressive. None of the details were applied without a reason. Again the colours, pattern placements and embellishments were applied to express a meaning. Also by wearing masks, the characteristics were expressed easily. This method came in expressionism. For an example, the ensemble was wearing masks with fearsome expressions when performing as the army of the detath, and the same actors wore different masks when in a scene of a hospital.

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Also in the expressionism movement the characters did not represent a single personality, but a social group. In this parable also the costumes were designed symbolically to represent social group other than just a single character.

According to the mentions by Director, indika Ferdinando, the term "*Abhidarmaya*" in Buddhist philosophy could be taken to explain the whole idea of the research. It is how the reality is discussed as a construction through senses. The whole physical experience in the moments was created by the combination of various sensations. Some were physical which could be heard, seeing and touched, while some were only felt by mind and heart yet, the reality in that particular moment was created by the combination of all those senses.

5. Conclusion

To conclude the research, the costumes as a major visual element in theatre, has a great impact on its theatre style and all the other elements. This study was aimed to find out how and in what ways do costumes impact on the theatre style in a holistic platform. The research was as a practice based study, designing costumes for an experimental theater practice. The particular play was aimed to bring back the concept of holism, in to contemporary theatre practice, from Sinhalese ritual theatre. The selected play follows several theatre styles and also since it had generated in a holistic platform, all the elements were interconnected and working together, delivering a multisensory experience. Observing each element individually, as well as a whole, this research helped to find out the costumes has a strong impact on its theatre style in a holistic sensorial platform.

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IMPACT OF CULTURE ON CONSTRUCTION EDUCATION IN SOUTH AFRICA

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Abstract

The purpose of this study is to assess the impact of culture on construction education in South Africa with a view to determining how cultural backgrounds influence students' behaviour. The data used in this paper were derived from both primary and secondary sources. The secondary data were collected through a detailed assessment of related literature. The primary data were likewise collected via a structured questionnaire aimed at 130 respondents who were students registered for Construction Management (CM), Quantity Surveying (QS), Civil Engineering and Building Science at a South African higher education institution. Out of the collected 130 questionnaires, only 101 were usable, representing a response rate of 78 per cent that was deemed viable for statistical analysis for this study. Data received from the questionnaires were analysed using descriptive statistics procedures. The higher education institution used for the study has a variety of students and lecturers: through this study it is evident that the cultural background of the students shapes their attitudes and values, knowledge base as well as the skill set and these, in turn, influencing classroom behaviours, their study habits, their writing styles and faculty student interactions. The study concluded that culture is an important concept when it comes to education, especially construction education, which needs to be managed appropriately. The study, therefore, recommended that in order to manage cultural differences, students need to be aware of the cultural backgrounds of those with whom they work and interact since failure to manage cultural differences in a collaborative learning environment could possibly lead to student failure.

Keywords: Culture, Construction education, Higher education institutions, South Africa

1. Introduction

The Republic of South Africa (RSA) is a multicultural democratic country in Africa which is bordered by countries such as Mozambique, Namibia, Botswana, Lesotho, Swaziland and Zimbabwe. The country is divided into nine provinces and has a total population of about 54 million people (2014 mid-year estimate) Statistics South Africa (Stats SA) (2014). In 2013, there was a total of 136 public and private higher education institutions (HEIs), where 23 of them were public HEIs and the remaining 113 private. From these higher education

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institutions, 85 per cent of the students were enrolled in the public HEIs and this large percentage saw the Department of Higher Education and Training (DHET) establish two new public HEIs in the same year. The two new public HEIs are the Sol Plaatjie University and the University of Mpumalanga which both started operating in 2014. Higher education institutions (HEIs) have become essential for employment, for social mobility, economic development and growth and to this day, the significance of a vibrant higher education sector is even internationally recognised (Pouris & Inglesi-Lotz, 2014). The role of education in improving work-skills, learning and in developing personal preferences is unquestionably important and it continues to be one of the pointers of human development and wellbeing (Timæus *et al.*, 2011).

The construction industry is one of the biggest industries in the world and contributes greatly to the economy of any country. Construction is quite different from other industries as it has several unique characteristics which include the construction process, management practice, organization structure, working environment and the characteristics of workers' behaviour. In any building project for example, regardless of the type or size, different people are required to provide different services through the process of designing, construction and/or maintenance, all from the point of inception until completion. The construction industry employs a variety of people who come from different environments and backgrounds: this would mean that people are used to different ways of doing things. It must also be acknowledged that in order to work effectively and efficiently, the needs of these different individuals must be addressed and met. As such, education is connected to culture and the methodology of education is very much connected to the culture of the country at hand (Wursten & Jacobs, 2014).

Culture is an important subject when it comes to the ever-growing, everchanging construction industry, particularly considering the concept of education. Scholars such as Spencer-Oatey (2008, 2012) define culture as a vague set of basic assumptions and values, orientations to life, beliefs, policies, procedures and behavioural conventions that are shared by a group of people, and that influence but do not determine each member's behaviour and his/her interpretations of the meaning of other people's behaviour. Hofstede (1984) and Hall and Jaggar (1998) express the view that culture is the collective programming of the mind that distinguishes the members of one human group from another. In this sense, it includes systems of values and values are among the building blocks of culture. Furthermore, Kagerer and Gandarilla (2011) maintain that even though culture commonly refers to societies, it can also be applied to any human collectivity or category which can be an ethnicity, an organization, a family or a gender. Hofstede (1984) has studied the concept of culture and according to his study in Kagerer and Gandarilla (2011), there are IMPACT OF CULTURE ON CONSTRUCTION EDUCATION IN SOUTH AFRICA

ways in which cultures differ from one another and this can be seen through different dimensions.

Currently, the South African education sector faces many challenges. However, even though the sector faces the challenges, the issue of cultural differences remains a factor that should be looked into as opposed to being totally ignored. The country's education sector comprises various individuals, all with different backgrounds and this sometimes creates challenges when it comes to the teaching and learning processes. Culture and education are inseparable, as they are simply two sides of the same coin (Obanya, 2005), hence the need to find ways to embrace culture in education and not ignore it. The problem assessed in this research project is the impact of culture on the teaching and learning processes of construction education in South Africa, a case of a South African higher education institution.

2. Literature Review

2.1 THE CONCEPT OF CULTURE

Traditionally the term 'culture' has always been defined in terms of people's origins, covering the aspect of where people come from, their upbringing as well as how they interact with each other. It is evident from the various definitions that the term 'culture' is a difficult term to fully define as it has many aspects to it. However, studies on the concept of culture define it as the collective programming of the mind which distinguishes the members of one group from another, and as such, it is passed on from one generation to the other. The change occurs due to each generation adding value of its own before passing it on to another generation (Hofstede, 1980). According to Khoza (2006), "Culture is to people as water is to fish, we all live in it". Additionally, culture again refers to aspects of 'the way of life' that people learn in a society, with the addition of language, customs, values and norms, beliefs, dress code, roles, knowledge and skills. It is passed on from one generation to the next through the process of socialization. Allison and Kamisky (2015) stated that culture can be defined in a variety of ways: this includes it being defined as a verb ('culture' as in microbial cells), as a noun ('culture' as a group of beliefs or ideas) or even as an adjective ('cultural' as in cultural tradition).

Additionally, there are various ways of categorising culture mentioned by Allison and Kamisky (2015) which include it being topical, historical, behavioural, normative, functional, mental, structural and symbolic. When we say culture is topical, this means that culture consists of everything on a list of topics, or categories, such as social organization, religion, or economy, whereas historical culture is passed on from one generation to the next, and means

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tradition or social heritage (Allison & Kamisky, 2015). Behavioural culture refers to the way people live life, which is shared and learned behaviour of humans. Functional culture, on the other hand, focuses on the ability of humans to adapt to different environments and people, to solve different problems and so forth. Mental culture is how the mind works with regard to ideas and habits that make humans different from other species. Finally, symbolic culture refers to symbols that have meaning and are shared by the society (Allison & Kamisky, 2015). Rathje (2009) state that the most common understanding of culture is one that imagines a high level of internal uniformity within a social system. They further explain that the concept of culture was previously limited to contexts of ethnicity or nationality. According to Tso (1999), culture describes the social system created by a group of people; it starts from the moment that a few people get together regularly and begin to establish norms and rules through which they will interact and communicate with each other and maintain order. It is about patterns of meaning; it is about shared beliefs, values, perspectives, and worldviews; it is about shared behaviour, practices, rules, and rituals (Allison & Kaminsky, 2015; Chan & Tse, 2003).

In the work of Khoza (2006) culture was used in two ways and these include the word being used in both the wide and the narrow sense. In a wide sense this means that culture underlies our social identity; it is the bond that forms clusters of ethnic identities in multicultural societies when we speak of many cultures in one society. However, when we speak of the narrower sense of culture, this refers to the culture that pervades business and business organizations and this grows inside the business itself (Khoza, 2006). Sillars and Kangari (2004) state that culture can also be defined as the business traditions, processes and attitudes that an organization uses in pursuit and performance of its work (Allison & Kaminsky, 2015). Culture represents different ways of relating to other people, and interpreting the world and all environments (Jandt, 2004). Khoza (2006) states that the word 'culture' is layered with meanings and can be confusing. Belshek (2006) also highlights that culture is not a simple concept to define. It has no single definition that has achieved consensus in literature. Therefore, out of the numerous definitions examined, Hofstede's definition of culture guides this study: Culture distinguishes members of one group from another; it is passed on from one generation to another and it always changes owing to additional values inputted by the newer generation (Hofstede, 1980; Belshek, 2006).

2.2 CULTURE AND CONSTRUCTION EDUCATION

The construction industry is known for its diversity as it employs people from different backgrounds, perspectives and systems. This would also mean that diversity also exists in the education sector. In considering construction education, there has to be a mention of the construction industry as a whole

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since the industry determines what the providers of construction education should be teaching students in order to prepare them for the actual industry. According to Wit *et. al.* (2010), within a contemporary knowledge economy students need new skills for college and careers, and failure to foster these skills and a culture of learning leaves them vulnerable. The Smith Institute (2014) indicates that it has become evident that the construction sector faces a challenge when it comes to recruitment as youngest people are unaware of the range of the available employment opportunities and most recruits happen through referrals.

The Smith Institute (2014) further adds that the industry must use modern ways of attracting recruits and using modern adverts. Furthermore, a culture change is essential in a way that it would be more welcoming to women. The choice to study construction-related courses can be based on or determined by, amongst others, interests, passion, curiosity and the availability of funds. However, according to the ECTE (2005), academic options and choices in some countries are determined by examination scores, sometimes as early as at the age of 13. In terms of colleges and majors to study, parents in some countries give the students no choice when deciding on those choices (ECTE, 2005).

2.2.1 Students' culture in construction education

We are shaped by our view of those outside our defined culture based on the differences in religion, language, ethnicity, values and norms (Baier, 2005). The cultural background of the students shapes their attitudes and values, knowledge base as well as the skill set and these, in turn, influence classroom behaviours, their study habits, their writing styles and faculty student interactions (ECTE, 2005). Also, our identity with regard to where we were born and raised influences our behaviour and the ability to adapt to changes (Kagerer & Gandarilla, 2011). In the university environment, students are exposed to different factors that influence their behaviour, attitudes, views and perspectives on their studies and these factors may include issues around financing their university fees, their transition from high school to university, the classroom culture in the new institution, the difference in the scope of work, having to work in teams/ groups, and obtaining experiential learning.

2.2.2. Classroom culture in construction education

The (ECTE) (2005) explains that in some cultures, students are expected to remain silent in class, whereas in others, there is a deeper formality whereby students display respect by rising when the professors enter the classroom and they address the professors by titles, hence conforming to a more formal standard of behaviour. In construction education the classes are designed in away that the faculty expects to have a level of respect between the university staff (lecturers, tutors) and the students. Sometimes the tutors who are selected

to offer tutorials to the students are often found to be peers of the students and therefore the level of respect becomes questionable by the students.

2.2.3. Students' culture in collaborative learning

Collaborative learning is a social interaction that involves learners and teachers in a community whereby those members acquire and share knowledge and experience (Zhu, 2012). Collaborative learning involves students working together to complete tasks where the instructor or lecturers hands out a task that should be carried out and completed by a group of students working together to reach a common goal. In some cultures, group dynamics are developed in a more systematic and sustained manner, with greater value placed on interdependence and collaboration than on individual performance (ECTE, 2005). Project success can be observed when the goals of an individual or organisation have been met and accomplished. As Kivrak et al. (2009) stated, a successful management of cultural differences is seen as one of the key elements in project success; moreover, it can also enhance organisational effectiveness and give an organisation or a group a strong competitive advantage. Additionally, the same can apply in collaborative groups, whether in an educational institution or an actual construction project and it is also worth noting that the opposite can be expected when cultural differences are not managed. The failure to manage cultural differences can possibly lead to delays in project deliveries, decrease in productivity and a bad image for the organisation (Kivrak et al., 2009).

3. Methodology

The study made use of a survey research design. Data for the study were collected from students who registered for Construction related programmes like Construction Management (CM), Quantity Surveying (QS), Civil Engineering and Building Science at a South African higher education institution. Structured questionnaire was used to collect the data. The first section was based on the demographic data of the respondents, Section two relates to the impact of culture on construction education and the questions in this section were based on a Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was examined and criticised by experts to ensure its adequacy and effectiveness in achieving the intended results. The reliability analysis was also carried out on the research instrument as well. One hundred and thirty (130) copies of questionnaire were administered to respondents purposively selected among the students who were registered for Construction related programmes as mentioned above. Out of 130 copies of questionnaire administered, 102 were returned, but one of them was discarded due to incomplete information. Therefore, only 101 were usable, representing a

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response rate of 78 per cent that was deemed viable for statistical analysis for this study. Data were analysed using percentage and the mean item score (MIS) to derive straight-forward totals and rank the variables. MIS was computed using the following formula:

$$\text{MIS} = \frac{1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}{\Sigma N}$$

where;

 n_1 = the number of respondents for 'strongly disagree'; n_2 = the number of respondents for 'disagree'; n_3 = the number of respondents for 'neutral'; n_4 = the number of respondents for 'agree'; n_5 = the number of respondents for 'strongly disagree'; N = the total number of respondents

4. Results and Discussion of Findings

4.1. BACKGROUND INFORMATION OF THE RESPONDENTS

This section gives insights about the background information of the respondents. The results from the questionnaire survey indicate that, in terms of the ethnicity of the respondents, majority of the respondents were African with a percentage of 90 per cent, followed by whites at 6 per cent, Indian or Asian at 3 per cent and 1 per cent were coloured. Also, 84 percent of the respondents are single, 12 per cent are married, 4 per cent are co-habiting and none of the respondents were divorced or widowed. Further, the result showed that 90 per cent of the respondents were South African, while the remaining 10 per cent non-South African.

Additionally, the result indicated that of the total students participated in the study, 82 per cent are currently registered for a B. Tech. degree while 18 per cent of them are registered for third year in Building science. The respondents currently registered for the B.Tech. degree are registered for various courses: 46 per cent of them are registered for Quantity Surveying, 28 per cent for Construction Management and 10 per cent for Civil Engineering and the 17 per cent represents those registered for third-year Building Science. Also, when asked who is funding their university fees, the result revealed that 34 per cent of the respondents said that they are responsible for their own fees, 30 per cent of the respondents are studying through a bursary, 23 per cent of the respondents are

studying through NSFAS, another 5 per cent are studying through scholarships and 3 per cent are making use of study loans.

5. Findings

As part of the influence of culture on education of students, the students were asked about the way in which they address their lecturers. The results revealed that 69 per cent of the respondents address their lecturers by title and surname, 19 per cent use 'Sir/Madam' and 12 per cent said that they refer to their lecturers by name as shown in Figure 1.

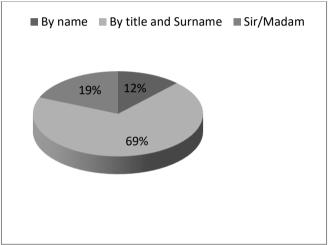


Figure 1, Ways students address lecturers

The findings, as shown in Figure 2, further revealed that a failure to manage cultural differences in collaborative learning could lead to a decrease in productivity and 31 per cent of the respondents agreed with this factor, 21 per cent indicated that it may cause delays in project deliveries, 17 per cent of the respondents said that it may create a bad image for the group, 16 per cent said it leads to project failure and 15 per cent of the respondents said that it gives the group a weak competitive edge.

Furthermore, the study sought to understand the extent to which the cultural backgrounds affects the students' behaviour. The findings indicated that the cultural background influences the students' values more than the other factors and the respondents ranked this factor first with an MIS score of 4.09. Attitude was ranked second with an MIS score of 4.08; ranked third was the student interactions with an MIS score of 4.03; ranked fourth was the study habits with an MIS score of 3.81; ranked fifth was the classroom behaviour with an MIS

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score of 3.78; and ranked sixth was the writing styles with an MIS score of 3.65.

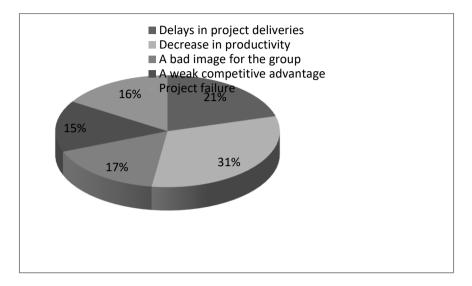


Figure 2, Effects of the failure to manage cultural differences

In addition, ranked seventh was the ability to change with an MIS score of 3.60; ranked eighth was the knowledge base with an MIS score of 3.60; ranked ninth was the influence on the skill set with an MIS score of 3.50 followed by an MIS score of 3.50 for the abilities to learn which was ranked tenth and last.

Cultural backgrounds influence the students	MIS	RANK
Values	4.09	1
Attitudes	4.08	2
Student interactions	4.03	3
Study habits	3.81	4
Classroom behaviour	3.78	5
Writing styles	3.65	6
Ability to change	3.60	7
Knowledge base	3.60	8
Skill set	3.50	9
Abilities to learn	3.50	10

Table 1, Influence of cultural backgrounds on students' behaviour

6. Discussion of Findings

The ECTE (2005) explains that in some cultures, students are expected to remain silent in class, whereas in others, there is a stricter formality whereby students display respect by rising when the professors enter the classroom and they address the professors by titles, hence following a more rigid standard of behaviour. The survey study showed that within construction education, 69 per cent of the respondents reported that they refer to their lecturers by title and surname, 19 per cent reported that they use "Sir/Madam' and 12 per cent said they refer to their lecturers by name. This clearly shows that in some cultures there is a stricter level of formality whereby students address their professors and lecturers by titles, hence conforming to a more rigid standard of behaviour and confirming the results of the ECTE (2005) study.

Also, Kivrak *et al.* (2009) outlined that successful management of cultural differences is seen as one of the key elements in project success; that it can also enhance organisational effectiveness and give an organisation or a group a strong competitive advantage: a failure to manage cultural differences can possibly lead to delays in project deliveries, decrease in productivity and a bad image for the organisation. The study findings of impact of culture on construction education revealed that a failure to manage cultural differences in collaborative learning could lead to a decrease in productivity: it may cause delays in project deliveries, it may create a bad image for the group, it leads to project failure and it gives the group a weak competitive edge. These findings support the views of Kivak *et al.* (2009) about the failure to manage cultural differences.

Further, the research findings revealed that the cultural background influences the students' values, attitudes, student interactions, the study habits, the classroom behaviour, the writing styles, the ability to change, the knowledge base, the skill set and the abilities to learn of construction students. The findings were in agreement with the study by ECTE (2005) which highlighted that the cultural background of the students shapes their attitudes and values, knowledge base as well as the skill set and these, in turn, influence classroom behaviours, their study habits, their writing styles and faculty student interactions. The findings are also in agreement with the study by Baier (2005) that indicates that we are shaped by our view of those outside our defined culture based on the differences in religion, language, ethnicity, values and norms. Also, our identity with regard to where we were born and raised influences our behaviour and the ability to adapt to changes (Kagerer & Gandarilla, 2011).

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7. Conclusions and Implications of Research Findings

The findings indicated that cultural background influences the construction students' values more than the other factors such as attitude, student interactions, the study habits, classroom behaviour, the writing styles, the ability to change, the knowledge base, the influence on the skill set, and the abilities to learn. Furthermore, most of the respondents reported that they refer to their lecturers by their titles and surnames and only a few of the respondents said that they use either 'Sir/Madam' or they just refer to their lecturers by name.

A failure to manage cultural differences in collaborative learning could lead to a decrease in productivity; it may cause delays in project deliveries; it may create a bad image for the group; it leads to project failure, and it gives the group a weak competitive edge.

From the above findings, it is evident that the cultural background of the students influences their attitudes and values, the knowledge base and the skill set. These in turn influence the classroom behaviours, study habits, the writing styles and their student interactions. Additionally, people's identity regarding where they were born and raised influences their behaviour and ability to adapt to changes.

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STUDY ON THE RELATION BETWEEN SOLID WASTE VOLUME AND RESIDENTIAL COLLECTION METHODS WITH REFERENCE TO SOYSAPURA FLATS

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Abstract

Everyday human generates waste and municipal solid waste is supposed to be increased with urbanization. 3 billion urban residents generate 1.2 Kg of waste per person per day. This study was carried in Soysapura Flats which is located 17 Km away from the financial capital of Sri Lanka. The main objective was to study the impact of the volume of urban domestic solid waste on collection and storing methods in Soysapura Flats. The literature reveals that the volume of waste generated in developing countries continues to increase and the contribution by the urban domestic waste is effective but there is a lacuna of studies related to the residential waste collection and storing in the aspect of volume. The study used a combination of both quantitative and qualitative methodologies. 80 families were selected and interviewed to identify their methods of waste disposal, devices, practices and attitudes. And necessary measuring tools were used in order to carry out the volume measurements. The findings revealed that 8.062 litres of degradable waste and 5.828 litres of nondegradable waste generated per day by a family of Soysapura Flats. The degradable volume of waste was easily managed with the present collection method and system but not the non-degradable waste category. Further detailed investigation is needed to identify the impact of waste volume on collection methods, especially in the aspect of waste and waste types.

Keywords: Urban solid waste; Residential collection methods; Impact of waste; Waste volume.

1. Introduction

Solid waste has become a major issue for the world as well as Sri Lanka. Day by day its severity increases due to several key factors such as population growth, rapid urbanization, hazardous wastes, drawbacks of state waste management strategies and attitude of people. The waste management can be clearly stratified into several layers as waste generation, classification, collection, transportation, disposal and treatment (Williams, 2005). This study was concentrated on the aspect of the collection and storing of waste at the place of generation.

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Waste collection and storing at the source of generation can be considered as the immediate steps after the waste generation. The importance of the waste storage at the source must be well identified. According to United Nations Environment Programme (2005), Storage and collection can be considered as important scales in understanding successful or unsuccessful solid waste management systems.

In Sri Lanka, there is a clear chain of waste transfer from waste generation to open dumping. Most of the approaches and solutions were given on the final levels (level of dumping and landfilling) of this chain. The initial level of the chain is the waste generation where the issue can consider to be simple in handling due to some points such as less contamination and attitude of people.

According to Ilangovan (2004), countries with low and middle income are more vulnerable with the issues regarding solid waste. Highlighting factor was the amount of money which was spending over solid waste management. The present world monetary allocation for waste management is \$205.4 billion and it will be increased to \$375.5billion in 2025 (Hoornweg & Bhada-Tata, 2015). Most of the amount of money was spend for waste collection and transportation by Municipal Councils (MC) around the world but not for the disposal and treatment methods (Bandara & Hettiaratchi, 2010).

Every fact proves that the attention must be drawn towards the correct process of handling the waste at the level of waste generation. Therefore a clear identification of some factors are very much important. This study was intended to investigate the impact generated by the volume at the level of waste collection in urban domestic context, as it is appeared to be one of the most crucial parameters in studying and analysing waste.

2. Background

2.1. SRI LANKA

Sri Lanka is a tropical island located in the Indian Ocean with a total land area of 65,610 km2. The total population is 20.38 million people (Ministry of Policy Planning and Economic Affairs Sri Lanka, 2015). According to Vidanaarachchi, Yuen, & S.Pilapitiya (2006), the urban population in Sri Lanka is 22%. The country has 9 major provinces and 25 districts. Western province is the highest contributor for the country's overall waste generation. With the population increase, the waste has become a huge issue for the Sri Lankan context.

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According Wijerathne, et al (2012) open dumping has become the solution to the present waste in Sri Lanka while most of the local authorities are still continuing it without delivering sustainable solutions

2.2. SOYSAPURA HOUSING SCHEME

It is Located 17Km away from the financial capital of Sri Lanka and Belongs to western province and Colombo district. The housing scheme was established before 1994 and it is considered as a low raised housing scheme. The Soysapura housing scheme is under the control of Moratuwa MC.

- Total buildings- 103
- Total houses- 1912
- Gramasewa divisions-2 (548B Soysapura South and 548A Soysapura North)
- Population-

548B Soysapura South	-2710
548A Soysapura North	-2841
Total	-5551

• Average family members per house -2.9

103 buildings are spread in an area of 44.91 acres. The internal roads interconnect the buildings and used in the waste collection by the vehicles of Moratuwa MC.

The single building unit was built with chutes; a mechanism for collecting waste, see Figure 1. But the system of chutes failed with the passage of time due to issues regarding classification of waste, type of waste and the collection rate of waste. Later these chutes were sealed and the waste was collected inside the house using other methods.



Figure 1, Placement of chutes in a single building unit

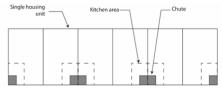


Figure 2, Cross section A-A/

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There is a common house plan for the Soysapura housing scheme. Main components of a single house is Living room, Kitchen, 2 rooms and a Bathroom.

The space is somewhat restricted within the house. The furniture, electronic appliances and utensils were placed within this restricted space.

Waste generated by the Soysapura flats were highlighting the qualities of urban domestic waste. Basically, the Moratuwa MC collects waste under two categories as degradable and non-degradable. The most common terms used by the house owners are "*Indul*" (degradable waste) and "*Nodirana kunu*" (non-degradable waste). "*Nodirana kunu*" will be collected by the MC on every Wednesday and Sunday, "*Indul*" will be collected daily except Wednesdays and Sundays.

3. Methods and methodology

The Soysapura housing scheme is one of the oldest and most populated urban settings in the western province of Sri Lanka. It is a place where no modern waste collecting system is practiced. Most of the house dwellers are under middle class-income. The flats were located in a large horizontal area. And it can be considered as a small township.

The sample was 80 families randomly selected from Soysapura flats. Face to face Interviews were conducted among families using structured questionnaires. All the 80 families were used in measuring the degradable waste volume while taking their volumetric measurements, 10 families were monitored in measuring non degradable waste volume due to limitations. Waste was considered as the unit of analysis. The necessary measuring tools were developed in order to carry out the volume measurements.

4. Results and discussions

Several collecting and storing methods were practiced by the house owners and their satisfaction level was identified by the questionnaire survey. 85% were satisfied with the present waste management process by the MC and 15% of them were not.

As a result of the questionnaire survey, 72% of the families were using the kitchen area as the place to keep their waste collections, while 20% using an outside place of the house, 4% living room, 3% bathroom and 1% a room. According to observations, kitchen was used due to easiness in handling waste, ability to reach, the ability of placing, attitude about waste and usage. Through

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these points, a clear link between the spatial arrangement of the kitchens and the garbage collecting and storing devices were clearly highlighted in the Soysapura housing scheme.

Most house owners tried to restrict their waste collection method into several areas inside the kitchen, Figure 4 depicts the current situation. Most of them were choosing the nearest and most easily reachable place to the sink in placing their degradable waste bucket.

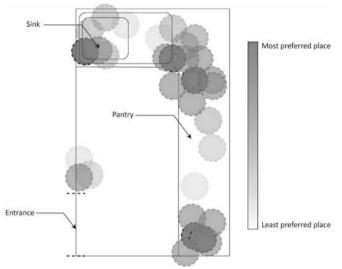


Figure 4, Placement of waste bins in the kitchen

Most of the house owners place their non-degradable waste collecting device near the degradable waste collecting device. Indirectly they have tried to make a single collection place for both of the waste types.

A plastic bucket was distributed by the Moratuwa MC among the house owners with the intention of collecting and storing short term degradable waste ("*Indul*"). It must be used by every house owner and the MC will reject to collect the waste if the classification was not done under the correct process.

Main parts of this bucket were the Lid, Handle and Body. The overall volume of the bucket was 18 litres.

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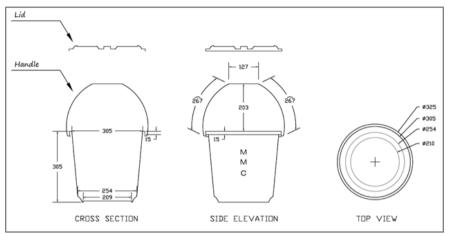


Figure 5, Measurements of the "Green colour bucket" (All the measurements are in mm and scale is 1:1)

In many instances the height, opening and base of the "green colour bucket" have become favourable factors in handling degradable waste in Soysapura housing scheme. For example, the bucket height of 1ft has made a link with spatial arrangement of kitchen and the human body measurements.

The degradable waste volume generated in the houses can be easily handled by the opening of the bucket which has an area of 706.85cm². The form of dishes and the type of degradable waste were some directly responsible reasons, for example, rice, curries, vegetable and fruit scraps, most of them have the ability of using the maximum volume of the given bucket, but there are exceptional situations like rotten and uncooked green leaves, banana leaves, coconut shells, "rambutan" peelings in the bucket.

The other most effective part of the bucket was considered to be the lid. As there are favourable climatic conditions for many insects and rodents the lid plays a major role in protecting and enclosing the waste. And it is a point of cleanliness. Finally, 79% of the house owners were satisfied with the "green colour bucket" and its function while 21% were not.

There is a clear link between the satisfactory level of waste management by the MC and the satisfaction about the green colour bucket and its function. 85% and 79% of people have said yes respectively for above questions. Similarly, above link is highlighting the relation between the waste collecting bucket and the collection rate of MC. But if the MC stops daily collection the result may

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change in a completely opposite manner. In each of the above steps, the volume of waste plays a major role.

Plastic buckets with various sizes were used to store non-degradable waste. Their volumes and process of the usages were highly varying. Most of the families who were less than 3 members have been using a dustbin or a plastic bin to collect their non-degradable waste. Most of them were practiced to a pattern of waste generation in which they could predict the volume of the waste generation per week.

22 families were using open containers. These open containers have become a smart solution in storing excess volumes of waste. 4 families were using the buckets with lids and they were using the lid as a tool in compressing the waste. But the negative fact was that the users were unable to keep several buckets due to the issues regarding space.

54% of the house owners preferred to use polythene bags to store and collect waste due to its collection rate, space consumption and easiness in handling. Most of the house owners were able to manipulate the waste volume using polythene bags to store waste. Here they were unable to reduce the volume of waste but they were able to increase the number of collecting devices (the polythene bags). In the other hand, 15% used garbage bags, 15% used dustbins, 11% used paint buckets and 5% used corrugated and cardboard boxes in collecting and storing their waste.

But the issues were aroused when the number of overall volume of polyethylene bags which were used to collect waste, increase when compared with the space allocated in the house.

There were clear links between collection methods of non-degradable waste and the family members of the house, for example, 32 of the families who were using polythene bags to collect the waste consisted more than three members. Special point was that those families were with small children who were under the age 6 and their waste generation was high. And most of them were unable to predict the waste that could be generated in the upcoming week.

4.1. DEGRADABLE WASTE VOLUME

The common "green colour bucket" was used as the vessel to collect and measure the degradable waste. As the initial step, the exact volume of the vessel was calculated. It was 18 litres. A specially made ruler was used in measuring the height of the garbage level in the bucket. The ruler was

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calibrated at every 2-liter mark to take the approximate height of the waste level and to reduce the fractional error. The measurements were recorded.

Overall degradable waste volume generated by 80 families per day	645 litres
Average volume of degradable waste generated by a family per day	8.062 litres

Table 1, Result generated using 80 families.

4.2. NON-DEGRADABLE WASTE VOLUME

Average volume of waste disposed by a family per day

Huge variation of types of wastes, collecting devices, family types and private issues were limitations for the calculation of the volume. Therefore a method was developed. A vessel was used with known measurements (50 litres). The questionnaires and observations were used to collect the information and to have an idea on approximate quantity and types of wastes generated in the Soysapura housing scheme. After the questions were raised. , the volume of the vessel was approximately predicted to suit the one-week non-degradable waste volume. A level indicator was attached to the wall of the vessel to take the waste volume measurement. The indicator ruler was calibrated at every 2-litre level. A disk was used to take the correct level of waste.

Finally, 10 families were selected from the Soysapura housing scheme, 5 of them were nuclear families and others were extended families. They were given the vessels to dispose of waste. They were given full freedom without interfering their normal disposing behaviour. After a week the volume measurements were recorded.

Average volume of the waste disposed by 5 nuclear families per week	33.6 litres
Average volume of the waste disposed by 5 extended families per week	48 litres
Overall volume of waste disposed by 10 families per week	408 litres
Average volume of waste disposed by a family per week	40.8 litres

Table 2, Result generated using 10 families.

The volume of waste disposed of by the extended families was visibly higher than that of the nuclear families. The huge variety of the waste was a special factor in the collected waste. 3 of above 10 families were concerned about the

5.828 litres

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volume of the given bucket. And they have managed the bucket volume by stacking and crushing of waste.

Free voiding space between waste objects was very high. And some types of wastes such as Styrofoam boxes, salmon tins, water bottles, soft drink bottles, coconut shells and polythene were directly affecting to the waste volume calculations. Special categories of waste such as napkins, sanitary pads and medical waste were there in the buckets and the contribution to the volume of waste was considerable.

The degradable volume of waste is most probably constant in its value but the field observations proved that the non-degradable volume of waste was not constant due to several reasons such as consumer attitudes, market behaviour, advertisements, product variations and marketing trends. For example, most of the degradable waste bins were with food wastes and it is occurring in the same pattern but the non-degradable waste bins were filled with different types of wastes and above mentioned reasons directly control the volume of the generating waste.

The discussions and interviews proved that the waste volumes were changing with the month of the year. For example, in the month of April, the both volumes of degradable and non-degradable wastes are rising in an enormous manner due to the Sinhala and Tamil New Year season and it is a vacation period for school children as well as office workers.

4.3. WASTE BEHAVIOR IN THE ASPECT OF VOLUME

The degradable volume of waste generated in the Soysapura housing scheme is dynamic due to the waste content and the type of waste. But the nondegradable waste is not behaving in such a manner, instead, it is static and rigid. This rigidity results in generating free void spaces and negative volumes of waste.

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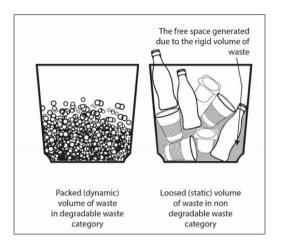


Figure 6, Waste volume comparison

Highlighting factor is that the non-degradable waste is making a huge sum of negative volumes. For example, the yoghurt cups and soft drink bottles can be considered. The material volume of a yoghurt cup is very much less than the overall volume it acquire in the space. Simply the negative volume is too much higher when compared with the positive volume.

Through the observations and studies it is clear that the negative volume of degradable waste is very less while non-degradable waste is very high in the studied context. This type of study is important in analysing the type of waste and the link between waste types and collecting methods. The analysis could pitch on four methods and the findings can be coordinated for a final conclusion over these four paths.

• Increase the volume of the collecting device

The size of the collecting device matters. As most of the house owners were restricted to a limited space and originally the houses were designed with chutes but not for other waste collection methods. And issues regarding handling will be aroused.

• Increase the number of collecting devices

It is not a proper solution for urban housing schemes like Soysapura. The space matters when the number of collecting devices is increased. And the house owners must find new areas of the house to place these devices. There is a

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trend of using this method by the ground floor house owners as they have a small land area but not for the upper floors.

• Manipulation of the space allocating for waste storing and collection

Using of Vertical and horizontal space is so much important fact in urban housing schemes. Especially the vertical space has more possibilities in collecting waste.

• Decrease the volume of waste generation

There are two aspects in reducing the volume of waste. They are pre generation of waste and post generation of waste. Most of the long-term and sustainable solutions seem to be with the aspect of pre generation. But the short term and most needed sudden solutions are in the aspect of post generation. Because many long chain processes must be studied and addressed in finding solutions in the aspect of pre generation. But the solutions can be easily and practically given in reducing waste after generation. And this type of waste management model will suit the present waste collection and storing issues in Sri Lankan context.

5. Conclusion

Through the above observations, studies and surveys, the combination of waste classification and waste volume reduction is the most suitable waste handling method for Soysapura housing scheme. Currently, the degradable waste volume of the Soysapura housing scheme is not making a huge impact on the waste collection method. The "green colour bucket" possess a volume of 18 litres. According to the survey, the approximate volume of degradable waste generated by a single family is 8.062 litres per day. It clearly suggests that the storing and collection of the degradable waste volume is not an issue when compared to the waste bin and the collection rate and process by the MC. But further studies must be carried in searching the ability to store degradable waste for several days. Current degradable waste volume convinces that the volume of the present device is very much high. In the other hand, new waste collecting devices can be designed to suit and handle the present volume of degradable waste. Even though the findings reveal that the impact of the volume of degradable waste is less on the present collecting device, the further studies must be carried to handle this volume of waste at the crucial levels of waste management in Sri Lanka such as landfilling and open dumping. Because the factors such as climatic conditions and chemical content can enhance the issue.

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Even though the volume of non-degradable waste generated by a family per day is 5.828 litres it has impacted the Soysapura housing scheme in a severe manner. None of the present waste collection devices are suitable for handling the non-degradable waste volume. And inappropriate waste volume handling has directly caused the issues of waste such as open dumping, recycling and MC waste collection. The non-degradable volume of waste suggests that the contribution to these issues by the Soysapura housing scheme is countable and effective.

The present non-degradable volume can be linked with the theories and concepts such as zero waste and waste management hierarchy. For example, the zero waste theory can be modified and developed to suit present condition in Soysapura housing scheme in the aspect of waste volume. If the waste volume of non-degradable waste can be reduced to 1/4 of its actual volume there are huge possibilities in supplying sustainable solutions. Finally, the volume is a tool in achieving the targets related to Zero waste theory and waste management hierarchy. Rigidity and the static nature of non-degradable waste is high. The best solution will be reducing this rigidity and static nature of waste. Therefore the free voiding and negative volume of waste can be reduced to a great extent. This will directly responsible for developing waste collection methods while considering urban practices, a variation of the type of waste, the form of waste, the material of waste, space management and attitudes.

Positive and negative volumes of waste must be considered. And a classification process must be developed while collaborating negative and positive volumes of wastes. The collecting devices and methods must be suitable for handling these positive and negative volume of waste.

Waste collection methods can be concentrated around the kitchen area and the collecting devices must suit the conditions and the layout of the kitchen. The relation of degradable waste and non-degradable waste is so much important in giving a unified solution for handling waste volumes.

The form of the waste matters when considering the volume, for example, the volume can be same for objects with two different forms but the impacts are different. Therefore the future studies must be carried on the forms of the products that later turns into waste. Especially in the aspects of the ability to stack, reducing volume, zero volume and reusable volumes.

If the volume of waste can be reduced, Moratuwa MC will be able to reduce the expenditure on the collection, fuel, transportation of waste and CO2 emission. For example number of the vehicle turns and vehicles can be reduced and that monetary value can be invested in waste disposing and treatment.

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Following types of waste volumes and their relations must be considered when addressing urban domestic solid waste. Degradable and non-degradable volumes of wastes

- Positive and negative volume of waste
- Free void volume of waste
- Static and dynamic volumes of waste
- · Low density waste volumes and high density waste volumes

The unit studies must be carried on other municipal councils and the waste generation places as the volume of waste is a prominent factor in explaining, studying and handling of waste. Finally, the collecting devices and methods can be considered as a crucial factor in handling domestic waste in Sri Lankan urban context.

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EXPANDING VERTICAL GREENERY IN BUILDING FACADES IN SRI LANKA

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Abstract

This study is focused on exploring enablers and barriers of implementing vertical greenery in Sri Lanka and suggesting strategies to overcome barriers. First, a comprehensive literature review was undertaken to identify a set of enablers and barriers. As the research approach, a mix approach was adopted in this study using questionnaires and semi structured interviews in two phases. Questionnaires were utilized to gather data on enablers and barriers. Data gathered using questionnaires were analyzed using one sample t-test in SPSS statistical software package and Relative Importance Index (RII) to identify the most critical enablers and barriers of vertical greenery. Accordingly, ten enablers and eleven barriers were identified in total where restoring the biodiversity into urban building and reducing carbon dioxide while increasing oxygen to the environment are the most significant enablers and the lack of awareness of the benefits and performance of vertical greenery systems has been identified as the most critical barriers. In order to identify the strategies to overcome identified barriers an expert survey was carried out using semi-structured interviews and analyzed using content analysis. Several strategies were identified mainly in three areas as, research strategies, government intervention and regulatory framework related strategies and awareness strategies.

Keywords: Vertical Greenery, Building Facades, Enablers, Barriers, Sri Lanka

1. Introduction

In the modern era, increasing environmental perception has directed urban systems and construction projects towards sustainability practices (Perez, Coma, Martorell & Cabeza, 2014). Green roofs for healthy cities (2008) mention the concept of green walls as an ancient one in the history of building construction dating back to the Babylonians with the much-admired Hanging Gardens of Babylon, one of the seven antiquated marvels of the world. Further to them 'Vertical Garden' is a distinct term that is utilized to refer to all types of vegetated wall surfaces. Vertical greenery frameworks have been the elements of designs for centuries where it is a typical practice to decorate building facades with the use of self-climbing plants and vines growing upward or cascading down which rooted on the floor, containers, or rooted on building surface (Greenscreen, 2012). However, Patrick Blanc, a botanist who inspired from nature is famous as the modern innovator of the concept of vertical

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garden and also as has been creating vertical gardens on public and commercial buildings, hotels, restaurants, lounges, museums, art exhibitions and private places since 1988 (Wan, 2011).

Several studies have been conducted to investigate the applicability of vertical gardens in different contexts and to explore the benefits of applying vertical gardens in urban settings [e.g., Perez et al. (2014); Wong et al. (2009); Cheng, Cheung and Chu (2010)]. In Sri Lanka, there are few buildings with green facades. Kandalama hotel, designed by Architect Geoffrey Bawa is the best example in Sri Lanka with vertical greenery concept (Aitken Spence Hotel Managements (Pvt) Ltd, 2016). Jefas, Chandrathilake and Silva (2012) have conducted an experimental research analyzing the effect of vertical greening systems on temperature (air and surface) of multi storeyed buildings in Sri Lanka. However, the concept is still not widely applied in the tropics like Sri Lanka. However, vertical greenery can be much more effective as an energy saving approach concerning the fact that one of the main goals of this system is the reduction of solar radiation (Wong, Tan, Tan, and Wong 2009). Despite the benefits of vertical greenery in environmental perspective, Perez et al. (2014) described that there are difficulties in implementing green facades or green vertical surfaces. However, there is a gap in researches on addressing the barriers to vertical facades. Accordingly, this study aimed to explore the enablers and barriers in implementing vertical greenery in Sri Lankan context and to suggest strategies to enhance the potential application of the system in Sri Lankan buildings.

2. Research methodology

A mixed method approach was adopted in this study. A literature review was carried out to identify the vertical greenery concept, and enablers and barriers in adopting vertical greenery in building facades in the global context. A questionnaire was developed based on literature findings to collect data on enablers and barriers of vertical greenery systems in Sri Lanka. The data collected from questionnaire survey was analyzed using one sample t-test and relative importance index (RII) find the important enablers and critical barriers in the Sri Lankan context. Interviews were carried out to propose strategies to overcome identified critical barriers. Interview findings were analysed using content analysis.

3. Literature review

3.1 BENEFITS OF VERTICAL GREENERY

As a new building technology, vertical greenery systems are gaining attractiveness mainly due to its wide range of positive benefits (Loh, 2008).

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Conventional greenery in architecture has been applied mainly for aesthetic appearance (Perez, Coma, Martorell and Cabeza, 2014), or to provide a cover for a building (Growing green guide, 2014). However, now it is also applied for environmental and socio-economic benefits.

According to Pan and Xiao (2014), plants as green envelopes can be planted in a small area of growing environment in order to resolve today's ecological and environmental issues in highly urban areas. Green facades improve environmental benefits by fundamentally enhancing the potential area for greenery in urban areas (Kohler, 2008). Thus, vertical greenery enables restoring biodiversity into the urban environment (E1) supporting preservation and protection of habitats of plants and animals (Wong et al., 2010).

Reduce Urban Heat Island Effect denotes vegetation cools buildings and the neighboring area through the processes of screening, dropping temperature, and evapotranspiration (Green roofs for healthy cities, 2008). Appropriate use of vegetation on the built environment can sufficiently regulate the city microclimate to generate a cooler microclimate (E2). At the same time, Wong et al. (as cited in Environmental Protection Department of Stuttgart, 2008) reported depending on the quantity and category of greenery, facades completely covered with greenery are protected from intense heat generated by solar in summer and can reflect or absorb in its greenery between 40% and 80% of the received heat.

Stec, Paassen and Maziarz (2005) mention the benefit of reducing CO_2 and increasing O_2 in the building environment (E3) as plants absorb a significant volume of solar radiation for their growth and biological functions throughout the photosynthesis process. Further, vertical greenery systems help to improve air quality by filtering particles (E4) such as airborne dust particles (Wong et al., 2010). Vertical greenery systems also reduce the need of drainage facilities in the building (E5) by managing the storm water volume (Sheweka and Magdy, 2011).

In the urban context building facades with greenery provides better appearance to the building envelope (E6) attracting clients and leading to other social benefits (Skinner, 2006). Vertical greenery provides economic benefit of reducing energy cost during operation of buildings (E7) through aforementioned improved energy efficiency due to reduced heat gain (Green roofs for healthy cities, 2008). Also it can cause a positive effect on reducing maintenance or replacement cost by increasing the durability of building façade (E8) through protection of building exterior from UV radiation, as the temperature variations tend to deteriorate materials (Rakhshandehroo, Yusof, Johari, and Deghati 2015 (cited in Hasan, Karim, Brown, Perkins, and Joyce

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2012). Due to its economic benefits in the long term, vertical greenery systems can be further used as a green marketing tool (Green Roofs for Healthy Cities, 2008) as they enable increasing a building's property value (E9) (Wong et al., 2010).

As explained under environmental benefits, reduced heat gain creates thermal comfort inside the buildings (E10). Green roofs for healthy cities (2008) mentions green infrastructure as a key approach in delivering cleaner air and water, while improving living environments. Not only increasing the appearance of individual properties, but also enhancing the visual richness of the urban environment (E11) with vegetation can be considered as social benefits as greenery enable releasing stress and effect on human psychology (Sheweka and Magdy, 2011; Loh, 2008). This notion has been supported by a study carried out by Wong et al. (2010) which showed that greeneries in buildings enhance psychological well-being of city dwellers with therapeutic effects by improving the health of its users and also result in closer and more frequent contact among city residents and greenery. Thus vertical greenery systems contribute human health and mental well-being (E12). Moreover, Vertical greenery provides acoustic insulation to buildings (E13) and various studies have shown that the sound absorption coefficient of walls increases with larger greenery coverage (Van, Renterghem, Hornikx, Forssen, & Botteldooren, 2013; Wong et al., 2010).

3.2 BARRIERS FOR VERTICAL GREENERY

Wong et al. (As cited in Johnston and Newton, 1993) stated, although there are many benefits in reintroducing vegetation to the faces of urban buildings and their related spaces, many technical problems can be faced during implementation. Authors further pointed out impacts to the load bearing capacity of the building (B1). Also vertical greenery is generally allied to drawbacks such as greater initial investment (B2), higher maintenance costs (B3), and possible damages to the building facades (B4) (Perez, Coma, Martorell & Cabeza, 2014). Moreover, greenery is variable along the time and the space, therefore this statement makes the quantification of its performance. Vertical gardens dry off speedily, especially if they get exposure to sunlight and there is no way to move them and get them out of direct sunlight and they are blocking the views (B5) (Fresh organic gardening, 2013).

According to Rakhshandehroo, Yusof, and Deghati Najd (2015) plants in the vertical greenery takes a long time like 3-5 years to reach full coverage (B 6). Therefore, It is challenging to maintain regular plant substance for a long time span over large vertical surfaces (Green screen, 2012). There is no guidance internationally and no archival research that evaluates worker safety associated with vertical greenery (Behm and Hock, 2012). In Singapore, Wong et al.

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(2010b) found that locally, there is a lack of technical figures and maintenance guidelines which lead to create lack of information on operation of vertical greenery systems (B7). There is a lack of information on plants that are performing well on vertical greenery systems (B8) (Wong et al., 2010).

The main obstacles to future growth are formed by the lack of understanding of the role of green skins among public relating to benefits & peformnce (B9), lack of investment (B 10) capacity and lack of construction managers. Other barriers to developing green systems are economic, lack of technical information (B11), and the deficit of research for professionals (Samiei, 2013).A vertical garden can be messy and thus requires a lot of maintenance and dirt tends to fall out from the sides of containers and water may leak out, whereas leaking water can damage the support structure, fence or wall (Fresh organic gardening 2013). Vertical greenery systems increase the chances of ponding and mosquito breeding (B12) and also vertical greenery systems create an influx of pests and other unwanted animals into buildings (B13) (Wong et al, 2010). Further Wong et al (2010) mentioned that there is lack of grants and subsidies for implementation (B14) of vertical greenery systems.

4. Research findings and discussion

A total number of 50 questionnaires were distributed among architects, landscape designers, facilities managers, maintenance managers, chief engineers and members representing government bodies in Sri Lanka. Out of that, 31 responded and hence, the responding rate for the questionnaire survey is 62%. There are 10 architects, 12 engineering and facilities management professionals, 3 landscape architects and the rest is professionals representing government bodies. In this sample, 87% respondents have more than 5 years of experience. Therefore the sample can be considered as representative and knowledgeable on vertical greenery concept. The data collected from questionnaire survey was analyzed using one sample t-test and relative importance index (RII). Based on this analysis, important enablers and critical barriers were determined in the Sri Lankan context.

4.1 ENABLERS FOR VERTICAL GREENERY SYSTEM IN SRI LANKA

Thirteen number of enablers identified in the literature review were rated by respondents on a five point scale for their importance to become an enabler in the Sri Lanka context. Results were analysed using one sample t test available in SPSS software. If the t value calculated for an enabler is greater than critical t-value of 1.697, the particular enabler is considered to be significant. In case if the t value is less than the critical t-value such enablers are considered to be less significant in the Sri Lankan context and not considered for RII analysis. Table 1 shows the results of t-test and RII analysis.

Enablers of vertical greenery	t-test ana	alysis	RII and	alysis	
	t-	Signif	Mean	RII	Rank
	value	icance	rate		
Restoring biodiversity into the	13.83	0.000	4.39	0.877	1
urban environment (E1)	0		4.39	0.877	1
Reducing CO ₂ and increasing	13.61	0.000			
O_2 in the building environment	6		4.32	0.865	2
(E3)					
Enhancing the visual richness	10.37	0.000	4.29	0.959	3
of the urban environment (E11)	4		4.29	0.858	3
Generating a cooler	8.280	0.000	2.04	0.707	4
microclimate (E2)			3.94	0.787	4
Providing better appearance to	6.352	0.000	2.07	0.774	-
the building envelope (E6)			3.87	0.774	5
Thermal comfort inside the	8.032	0.000	0.54	0.540	
buildings (E10)			3.74	0.748	6
Reducing energy cost during	5.437	0.000			_
operation of buildings (E7)			3.65	0.729	7
Contributing human health and	4.491	0.000			
mental well-being (E12)			3.58	0.716	8
Increasing a building's property	3.978	0.000			
value (E9)	5.570	0.000	3.55	0.710	9
Improving air quality by	3.724	0.001			
filtering particles(E4)	5.721	0.001	3.45	0.690	10
Reducing the need of drainage	-1.489	0.147	Less	sion	nificant
facilities in the building (E5)	1.107	5.117	enable	U	mount
Providing acoustic insulation to	-1.901	0.067	Less		nificant
buildings (E13)	1.701	0.007	enabler		meant
Increasing the durability of	-1.880	0.070	Less		nificant
building façade (E8)	-1.000	0.070	enable	0	micant
bunung laçade (Eo)			enable	1	

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Table 1: Results t-test and RII Analysis for Enablers of Vertical Greenery in Sri Lanka

According to the Table 2, the enablers namely "Reducing the need of drainage facilities in the building", "Providing acoustic insulation to buildings" and "increasing the durability of building façade" received t-test values of -1.489, - 1.901 and -1.88 respectively which are less than the critical t-value (1.697). Therefore, those enablers are considered to be less significant in the Sri Lankan context and not considered for RII analysis. Then as per the results of further analysis, remaining ten enablers were ranked according to the table where "restoring biodiversity into the urban environment (E1)" as the highest rank.

4.2 BARRIERS FOR VERTICAL GREENERY SYSTEM IN SRI LANKA

Seventeen barriers identified in the literature review were also rated by respondents on a five point scale for their severity to become a barrier in the Sri Lanka context. Results were analysed using the same methods which used to analyse enablers that is one sample t test and RII. If the t value computed for a barrier is greater than the critical t value of 1.697 the particular barrier is considered to be critical and barriers resulted less than the critical t value were not considered for the RII analysis . Table 2 shows the results of t-test and RII analysis.

Barriers of vertical greenery	t-test and	alysis	RII and	alysis	
	t- value	Signif icance	Mean rate	RII	Rank
Lack of awareness of the benefits and performance of vertical greenery systems among public (B9)	11.18	0.000	4.45	0.890	1
Lack of information on plants that will perform well on vertical facades (B8)	8.386	0.000	4.19	0.839	2
Weak legislation, enforcement and lack of government incentives (B14)	8.801	0.000	4.16	0.832	3
Vertical greenery systems are not widespread in Sri Lanka (B15)	6.384	0.000	3.81	0.761	4
Greater initial investment (B2)	4.045	0.000	3.61	0.723	5
Lack of technical information (B11)	4.224	0.000	3.55	0.710	6
Lack of engineers and architect's concern regarding Vertical greenery systems (B16)	3.981	0.000	3.45	0.690	7
Lack of environmental policies in the organisations and less concern of environmental values (B17)	3.815	0.000	3.29	0.658	8
Higher maintenance costs (B3)	2.635	0.013	3.23	0.645	9
Damages to the building facades (B4)	-3.013	0.005	2.61	0.523	10
lack of information on operation of vertical greenery systems (B7)	3.230	0.003	3.39	0.445	11

Table 2: Results t-test and RII Analysis for Barriers of Vertical Greenery in Sri Lanka

Impacts to the load bearing capacity of the building (B1)	-1.827	0.078	Less significant barrier
Takes time to grow and spread on the walls (B6)	-1.961	0.059	Less significant barrier
Blocking the view of the building (B5)	-1.871	0.071	Less significant barrier
Encourage pests and unwanted animals into the building (B13)	-2.044	0.050	Less significant barrier
Creates a chance of mosquito breeding (B12)	-1.901	0.067	Less significant barrier
Lack of investment capacity within the organizations (B10)	-1.438	0.161	Less significant barrier

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According to the Table 2, six barriers received t-values less than the critical t-value (1.697). Therefore, these barriers are considered to be less critical in the Sri Lankan context. Remaining eleven barriers were further analysed and ranked according to the table 2, where "lack of awareness of the benefits and performance of vertical greenery systems among public" was ranked as the most significant barrier among the identified eleven barriers. Then the significant barriers identified were further investigated to develop strategies to overcome the same which lead to expand vertical greenery in Sri Lanka.

4.3 STRATEGIES TO OVERCOME CRITICAL BARRIERS FOR EXPANDING VERTICAL GREENERY IN BUILDING FACADES IN SRI LANKA

In order to proposed strategies to overcome rest of the barriers which are considered to be critical, the data collection was further extended to semistructured interviews with three numbers of experts selected among the questionnaire survey respondents. Table 3 shows the profile of interviewees. Findings of interviews were analysed using content analysis.

Interviewee	Designation	Years of experience
А	Chief engineer	42
В	Lecturer, Member of Green Building Council, Sri Lanka	28
С	Lecturer, Member of Green Building Council, Sri Lanka	17

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Strategies identified through interviews will be explained in this section. Vertical greenery concept is still in the infant level in Sri Lankan context and experts have less practical experience with buildings implemented vertical greenery in Sri Lanka. Therefore, rather than providing technical solutions, they proposed strategies based on three main categories namely, research, raising awareness, and government intervention and legal provisions.

4.3.1 Research based strategies

Adopting right technologies with the consultation of experts was identified as a solution to prevent or mitigate the wall damages caused by the vertical greenery. Vertical greenery concept was adopted from international context, therefore, it is really necessary to localize it into the Sri Lankan climate and biodiversity. Therefore, identification of the suitable plants which sustain in the climate was a challenge without doubt. In addressing this issue, further research should be carried out using local plants to evaluate the suitability to grow as vertical greenery. When it comes to cost reduction of the system, capital cost and the maintenance cost could be identified as main components. Extra capital cost due to the installation of a vertical greenery system can be minimized by further research on technologies and adopting latest economical technologies from international context. The maintenance cost can be controlled by selecting the components of the greenery system including plants by following a life cycle cost assessment which leads to reduce maintenance cost which based on several facts such as replacement of dead plants, water requirement, fertilizer requirement and maintenance requirements of the structure i.e. corrosion control.

4.3.2 Government intervention and regulatory framework

Establishing a strong regulatory framework is one of the major supports towards promoting the vertical greenery. Exiting weak legislation in Sri Lanka is not adequately facilitating implementation of the vertical greenery and even other green building concepts at large. Therefore, it is necessary to increase the legal requirements in legislative enactments like National Environmental Act and Urban Development authority regulations by introducing some compulsory provisions to implement vertical greenery in buildings which is a best practice followed in international context. Further this can be identified as one of the factors to consider in given building approvals by local government bodies too. Considering the world scenario, positive impact of a strong regulatory framework to implement such concepts is proved with number of evidences. Apart from that providing government incentives, tax reliefs, grants, subsidies and awards also can be utilized to increase the motivation of building owners towards vertical greenery and to reduce cost for the building owners.

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4.3.3 Awareness based strategies

Improvement of community awareness about the vertical greenery concept and benefits, can be identified as a mechanism to promote vertical greenery. This method can be utilized to eliminate or mitigate number of barriers identified in this research such as lack of Information on plants, Lack of technical information, Lack of information on the operation, Lack of awareness of benefits of vertical greenery, Lack of engineers and architect concern and lack of spread in the country.

In carrying out such awareness programmes, role of different organizations established to promote green building concept can be identified as important. Organizations such as Sri Lanka Green Building council can carry out various strategies. Based on the research findings green building council or such organizations can intervene for the dissemination of knowledge such as information on suitable local plants, effective technologies and effective operation strategies. Further integrating the need for vertical greenery in their green building rating system will also lead to spread practice which will increase the concern of Engineers and Architects too in designing and constructing new green buildings.

Apart from the intervention of such non-government organizations, the government of Sri Lanka can also carry out several awareness programmes using different government bodies such as Central Environment Authority, Urban Development Authority, Ministry of Environment, Ministry of Mega polis and western development and other local government bodies.

5. Conclusions and recommendations

The study focused on exploring enablers and barriers for vertical greenery and identifying strategies to expand the vertical greenery by overcoming barriers. Enablers for vertical greenery were identified and ranked based on their relative importance, which revealed most significant enablers in Sri Lankan context. Considering barriers for vertical greenery, the research has identified number of barriers and further ranked based on the relative importance to reveal the significance barriers. Expanding of the vertical greenery is based on developing strategies to overcome the barriers identified in the research.

Based on the expert opinion several strategies were identified and categorized in to three as research based strategies, government intervention and regulatory framework based strategies and awareness based strategies. Implementation of the identified strategies will lead to expand the vertical greenery in building facades in Sri Lanka.

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AN ANALYSIS OF FACTORS OF USER GENERATED CONTENT ON SOCIAL NETWORKS THAT MOTIVATE PLEASURE TRAVEL ENTHUSIASTS OF SRI LANKA

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Abstract

This research contributes to the knowledge of user generated content on social networks and how it can be used to motivate pleasure travellers. Different roles in the communication process of user generated content on social networks and how their qualities determine the effectiveness of content were explored. The research was focused on the pleasure travel enthusiasts of Sri Lanka. Pleasure traveling often involve hiking, trekking, rafting, sightseeing etc. within attractive destinations. This research examined the qualities that should be in the creator and in the message of user generated content to motivate a potential traveller. The hypothesis was derived with seven identified qualities that should possess in the 'creator' and in 'content' and they were tested using interviews and a questionnaire. Interviews were done with content creators and a questionnaire was distributed among pleasure travel enthusiasts to inquire whether the predetermined seven qualities of content are applicable to motivate pleasure travel enthusiast of Sri Lanka. It was concluded that, only five out of the seven qualities which were determined earlier has the power of motivating a pleasure traveller. Based on the study, author could drew a guiding framework for content creators and also determine that 'identity disclosure', 'reputation' and 'storytelling ability' of the creator and 'clarity and construction' and 'usage of media' of the content help in motivating potential travel enthusiasts.

Keywords: Social media, user generated content, pleasure travellers, motivation for travellers, travel content creators

1. Introduction

This dissertation discusses on User Generated Content (UGC) on social networks and how it can be used to motivate pleasure travellers. UGC refers to pictures, videos, Graphic Interchange Format (GIF) and any kind of posts uploaded to social networks by users. UGC is a major phenomenon in the current digital world due to the immense number of content that are generated JITHMI ALWIS & SUMANTHRI SAMARAWICKRAMA by millions of users on a daily basis for various purposes. Most commonly UGC stands for honest opinions and recommendations of the users. Meanwhile, traveling is an experiential process which needs lot of recommendations and information in the decision making process towards selecting an appropriate destinations for pleasure traveling. UGC can be used as an informative source and as means of inspiration for users and their

decision making process in traveling. Findings of this research are the qualities of the 'creator' and 'content' which helps in motivating pleasure travel enthusiasts. Here, author examined the thought process of the travel content creators, and the opinions of the potential travel enthusiasts.

1.1 CONTEXT & BACKGROUND

Social media has led to paradigm shifts in ways people work, do business, interact, socialize, learn and obtain knowledge (Ismail & Latif, 2013). With the up bloom of social networks internet has started to mediate travel experiences. Because it helps the travellers to tell the world and relive their tours through creating content.

Social media and internet sensation impacts travellers in a positive way and encourage them to share their personal experiences, stories and recommendations. Pictures and content added to social networks by travellers are widely appreciated and shared in sub communities of social networks. These content often contain first-hand information on transport, destinations, accommodation, routes etc. Social networks are heavily condensed with both creators of content and content which are generated every day (Ismail & Latif, 2013). Therefore it is important that the created content are effective, useful and relevant to the readers. User generated content acts as catalysts to motivate travellers to select their next destination or to travel more.

1.2 RESEARCH PROBLEM

In the current social media world, lot of UGC related to traveling can be found. They are more often trending topics which attract lots of travellers. Nowadays, travellers tend to upload pictures, videos, travel description etc. to social networks after their journeys. These created content are useful for other potential travellers in travel decision making. By seeing content that are created by other travellers, potential travellers are motivated to travel and to explore. But, 'all' the content on social networks don't motivate potential travellers. Content has to be effective, attractive and useful to the users. If the factors AN ANALYSIS OF FACTORS OF USER GENERATED CONTENT ON SOCIAL NETWORKS THAT MOTIVATE PLEASURE TRAVEL ENTHUSIASTS OF SRI LANKA

which decide the effectiveness of UGC can be determined, it will guide creators to create more effective and useful content.

How do user generated content on social networks motivate pleasure travel enthusiasts? (Based on the feedback from travellers on 'creator' and 'content').

1.3 RESEARCH QUESTIONS

RQ1 - How social networks have become a tool for generating travel related content?

RQ1.1 - How social media helps communication?

RQ1.2 – What are the steps of travel consumption?

RQ2 - How social networks mediate user generated content and travellers?

RQ3 - What are the factors that need to be looked at when creating UGC on social networks by the creator through content?

1.4 HYPOTHESIS

It can be understood that qualities possessed by the 'creator' and the 'content' are the main factors that need to be considered in creation of effective content, which could motivate the users.

H1 – The potential travellers are motivated by UGC due to, 'identity disclosure', 'reputation of the author', 'prior experience and expertise' and 'storytelling ability' of the creator and 'clarity and construction', 'peer acceptance' and 'usage of media' of the content. Therefore UGC would motivate potential travellers due to the above reasons.

Identified attributes of the creator and the content will be used to analyse the effectiveness of UGC to motivate a potential pleasure travel enthusiast.

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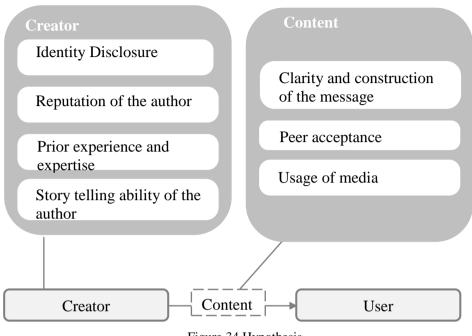


Figure 34 Hypothesis

1.5 METHODS AND METHODOLOGY

This research comprised of four stages.

- 1. Research using past literature
- 2. Semi structured interviews
- 3. Questionnaire
- 4. Analysis

First stage of the research was data gathering from published literature. In order to gain knowledge various books, journals and academic articles were read. They have been used in the project to determine the qualities of the 'creator' and 'content'. After referring to conclusions and frameworks made by past literature, seven qualities that should possess in user generated content to motivate pleasure travellers were identified. Zhiwei Liu's (2014) framework 'what makes a useful online review' and Laurent Muzellec (2015) 4 Cs of credibility framework were used to determine the below factors.

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Seven qualities that were identified are, identity disclosure of the creator, reputation of the creator, prior experience and expertise of the creator, storytelling ability of the creator, clarity and construction of the content, peer acceptance of content and usage of media in content. This research tested whether the above seven qualities motivate pleasure travellers in the Sri Lankan context.

After gaining a clear idea about the topics, as the second stage of the research, three semi structured interviews were done with travel content creators to understand factors that creators concern before creating content. Difference between methods of uploading content, types of content and the impact of different methods, factors that affect feedback from users for content were discussed. These three interviewee were young travel content creators on social networks who are in the age group of 20 to 30. Interviewees were selected based on below mentioned factors related to their online behaviour and interest for traveling and creating content. Their social network accounts have over 1000 followers and have above 250 positive appreciation for each post. They have visited over 10 travel destination in the past 7 months and they upload travel related content consistently.

Gathering data from a questionnaire was the third stage. The questionnaire was distributed to potential travellers and travel enthusiasts. Sample to distribute the questionnaire were picked based on their enthusiasm for travelling, online behaviour and responds to online travel content and who are in the Sri Lankan context. Questionnaire was distributed through Facebook pages related to pleasure traveling since the audience of those pages fall into the defined sample.

Analysing the gathered data was the final stage of the research. 73 responses were gathered for the questionnaire and the next step was to analyse the collected data. Data were analysed using charts in Microsoft excel. After analysing the data, qualities of the 'creator' and 'content' were determined and how they act to motivate users were found out. It was concluded that the qualities of the 'creator' and 'content' make an impact on the reader to be motivated. Finally a framework was drawn for the essential qualities that should be in user generated content to motivate a potential traveller.

1.6 LIMITATIONS

- This research will be limited to the young pleasure travel enthusiasts of Sri Lanka.
- Only the qualities which were pre-defined in the research using theoretical frameworks will be tested through interviews and the questionnaire.

02. How social networks have become a tool for generating travel related content?

The term Social Media refers to the use of web-based and mobile technologies that turn communication into an interactive dialogue (Baruah, 2012). Social networks provide users a platform to share and interact. It helps in sharing critical information, unforgettable memories, experiences and opinions on matters. The Internet has significantly changed the landscape of the tourism industry (Mack, et al., 2008). Since travel is much of an experiential activity, travellers tend to look for first-hand information and guidance before traveling. Internet has become a primary information source for travellers and Social Networks have started to contribute in a prominent manner. During their travels and after the travels, travellers create content for social networks to relive and share the experience with others.

Creators need tools and resources to create their content and a platform to distribute their content (McKenzie, et al., 2012). Social media have the power of provoking, motivating and passing messages in a more effective manner because of it's usage of multiple media types. Social networks offer a rich tool set. It gives travellers the opportunity to craft messages, add multimedia to posts, create hashtag trends, create commenting threads and functions to share.

With the wide usage of mobile phones, creation of content has become simple and easy. Other than for the tools needed for the creation, creators must be well equipped with creative minds. Social networks occupy a complex mechanism of communication. It acts as a sound platform in the distribution of UGC. As mentioned earlier, with the rich set of functionalities given by social networks, everyone is given a chance to create and distribute the content that is being made

03. Analysis and outcomes of the research

This analysis and outcomes are based on the responds gathered from three interviews and 73 responds gathered from the questionnaire. From the research

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it was evident that, 100% of the sample use Facebook daily and it seems to be the most popular social network among Sri Lankan pleasure travellers. 86.5% of them spend time on YouTube and 78.4% of them spend time on Instagram daily. It was also evident that 47.3% of them spend 1-2 hours and 20.3% of them spend 3-4 hours on the internet every day. Thereby it can be concluded that pleasure travellers of Sri Lanka are social network savvy and they spend a lot of time on social networks daily. 97.3% of them agreed that they often see travel related content on social networks. But only 39.7% agreed that they get motivated from 'all' the content that they see. Therefore it is clearly evident that, even though content are made by many creators in the communities, only some of them have the power of motivating another traveler. So, there should be certain qualities in the communication process (creator, message and the receiver) that decide the power of the content and its ability to motivate another. Aim of this study was to explore such qualities and it was proved that there are determinant qualities that help in motivation.

After the research it was proved that, out of the seven qualities, only five are acceptable. Based on this research, author determined that 'identity disclosure', 'reputation' and 'storytelling ability' of the creator and 'clarity and construction' and 'usage of media' of the content help to motivate potential travel enthusiasts. They are described below.

3.1 IDENTITY DISCLOSURE OF THE CREATOR

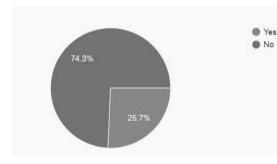


Figure 2 Questionnaire outcomes

Majority of the respondents (74.3% of the test sample), believed that the creator of the content should reveal his true identity for them to get motivated to travel after seeing a content. It can be firmly concluded that by revealing the identity of the creator, the communication between the creator and the sender will be

strengthened. Identity disclosure helps in increasing trust, credibility and transparency. Thus it leads potential travellers to believe in the content to get motivated to travel. It is well recommended that the creators of content to reveal the true identity for their content to achieve better effectiveness and usefulness. Conclusion was favoured by results of both the questionnaire and interviews.

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3.2 REPUTATION OF THE CREATOR

It was identified that maintaining a positive reputation on social networks is an important factor in communication for content creators. Reputation can also be considered as the degree of how much trust is kept on the author by a reader (Liu & Park, 2014). Content creators try to spread positive thoughts and vibes in order to gain respect and to show the reader what they are up to and communicate work with good intentions. 57.35% of the test sample agreed that the content creators should maintain a good reputation on social networks to trust their content. So it is important for content creators to maintain a sound and a positive reputation on social networks. Positivity of the virtual personality of the author is a key point in to get followers for his/her content. It indirectly matters in motivating the readers, in this case pleasure travel enthusiasts.

3.3 PRIOR EXPERIENCE AND EXPERTISE OF THE CREATOR

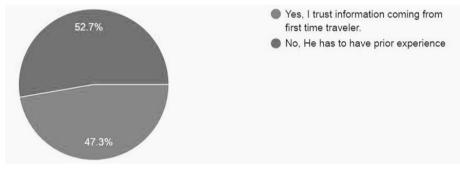
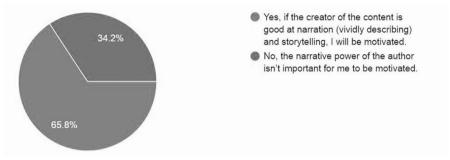


Figure 3 Questionnaire outcomes

Even though prior experience and expertise of the creator was defined as compulsory qualities of the creator, results of the research proved otherwise. Above qualities were accepted as positive and good qualities to be possessed by the creators. Yet, it was evident that readers don't pay attention for the expertise of the creators. During the interviews it was identified that the prior experience of the author doesn't matter to content readers. This was again confirmed by the questionnaire, because a majority of 52.7% of the test sample believed that prior expertise is not a compulsory characteristic to be possessed in content creators. What is important to them is appropriate and quality content despite whether they have an expert background and an experienced past. Therefore 'prior experience and expertise' of the creator isn't identified as a compulsory quality of the creator to motivate travellers.

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3.4 STORY TELLING ABILITY OF THE CREATOR

Figure 4 Questionnaire outcomes

From the interviews it was identified that the creators pay lot of attention to make their content story like and to deliver them with a strong narrative power. According to content creators their creativity and the ability to see things differently help them to deliver different and unique content. Narrative power is a difficult variable to measure. Yet it can be understood depending on the feedback from the readers. 65.8% of the test sample agreed on the fact that creator should possess a narrative power. From the questionnaire it was evident that 'story like' narrative content has the power to motivate travellers more. Therefore it can be concluded that the story telling ability is an essential quality to be possessed by the creator. Conclusion was favoured by results of both questionnaire and interviews.

3.5 CLARITY AND THE CONSTRUCTION OF THE MESSAGE

When it comes to the clarity and the construction of the message there are lots of aspects to look upon. From the interviews it was evident that the content should be of good quality and should be attractive. Creators post process (edit) the images that are captured and they only distribute them if they are attractive and beautiful. From the responses of the questionnaire it was evident that the attractiveness is a key quality in motivating the readers. 78.4% of the sample agreed that the clearness and the attractiveness of the message play a vital role in motivation.

A majority of 76.7% of the test sample agreed to the fact that action packed pictures tempt them the most. So, by adding action packed imagery instead of ordinary images, the reach and the distribution of the posts can be increased.

When it comes to the construction, majority agreed that it should be structured in the order of event happened. 80.8% of the sample agreed on the fact that the description of the events must be organized in order from the start of the travel

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to the end of the travel. It's a positive finding for the content creators. It can be understood that the order of the structure of the content do matter in motivating travellers. These factors should be understood by the creators in order to create effective and useful content.

From the results it was evident that just uploading a picture will not motivate the travellers. Quality, clarity and attractiveness of the content play a major role in motivating the readers.

3.6 PEER ACCEPTANCE OF THE CONTENT

From the questionnaire it was evident that the travellers aren't concerned whether their peers and colleagues accept the content. Only 45.9% of the sample agreed to the fact that their friends have to believe in the content, for them to identify it as a reliable and a credible source. Even from the interviews it was understood that the readers don't wish their friend's acceptance to trust the content.

Depending on the results of the research and mainly from the outcomes of the interviews, it can be concluded that acceptance of the peers is not a compulsory quality to be possessed. Interviews proved that it is a good quality yet not a compulsory quality. Peer acceptance is usually considered in trusting and when measuring the credibility of the content. But in order to motivate a traveller, 'peer acceptance' does not play a compulsory role.

3.7 USAGE OF DIFFERENT MEDIA IN CONTENT

Research firmly proved that using different types of media in one post helps to grab the attention and motivate travellers in an effective manner. A majority of 73% of the sample agreed to the fact that using different types of media would gain their attention. It is evident that rather than using one type of media, using a mixture of text descriptions, videos and photos is more effective.

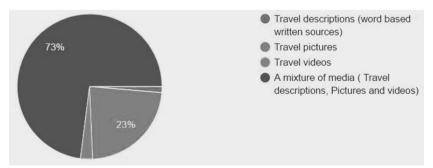


Figure 5 Questionnaire outcomes

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It was found out in the research that visuals have an upper hand in grabbing the attraction and attention of the viewers. It is recommended to use pictures along with the travel descriptions. Using different types of media in one post will elaborate the experience more and give a comprehensive explanation. This factor was firmly proved. Conclusion was favoured from the results of the questionnaire and the interviews.

4.0 Conclusion

Seven qualities that should possess in content creators and content to motivate pleasure travel enthusiasts were determined earlier in this research. Seven qualities that were identified were, identity disclosure of the creator, reputation of the creator, prior experience and expertise of the creator, storytelling ability of the creator, clarity and construction of the con-tent, peer acceptance of content and usage of media in content. This research tested whether the above seven qualities motivate pleasure travellers in the Sri Lankan context using interviews and a questionnaire that were distributed among content creators and pleasure travel enthusiast.

Through the analysis it was concluded that, only five out of the seven qualities which were determined earlier has the power of motivating a pleasure traveller. Based on the study, author could determine that 'identity disclosure', 'reputation' and 'storytelling ability' of the creator and 'clarity and construction' and 'usage of media' of the content help in motivating potential travel enthusiasts.

It is recommended for travel content creators to follow the following framework in creation of content. It will help in creating powerful and meaningful content in order to motivate travellers. The following framework were created based on the results of the research.

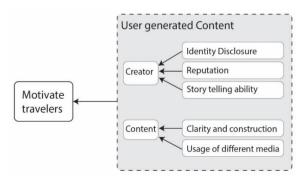


Figure 35 Framework for content creators

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Following are some main findings from the research,

- Visuals are the most important element in content creation. Even for the word based travel description, adding a picture will increase the reach in social networks. Creators should make sure that paying attention to produce quality and attractive visuals is a primary need.
- Creators should make sure that their experiences are well elaborated. Be it text based descriptions or pictures, informing others about the experience gained will help to motivate a potential traveller and ease them in decision making.
- Facebook was identified as the most popular social media among travellers.

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ADAPTABLE BUILT-ENVIRONMENT AS A POTENTIAL STRATEGY TO SUSTAIN POST-DISASTER RESETTLEMENTS IN SRI LANKA

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Abstract.

In the recent decades, internal displacements occur in greater number across the world each year without drawing much attention. To minimise the causes and attenuate the consequences of displacement, governments and other concerned entities involve themselves in the process of resettlement to different degrees. However, the large-scale resettlements are often criticised for offering only temporary relief without meeting the long-term expectations of the affected communities. Thus, the purpose of this paper is to explore the potentials of an adaptable built-environment to provide durable solutions to sustain post-disaster resettlements. Based on previous case studies 14 long-term struggles in adapting to a new built-environment are identified. A Likert scale questionnaire survey was conducted in 4 resettlement schemes in Sri Lanka, to scale the level of severity of the identified factors. Collected questionnaires were analysed using factor analysis technique to identify the underlying concepts of the adaptability issues. The findings of this study show that the underlying structure of the identified factors that affect the adaptability of the built-environment of the displaced community includes less availability of social infrastructure, the unfamiliarity of the houses, difference in the location, non-flexibility of the houses, comfort of the houses, and less availability of utilities. Similarly, the underlying structure of the host community includes less availability of social infrastructure, different usage of the land, community relationship, and less availability of the utilities.

Keywords: Adaptability, Built-environment, Displacement, Post-disaster, Resettlement

1. Introduction

A built-environment is a man-made surrounding that encompasses patterns of human activity (Holling, 1973). The relationship between built-environment and patterns of human activity is defined differently by two different schools of thought, one being the built-environment adapts to the patterns of human activities (Jigyasu and Upadhyay, 2016); and the second being that human activities adapt to the built-environment (Barenstein, 2015). However, conventional anthropological studies articulate that both built-environment and

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the human activities adjust to each other (Lawrence and Low, 1990). Irrespective of whether only one or several of these statements are true, this adaptation cannot be expected in the short term without ensuring certain basic conditions, as it is an outcome of a long-term social process.

Post-disaster resettlement is a process that introduces a new built-environment to the affected community. This new built-environment potentially redefines the social system as one interlinked with other subsystems of the community. Despite being among interrelated subsystems of a community, builtenvironment is itself a system with unique characteristics as it shares the boundaries of social and natural environments (Moffatt and Kohler, 2008). Unlike the built-environment, which is a man-made 'physical' system with a tendency to deteriorate as the community population grows with time, all the other subsystems are typical outcomes of self-organisation, social learning, and functional persistence of a community (Zaidi and Pelling, 2015). However, built-environment becomes a subsystem of a community as it is shaped by the interaction of the people (Moffatt and Kohler, 2008). Considering this complex nature, it is fair to assume that the new built-environment introduced by displacement to the concerned population may disturb the equilibrium of the community and lead to vulnerabilities. As a consequence, it may lead to resettlement failures in long-term as explained in several case studies (Das, 2008, Manatunge et al., 2009, Muggah, 2008, Perera et al., 2012, Takesada et al., 2009).

It is believed that human beings can adapt to any built-environment based on their lifestyle provided that certain basic conditions are fulfilled. Jigyasu and Upadhyay (2016) identify two basic conditions as the favourable typology of house design and the favourable location within the land plot. Further, the built-environment also evolves and modifies itself constantly to satisfy the changing needs of its people (Barenstein, 2015). While that is foreseeable, often the basic conditions connected to the population's socio-cultural needs, which are the core for the long-term adaptability of the built-environment, have often been overlooked in the resettlement planning. It is also true that resettlements following a disaster encompass considerable and unavoidable differences compared to conventional methods in the layout, house design, building materials, and construction processes with those for conventional situations (Jigyasu and Upadhyay, 2016).

In addition to this, the most overlooked aspect of understanding and determining the success of the resettlement is the role of the host community.

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Herein, the host community is defined as the community amid which or in whose neighbourhood the displaced people are resettled (Kabra and Mahalwal, 2014). The host community comprising a different social system shares the built-environment of the displaced community. The built-environment is interlinked with all the subsystems of a community. A sudden change in the pattern of interaction with the built-environment would have an immediate effect on the structure of the host community. Consequently, both the communities will suffer stress in adapting the new built-environment. However, providing the basic positive conditions for both the communities to adapt to the new built-environment lies at the core of the sustainability of the resettlement. Accordingly, the purpose of this study is to identify the underlying factors, which obstruct the built-environment adaptability within the post-disaster resettlement context.

2. Adaptable built-environment in the process of recovery

As discussed in the introduction, the basic positive conditions to adapt a new built-environment are described in the traditional migration theory of Lee (1966). Lee (1966) explains that each place has its own characteristics to hold and repel people. For example, the good weather holds people, and bad weather resists them. Also, some characteristics attract a specific group of people but repel another. Therefore, basic conditions should be positive for the whole displaced population for any resettlement to succeed. In the context of resettlement, which is involuntary, the government or the relevant authorities often select the place of destination. Therefore, the place of destination does not necessarily pull the community towards it. Consequently, the community ends up in a clump of obstacles if the place of destination does not provide the basic positive conditions.

However, identifying the relevant favourable conditions at the right time is often challenging for the government as well as donor organisations as the focus is mostly on the speed, quality, and cost-effectiveness of construction, and hazard mitigation (Jigyasu and Upadhyay, 2016). Further, the level of assistance given, and the type of settlement (rural/urban) also play a key role in providing basic positive conditions. However, the primary aim of any resettlement is to provide houses for the displaced people, as houses make up 60-70% of the total building stock of the whole built-environment in an urban context (Comerio, 1998). Hence, the bulk of assistance and funds go towards housing construction (Freeman, 2004). Depending on the scale of a resettlement and available resources, different approaches are used for housing reconstruction (Karunasena and Rameezdeen, 2010). The most common classification is based on the proportion of assistance given for housing,

namely owner-driven approach and donor-driven approach (Andrew et al., 2013, Chang et al., 2011b, Karunasena and Rameezdeen, 2010).

In the owner-driven approach, the government or the donor agency provides a certain level of financial and technical support while the recipient retains the control over housing construction. In the donor-driven approach, however, the government or the donor agency assumes full responsibility (Karunasena and Rameezdeen, 2010). It is fair to assume that the basic conditions for the adaptation of the new built-environment will be satisfied to some extent in the owner-driven approach as the recipients as a whole retain control over constructing their built-environment. On the other hand, it is not very much the case in the donor-driven approach. This view is confirmed by the study of Jigyasu and Upadhyay (2016) who demonstrated that all the examined donorprovided houses after the 1993 earthquake in Marathwada, India, have undergone renovations, repairs, or extensions. This shows that the community could not adapt the houses as it is provided and the houses did not support long-term adaptability. In addition to this case, there are many other case studies conducted in the donor-driven houses also prove the long-term struggle of adapting the new built-environment (Barenstein, 2015, Dikmen and Elias-Ozkan, 2016, Muggah, 2008, Takesada et al., 2009). However, reliance on donations and consequent donor-driven resettlements have become necessary for many economically less stable developing countries to make the best use of scarce resources (Andrew et al., 2013).

Though houses are the main segment of the built-environment, factors such as location, infrastructure, local culture, and settlement patterns play equally important roles to provide basic positive conditions for the adaptation (Jigyasu and Upadhyay, 2016). However, these reconstruction outcomes are rarely analysed, and no studies provide feasible solutions (Barenstein, 2015). Therefore, it is essential to identify the long-term struggles involved in the resettled and host communities adapting to the new built-environment. Based on previous case studies, long-term struggles in adapting to a new built-environment have been grouped into three broad categories, namely housing, infrastructure, and location. Table 1 provides the long-term adaptability issues identified based on the literature.

Main factors	No	Sub-factors	Authors
Housing	1	Local climate adoptable houses	(Barenstein, 2015)
	2	Incompatible house design	(Ahmed, 2011, Andrew et
		(functionality, socially and	al., 2013, Barenstein, 2015,
		culturally inappropriate)	Chang et al., 2011a,
			Gunawardena and
			Wickramasinghe, 2009,
			Karunasena and
			Rameezdeen, 2010)

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	3	Quality of houses (Durability, space availability)	(Ahmed, 2011, Chang et al., 2011a, Karunasena and Rameezdeen, 2010)
	4	Communal space availability	(Andrew et al., 2013)
	5	Inability to maintain, expand, and upgrade the structure	(Orencio and Fujii, 2013)
Infrastructure	6	Inadequate sanitation	(Badri et al., 2006)
	7	Access to physical infrastructure (Drinking water, electricity, roads, common buildings, schools, etc.)	(Andrew et al., 2013, Gunawardena and Wickramasinghe, 2009, Laugé et al., 2015, Thalayasingam, 2009)
	8	Reduction of community resources (Medical, educational, etc.)	(Cao et al., 2012, Cernea, 1995, Foresight, 2011, Magis, 2010, Manatunge et al., 2009, Muggah, 2000)
	9	Lack of transportation network	(Cutter et al., 2008, Kusumastuti et al., 2014)
Location	10	Resettlement in unfamiliar and inhospitable locations	(Andrew et al., 2013, Robinson, 2003)
	11	Vulnerability to environmental changes	(Foresight, 2011)
	12	Changes in land use patterns	(Ruiz and Vargas-Silva, 2013)
	13	Distance from the previous location/livelihood	(Gunawardena and Wickramasinghe, 2009, Jha et al., 2010, Lakshman and Amirthalingam, 2009, Manatunge et al., 2009)
	14	Land ownership/ title issues	(Barenstein, 2015, Godamunne, 2012, Gunawardena and Wickramasinghe, 2009, Koria, 2009, Orencio and Fujii, 2013)

	Table 1.	Building	adaptability	issues
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3. Research method and analysis

An empirical study is required to achieve a certain level of confirmation and standardisation on the identified long-term adaptability issues from the literature. Therefore, studying in depth, a specific developing country will yield more focused information to draw valid conclusions. Accordingly, Sri Lanka was selected to study the resettlement process in work reported here. The basis of the choice was that, firstly, Sri Lanka has decades of varied experience in displacement and resettlement arising from both armed conflicts as well as the natural disaster (Das, 2008). Also, several Sri Lankan case studies

(Das, 2008, Manatunge et al., 2009, Muggah, 2008, Perera et al., 2012, Takesada et al., 2009) report slow recovery of resettlements, as a result of builtenvironment and community adaptability issues. To answer the research question, which is 'what are the latent parameters that obstruct post-disaster built-environment adaptability', questionnaire survey method was chosen as appropriate for the data collection. According to Yin (2014), a questionnaire survey is relevant to answer research questions which are in the form of 'what' and focus on contemporary events on which the researcher does not have control. Accordingly, a 5-point Likert scale questionnaire was developed to identify the level of severity of each adaptability issue, based on the identified factors that are presented in Table 1. To improve the clarity and for better understanding, some of the identified factors were divided into sub-factors and in total 18 factors were presented for the respondents from the displaced community to rate (for example, accessibility infrastructure was categorised into access to electricity, water, and alike). Housing-related factors were removed from the questionnaire which was presented to the respondents from the host community as they are irrelevant. This survey was conducted in 4 different resettlement schemes in Sri Lanka. A short description about these four resettlements was presented in Table 2. It was piloted with two academics for face validity. From the survey, in total, 186 questionnaires were collected in which 110 are from the displaced community, and 76 are from the host community.

Resettlements	Description	No of questionnaires collected
Resettlement A	This is a tsunami resettlement on the east coast	Host: 30
	of Sri Lanka, where people were resettled	Resettled: 17
	inland but not far from their previous place.	
	Therefore, there is no change in the host	
	community and their livelihood.	
Resettlement B	This is a tsunami resettlement on the east coast	Resettled: 42
	of Sri Lanka, where people were resettled in a	
	new development. There is no host community	
	involved in this resettlement.	
Resettlement C	This is a tsunami resettlement on the east coast	Host: 30
	of Sri Lanka, where people from five different	Resettled: 27
	villages were resettled within one zone.	
	Moreover, there is a host community involved	
	in this area.	
Resettlement D	This is a post-war resettlement in northern Sri	Host: 16
	Lanka, where people were relocated after a	Resettled: 24
	prolonged displacement. Also, there is a host	
	community involved.	

Table 2, Survey zone description

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Collected data were analysed using factor analysis method in order explore the underlying structure of the identified issues. Factor analysis is a statistical method used to explore the underlying structure of the variables (Afifi et al., 2004). The main three uses of factor analysis are to understand the structure of a set of variables, to measure underlying variables, and to reduce data size to a manageable size (Field, 2007). By calculating the eigenvalues of the R-matrix, factor extraction was computed. By default, SPSS uses Kaiser's criterion of retaining factors with eigenvalue greater than 1. Eigenvalues associated with each factor represent the variance explained by that particular linear component (Field 2007). Before rotation, most of the variables loaded highly onto one factor. Therefore, a final decision has been made based on the rotated component matrix as it equalises the variables. Also, the suppression of loading has been set at 0.4 to make the interpretation considerably easier. Accordingly, 6 factors were extracted from the displaced community data, and 4 factors were extracted from the host community data (Refer Table 3 and 4 for rotated component matrix).

Componen	t				
1 2	3	3	4	5	6
limate adaptability of the	0).565			
ouse					
comfort of the house 0	.650			0.550	
ompleteness and capacity				0.891	
perational cost			-0.410		0.557
pace availability	0).694			
vailability of communal space 0.673				0.452	
bility to maintain the house 0	.758				
bility to expand			0.852		
ccess to drinking water					0.844
vailability of electricity 0	.514				
dequate waste disposal 0.709					
vailability of schools 0.854					
roximity to the main road 0.813					-0.415
vailability of hospitals 0.746					0.428
lospitality of the host 0	.570 0).468			
nvironmental changes 0	.838				
and use patterns 0	.429		0.717		
vistance to the previous	0	0.802			
ocation					
1	ysis.)	.802	.802	.802

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 8 iterations.

Table 3, Rotated component matrix (Displaced community)

Rotated Component Matrix ^a				
	Compone	nt		
	1	2	3	4
Availability of communal space	0.727	-0.456		
Access to drinking water		0.808		
Availability of electricity				0.955
Availability of schools	0.765			
Proximity to the main road	0.860			
Availability of hospitals	0.824			
Changes in land use patterns		0.857		
Relationship with new community			0.766	
Reduction in common resources			0.720	
Extraction Method: Principal Compor	nent Analysis			
Rotation Method: Varimax with Kaise	er Normalizat	ion.		
a. Rotation converged in 4 iterations.				

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Table 4, Rotated component matrix (Host community)

4. Findings

Six components from the displaced community analysis and four components from the host community analysis were extracted based on the rotated component matrix as provided in Table 3 and Table 4. The identified components were named based on their common grounds. Accordingly, the underlying reasons for the built-environment adaptability issues faced by the displaced communities are the inadequacy of social infrastructure, familiarity with the house type, location of the resettlement, adaptability of the house, comfort of the house, and availability of utilities. Further, underlying reasons for the built-environment adaptability issues faced by the note the inadequacy of social infrastructure, usage of land, relationship with the new community, and availability of utilities. In triangulation with literature, these factors are explained in the following paragraphs.

The inadequacy of social infrastructure and availability of utilities are identified as latent reasons for built-environment adaptability issues faced by both displaced and host communities. Reduction in availability of social infrastructure following resettlement has been reported in many case studies in other developing countries with similar conditions. As a consequence, the competition for resources could weaken social networks and reduce cooperation between the displaced and host communities (Badri et al., 2006). Access to drinking water, more than other infrastructure facilities, has been emphasised by resettled communities in many instances. Jordan et al. (2015) state that more than 50% of the resettled community struggle for access to safe drinking water. However, Gunawardena and Wickramasinghe (2009) based on a study of six different tsunami housing schemes in Sri Lanka, points out that the access of the community to electricity and energy sources has been better than in the pre-tsunami period. This demonstrates that some infrastructure

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facilities have in fact improved while others have worsened. It should be noted that this is among issues that if inadequately managed will affects both the displaced and host communities.

Unfamiliar house type, the location of the resettlement, adaptability of the houses, and comfort of the houses are identified as latent issues associated with the built-environment adaptability of the displaced community. Such cultural, social, and functional inappropriateness of the house is thus evident in matters of size, style, building materials, and infrastructure services (Ahmed, 2011). Karunasena and Rameezdeen (2010) state that, such issues did not arise in owner-driven houses. This indicates that the donor agencies have poorly understood the local needs and community participation was inadequate to communicate their needs. People tolerate the discomforts, as they have no other safe place to go (Sanderson, Sharma, & Anderson 2012). Further, unknown locations influence the socioeconomic standard of a community. Also, cultural, regional, and ethnic differences between host and displaced communities also influence the pattern of interaction with the built-environment (International Federation of Red Cross and Red Crescent Societies 2013).

Usage of land and relationship with the new community are identified as latent reasons associated with the built-environment of the host community. In time, new settlements change the land use pattern in a way in which it affects the livelihood of the host community. It affects the continuity of their lifestyle and ultimately it setbacks the adaptability of the built-environment. Further, findings reveal that these improper relationships between communities also affect the adaptability of the new built-environment. Therefore, builtenvironment has to be created, and all assistance and resources should be given to community bearing the host community in mind. This might reduce the imbalance in the society and lead to better built-environment adaptability.

5. Conclusion

The number of internal displacements and consequent resettlements are visibly growing across the world. Meanwhile, studies report continuous criticisms of large-scale resettlements for failing to harmonise with the communities in the long-term. One of the critical reasons for this criticism is the community faces difficulties in adapting to the new built-environment. Commonly in resettlement studies, the satisfaction of built-environment and resettlement is mostly perceived from the standpoint of the resettled community. However, various refugee studies observe that resettlement imposes a burden on the host community and consequently, reduces their satisfaction with the built-environment (Ager & Strang 2008). Resettlement agents show a considerable disproportion in considering host community as a stakeholder in the process of

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resettlement. Long-term adaptability issues that are faced by both displaced and host communities are identified from the literature and tested using factor analysis to identify the underlying structure of it based on the data collected in Sri Lanka. Findings show that two components which were categorised based on the rotated component matrix are common for both displaced and host communities. They are; availability of social infrastructure and availability of utilities. This shows that social infrastructure and the utilities are not wellserved or not sufficient for two communities. As a result, both communities are experiencing inadequacies, which restricts them to adapt the built-environment.

Also, displaced community reflected, house type, the location of the resettlement, comfort of the house, and adaptability of the house as the underlying reasons for the inability of built-environment adaptation. As well as, host community reflected usage of land and the relationship with the new community as the latent reasons for their inadaptability of the built-environment. Identification of these latent reasons for the inadaptability of the built-environment will give the insight to address these issues in future resettlement implementation in similar contexts to provide a more adaptable built-environment for both communities. Incorporating provisions to address these issues in the resettlement implementation policies and plans can reduce the probability of resettlement failures.

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PSYCHOLOGICAL RISKS OF RESETTLERS IN RESETTLEMENT PLANNING: A STUDY IN MORAGAHAKANDA RESETTLEMENT PROJECT (MRP)

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Abstract

In resettlement planning literature, much has been written on economic, land compensation, infrastructure and services aspects of the land. Psychological risks and stresses of resettled communities, however, have been under-researched. The current research looks at the psychological risks of resettlers in a Development-Induced Displacement and Resettlement (DIDR) project in Sri Lanka. Focusing on the stages of resettlement planning process discussed by Scudder and Colson four-stage model (1980) and the psychological risks discussed by Cernea's (1990) impoverishment risks and reconstruction (IRR) model; This study evaluates the significant level of the psychological risks faced by the communities in DIDR projects in Sri Lanka relating to before and after resettlement. Moragahakanda Resettlement Project (MRP) was selected as the case study which is located in Naula DS division of Matale District, Central Province, Sri Lanka. A questionnaire survey, documents and field observations were used to evaluate the current psychological risks. The responses received from multiple choice questions were analyzed by Significant Point (SP) index. The research findings point that there are no conspicuous changes of psychological risks related to before/after resettlement has occurred in re-settlers. The findings highlight that the psychological risk levels in transition stage have remained the same level in the potential development stage. This research provides a systematic guidance enabling the physical planners to prioritize the most significant psychological risks which should be considered in the decision-making process of DIDR projects.

Keywords: Psychology, Risk, Re-settlers, DIDR

1. Introduction

Throughout the world development projects and programs which promote by national, regional and local development, frequently leads to involuntary resettlement of tens of millions people in each year. Most significantly cities in developing countries Asia, Africa and Latin America are answerable for large percentage of such displacement. According to the World Bank records China has calculated between 1950-2000 over 45 million people were displaced by development projects. Construction of dams for irrigation and hydropower generation has been one development initiative that caused mass scale

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population displacement in many countries. The World Bank Environment Department (WBED) has calculated that roughly 40% of Development Induced Displacement and Resettlement (DIDR) result due to dam projects (Stanley, 2004).

Sri Lankan experience on DIDR first recorded in colonial times. When the colonial rulers acquired land from the locals for plantation development, thousands of Sinhalese farmers displaced (Muggah, 1998). Recently large scale relocation and resettlements were carried out during the accelerated Mahaweli Development Programme (1980-2016) for the construction of reservoirs for agricultural and hydroelectric generation.

While such projects can generate benefits to the society, they also impose costs, which are often tolerated by its poorest and most marginalized members. As Robinson (2003) explained, "For millions of people around the world, development has cost them their homes, their livelihoods, their health, and even their very lives. Impoverishment and disempowerment frequently become their lot, with particularly tough concerns for women and children".

To prevent these consequences international and national organizations come with several policies and guidelines. It was first grounded by World Bank in 1980 by formulating the first policy on involuntary resettlement. Then Asian Development Bank (ADB) and the Inter-American Development Bank have followed suit, developing their own policies on involuntary resettlement, the latest versions released in 1995 and 1998 accordingly (Stanley, 2004).

Pertaining to Sri Lankan context, land acquisition, compensation, relocation and livelihood restoration guided by Land Acquisition act 1950, National Involuntary Resettlement Policy (NIRP) 2001, National Policy for the payment of compensation 2008, National Environment Act 1980 and ADB guidelines.

Issues are, however, still remaining. Although the main focus of above intervention is on physical, social and economic status of resettles. Their concern on the psychological aspects of those people is significantly inadequate. Moreover, the theories which are currently used in resettlement programmes do not seem to be promising with a considerable inclination to their psychological aspect.

There are records that evidenced most of the DIDR programmes failed due to emergence of psychological risks like, Landlessness, Joblessness, Marginalization, Isolation, and Social Disarticulation.

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For instance, in India alone, more than twenty million people were forcibly displaced by development interventions between 1950 and 1980 from that, 75% have ended up worse off than before resettlement. Similarly, India, Thalchar Mining project resulted in increased landless from 20.97% to 90.37% and Maharastra Composite Irrigation Project and the Rengali dam project, percentage of landless families almost doubled after relocation from 4.6% to 10.9%. World Bank report on the Cameroon- Douala Urban resettlement project (1990) found that over 2000 displaced families were not capable to established permanent houses. And in Sri Lanka, Kothmale dam relocation project coursed to increase Marginalization (Stanley, 2004).

As pointed out by Fernandes, "The enormously high rates of depression, suicide, alcohol addiction, demoralization and ill health which continue today on many American Indian reservations in the US and due to effects of involuntary resettlement and that effects are likely to persist for many generations".(Terminski, 2012, p. 290)

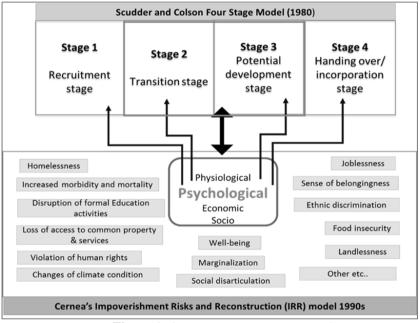
Therefore it is essential to think about psychological risks of resettlers to make resettlements as an opportunity for resettlers to improve their livelihood.

2. Existing Literature

Anthropologists have given the first theoretical explanation on resettlement highlighting in detail the impoverishment effects. Later many studies were taken by the social scientists (Rawls, 1971) to develop a theory to explain the ethics of DIDR. This was labelled as "Rawls general conception" of justice which states that, "all social values such as liberty and opportunity, income and wealth, and the bases of self-respect are to be distributed equally unless an unequal distribution of any, or all, of these values, is to everyone's advantage (Rawls, 1971). In a similar vein, in 1980s Scudder and Colson developed a four-stage model to describe how people and social-cultural systems respond to resettlement. Scudder divided the entire resettlement process into four stages and these stages were labelled as, planning and recruitment, transition, potential development and handing over or incorporation. Involuntary resettlement programs, however, were not significantly addressed in the Scudder-Colson framework. As a result, to address the concerns of Involuntary resettlement Cernea's Impoverishment Risks and Reconstruction (IRR) model was developed in the 1990s. The model discussed eight types of risks. Including, landlessness, joblessness, homelessness, marginalization, food insecurity, loss of access to common property resources, increased morbidity and mortality and community disarticulation. Later Downing and others have added, loss of access to public services, disruption of formal education activities, and Loss of civil and human rights into the list. But the model has

failed to acknowledge the stage which the risk becomes significant (Stanley, 2004).

In the current study, we attempted to combine the four-stage model and the IRR model to estimate the most significant psychological risks in stages two and three of resettlement planning process.



3. Research Design and Conceptualization

Figure 1, (Source: Compiled by the Author)

3. Research Methodology

This study used a mixed methods approach to measure psychological risks associated with resettlement projects. A target sample population of 338 respondents in the transition stage and 903 respondents in potential development stage drawn from the project affected area was selected to conduct the survey. The sample was designed to be a balance of male and female representing affected GN divisions. Stratified random sampling method and systematic random sampling method were used to select the size of the sample.

In order to measure the significance level of psychological, the study used the following stages:

- 1. Development of ranking scales
- 2. Field survey

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- 3. Calculation of Significance Points (SP) Index
- 4. Rating the identified psychological risks base on its significance

The procedure for developing ranking scales are further described in Table 1. The study approach includes five indicators with separate ranking scales to assess psychological risks. Table1 was presented to survey respondents in the questionnaire and asked to complete their preferences.

After ranking these factors for each psychological risk, the significance level was assessed using following the equation:

SP = (M+I+D+S)*P

Finally, the identified psychological risks were rated based on the derived SP index values. The maximum value is 100. (Table2)

4. Findings

In the literature review, twelve psychological risks and the dimensions of those risks separately identified (Table 3). Results of homelessness indicate that loss of group's cultural space and identity remain high in both stages 2 and 3, however, the loss of quality and the condition of the house remain low due to the lessened sense of identity. The drop of social status under marginalization has increased to high from moderate, however, loss of mutual interactions between neighbours remains moderate between the two stages. Dismantle patterns of social organizations and interpersonal ties have increased from moderate to high, yet, erosion of resettlers' relationships with host community remains at the same risk level.

Health status is a sensitive indicator of development. The decline in health in increased morbidity and mortality levels stay at a moderate level in stage 2 and 3 of the society due to already established medical establishments in stage 1. Further, counselling services were already established early stages and trauma levels were at the minimum levels. It may have helped to keep an outbreak of relocation diseases at a moderate level at all time. A serious decline in health levels results from displacement-induced social stress, insecurity, the outbreak of relocation-related diseases and psychological trauma caused by displacement.

The results indicate that drop of land extent causes high psychological in both stage 2 and 3. However, the drop of productivity of land in stage 2 causes

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high-risk levels in stage 3. Joblessness causes high risk when people are resettled in a new place. In this study, two dimensions tested in the risk of joblessness are the loss of wage employment and the shift in the occupational patterns. Findings show the loss of wage employment due to the resettlement causes joblessness in the society which increases the risk levels from moderate to high. The shift in the occupational pattern is yet another form of economic dispossession faced by the displaced people. The study data indicate that the shift in the occupational patterns causes high-risk levels at 2 and 3 stages.

It was noted in resettlement process that the loss of educational opportunities disrupts the formal education activities. As a result, risk levels may change from positive to high. It all depends on the facilities available in the newly settled destination. If the facilities are located far away from the resettlement area and also students are unable to find a suitable place in the school, the risk level is likely to escalate. In this study, the survey was conducted immediately after the beginning of the re-settlement period. Public services such as banks were not properly developed in the area during that time and hence the risk level of the respondents was unchanged between stage 2 and 3.Loss of access to common resources are usually affected between stages of the resettlement. Many people in agricultural areas in developing countries who are about to resettle experience high risk due to their dependence on common natural resources (Cernea, 2004).

The displacement of people by forced movement from their locality or environment and occupational activities is categorized as a violation of human rights. Development-induced displacement is a social problem affecting multiple levels of human organization from tribal and village communities to well-developed urban areas. In this study, two dimensions related to violation of human rights were studied: loss of ability to involve in making decisions and the insufficient compensation payments. The risk associated with the loss of ability to involve in making decisions remains unchanged at low levels in stage 2 and 3, however, it remains high during the stage 2 and 3 for insufficient compensation payments. This is a violation of human rights, nevertheless, it is happening in many resettlement projects of Sri Lanka. People are vulnerable on whether they will receive sufficient amount of compensation to rebuild their life throughout the resettlement period which makes the level of risk high.

The sense of belonging means acceptance as a member or part in a resettlement and this is a common human experience. A sense of belonging is a human need, just like the need for food and shelter. Feeling that you belong is most important in seeing value in life and in coping with intensely painful emotions which usually occurs during the resettlement stages. As such, the risk was high

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during this settlement project in both stages 2 and 3. The risk associated with the disturbance to cultural affairs remains at the moderate level in both second and third stages due to the fact that 1571 households belong to Sinhala community whereas only one family belongs to Muslim community whose religions are Buddhism and Islam respectively. This position will not lead to any social or cultural disturbances after resettlement process.

Deviation of climatic conditions is likely to cause disruptions in agricultural production which is a major cause of the high-risk situations in stages two and three. Farmers are particularly followers of the climate patterns as their production depends upon the deviation of climatic conditions. This situation is likely to get worse when someone relocates from the original place of work. Farmers are familiar with the previous location in terms of getting inputs for agricultural production and changing weather patterns, however, after the relocation re-establishment of the familiarity becomes difficult. This is the major cause of the high-risk level. (Refer Table 4)

4. Discussion and conclusion

Findings of this study indicated that resettled communities are very much vulnerable to psychological risks especially for 12 risks selected in the two stages of resettlement planning process. Out of the above risks, homelessness, landlessness, joblessness and loss of belongingness were ranked as the top four. These are the aspects future resettlement planners should consider seriously in relocating people in Sri Lanka.Similarly, some other researchers have also found the similar themes associated with psychological risks in development projects (Cerena, 2003; Scudder 1980; Colson, 1971; Stanley 2004; Downing, 2009; Robinson, 2003).

Drawing on the experiences and lessons learnt from MRP, this study proposes that the future resettlement mitigation or improvement associated with DIDR should consider reduce the psychological risks based on its level of significance. Further, it needs to increase the local capabilities to access the crucial resources which are directly involving to reconstruct the re-settlers' livelihood. The main findings of this study have implications for a broader understanding of psychological questions for the DIRR projects, especially in relation to the development of policies and programs to enhance psychological concerns through smarter and more sophisticated social and physical environmental programs. The study findings demonstrate that planners need to consider ways to improve psychological conditions and increase the emotional well-being of resettlers. It is important for planners to consider the emotional concerns of all stages of the resettlement process. If these risks are taken into

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account, future resettlement will be more successful and bring positive results and outcome.

Annexure 1

		Indicators			
Magnitude(M)-	Irreplaceable(I)-	Duration (D)-	Scale (S)-	Probability(P)-	
Life satisfaction	loss of resources	Length of the time over which, resettlers are able to change or be changed psychologically	The social sector which is most vulnerable for psychological risk	How likely that the psychological risk may occur	
8- Very high	5- Very	5- Permanent	5-Community	5- Definite	
6- High	4- High	4- long term (>20 years)	3-Family	4- High	
4- Moderate	3- Moderate	3- Medium term (5-15 years)	2-Individual person	3- Medium	
2- low	2- low	2- Short term (0- 5)	1- None	2- Low	
1-None	1- None	1- Transient		1- Improbable	

Table 1: Indicators with separate ranking scales

Table 2: Definition of significance ratings (positive and negative

SP Index	Psychological significance	Decision Rule
value		
SP > 60	High significance	Psychological risk which may influence the decision
		about whether or not to proceed with the project
SP 30- 60	Moderate significance	Psychological risk where it could have an influence
		on the decision unless it is mitigated
SP < 30	Low significance	Psychological risk with little real effect and which
		should not have an influence on or require
		modification of the project design or alternative
		mitigation
+	Positive significance	Psychological risk that is likely to result in positive
		consequences / effects

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Psychological Risk	Dimensions					
1.Homelessness	Loss of group's cultural space and identity/Loss of quality and the conditions of house					
2.Marginalization	Drop of social status/Loss of mutual interaction between neighbors					
3. Increased morbidity & mortality	Decline in health levels/Outbreak of relocation diseases					
4.Social disarticulation	Dismantle of patterns of social organization and interpersonal ties/ Erosion of resettlers relationships with non- displaced relations					
5.Landlessness	Drop of land extent/ Drop of productivity of land					
6.Joblessness	Loss of wage employment/Shift in the occupational pattern					
7.Disruption of formal education activities	Loss of Educational Opportunities					
8.Loss of access to common property and services	Loss of access to some public services /Loss of access to common resources					
9. Violation of Human Rights	Loss of ability to involve in making decisions regarding the project/ Insufficient compensation payment					
10.Loss of Belongingness	Feeling of Isolation					
11.Ethnic discrimination	Loss of religious places					
12.Changes in climate condition	Difficulties face by the resettlers due to climate condition					

Table 6: Selected psychological risks and the dimensions

changes in chinate condition	condition	
Table 5 : Re	esults of stage two and stage three	
		2

Psychological Risks	Dimensions (D)		Stages ()	М	Ι	D	S	Р	S	P Index
	D1	Loss of group's cultural space and	S2	6		4	5	5.5	83	High
1.Homelessness		identity	S 3	6.5	4.6	4	5	5.7	115	High
	5	Loss of quality and	S2	6.4		3.4	3	4	51	High
	D2	the conditions of house	S 3	1.9	2.2	3.4	3	2	21	Low
2.Marginalization D1	D1	D1 Drop of social status	S2	5.5		2.2	3	4	55	Moderate
	DI		S 3	7.2	3	3.3	3	4.7	63	High
	Loss of mutual	Loss of mutual interaction between	S2	5.5		2	3	4.25	45	Moderate
	neighbors	S 3	6.1	3.3	3.6	4.2	3.9	67	High	

3.Social disarticulation		Dismantle patterns	S2	6.5		2.7	3	4.5	55	Moderate
	D1	of social organization and interpersonal ties	S 3	6	3	2	3	4.5	63	High
		Erosion of	S2	4.5		2.4	3	4.2	42	Moderate
	D2	resettlers relationships with non- displaced relations	S 3	4	4.3	2	3	4	53	Moderate
	D1	Decline in health	S2	5		3.2	1	4	37	Moderate
4.Increased	D1	levels	S 3	5	2.7	2.2	1	3.5	38	Moderate
morbidity & mortality	Da	Outbreak of	S2	5.3		4.4	3	3.8	48	Moderate
	D2	relocation diseases	S 3	5.3	3.3	4.4	3	3.4	54	Moderate
	D1		S2	7.4		5	3	4.3	66	High
5 I	D1	Drop of land extent	S 3	6.5	4.4	5	3	4.2	79	High
5.Landlessness	DA	Drop of	S2	6.5		3.4	3	4.2	54	Moderate
	D2	productivity of land	S 3	6.5	4.1	3.25	3	4.2	71	High
	D1	Loss of wage employment	S2	6.6		3	3	4.2	53	Moderate
			S 3	6.6	4.2	3	3	4.2	71	High
6.Joblessness	D2	Shift in the occupational pattern	S 2	6.4		3	3	5.5	68	High
			S 3	6.4	4.2	3	3	4.2	70	High
7.Disruption of		Loss of	S2	5.3		5	5	4	61	High
formal education activities	D1	Educational Opportunities	S 3	1	1.3	3	5	1	10	Low
8.Loss of access to common property and services	D1	Loss of access to some public services (banks, hospitals)	S2	5.5		2.3	4.5	4.1	50	Moderate
8.Loss of access to common property and services	D1	Loss of access to some public services (banks, hospitals)	S2	5.5		2.3	4.5	4.1	50	Moderate
		Loss of ability to involved in making	S2	2		2	5	2	18	Low
9.Violation of	D1	decisions regarding the project	S 3	2	2	2	5	2	22	Low
Human Rights	D2	Insufficient compensation	S2	6.4		4.4	3	4.5	62	High
	D2	payment	S 3	5	4	4	3	4.56	73	High
10.Belongingness	D1	Feeling of Isolation	S2	5.7		5	3	4.8	66	High
				3.4	4.4	4.25	3	4.4	66	High
11.Ethnic	D1	Disturbance to	S2	4.2		2	5	4.5	50	Moderate
discrimination		cultural affairs	S3	5.3	3.6	2.7	5	3.53	59	Moderate
12.Climatic change	D1	Deviation of the climatic conditions	\$2	5.5	4	5	4	4.5	65 °°	High
change			S 3	6.6	4	5	4	4.5	88	High

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INFRINGEMENT OF RIGHT TO ENVIRONMENT DURING THE IMPLEMENTATION OF MEGA INFRASTRUCTURE DEVELOPMENT PROJECTS IN SRI LANKA

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Abstract

Sri Lanka has given priority to economic development to raise standard of living of citizens. Development projects funded by both local and foreign funded play a major role in the economic development process. Private sector based development projects has been increasing rapidly. Thus it is imperative that environmental resources are conserved and enhanced to sustainable development. Economic development lead to cause environmental damagers thereby violations of right to environment happen. Hhealthy and sustainable environment is important to the full satisfaction of a wide range of human rights. Human rights include the rights to life, health and water. Protecting human rights helps to protect the environment and respect to their need for a sustainable environment. The aim of this research is to identify the infringement of right to environment during the implementation of mega economic development projects in Sri Lanka. To achieve aim, four objectives were established. This research is mainly based on interviews with environmental sector experts. Questionnaire surveys with construction sector professional were conducted to identify the conflicting areas on existing environmental law and relevant regulatory authorities. As the final outcome of the survey found out existing Environmental law should be amended as a critical manner. Some significant actions should be considered for a proper implementation of the environmental law. The conclusion emphasis the existing said environmental law areas should be properly implemented and monitored by the regulatory authorities in order to mitigate the violation of environmental rights due to development projects.

Keywords: Development Projects, Right to environment, infringement, human rights

1. Background

All human beings depend on the environment, healthy and sustainable environment is important to the full satisfaction of a wide range of human rights.. At the same time, protecting human rights helps to protect the environment, respect their need for a sustainable environment. Studies on the relationship between human rights and the environment have grown rapidly

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many questions about the relationship of human rights and the environment remain unresolved. Human behavior, such as economical activities, growth of population, further urbanization and industrialization has an impact on human rights and the natural environment which has led to a growing environmental pollution in the 20th century. (Grossa & William, 2002) Environment law can be considered as an effective mechanism which support for the equilibrium between environment and infrastructure development. It is must ensure that protection and respect of both right to development and right to environment concepts during implementation of successful mega infrastructure development. Rapid and unplanned urbanization can lead to social, economic and environment challenges. Therefore implementation of mega infrastructure development is required to prevent adverse effects to the civil society.

1.1 MEGA INFRASTRUCTURE DEVELOPMENT PROJECTS AND RIGHT TO ENVIRONMENT

Mega Infrastructure Development Projects (MIDPs) are critical to the futureof cities, states, and individual livelihoods. The right to environment is addressed in the Constitution of Sri Lanka, the Constitution contains a number of sections that are relevant to the protection of environment. Among those Article 24 which stated that everyone has the right to an environment which is not harmful to their health or well-being. The existing legislation in Sri Lanka protects environmental rights. When it comes to environment, Sri Lankan parliament has taken necessary activities as much as possible to protect the environmental rights. Mainly National Environmental Act No. 47 of 1980, National Environmental (Amendment) Act, No. 56 of 1988 and National Environmental (Amendment) Act, No. 53 of 2000, contribute widely to protection of environmental rights.

1.2 AIM AND OBJECTIVES OF THE RESEARCH

The aim of this research is to critically study on intervention of the regulatory bodies of Sri Lanka in application of right to environment during implementation of MIDPs in Sri Lanka and suggest measures in improving their procedures. Research Objectives are to identify Right to Environment, examine what extent do the present laws protect natural environment in Sri Lanka in respect of MIDPs, identify conflicting and problematic areas on right to environment and concerns during the implementation of Mega Infrastructure Development Projects, review the right to environment and to suggest improvements in order to make effective mechanism for protection of right to environment during the implementation of said projects.

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1.3 RESEARCH PROBLEM

During the implementation of MIDPs in Sri Lanka, there are many observations/examples can be taken as serious violations of Right to Environment of citizens. Also there are many relevant authorities to supervise and control the system, but still the right to environment of people is not protected by the law. Therefore it is essential to develop framework to protect right to environment of people in the Island. Considering these observations and most important regulatory agencies for MIDP in Sri Lanka, the research problem of the study was identified as "To what extent does the involvement of Central Environment Authority (CEA) and Coast Conservation Department (CCD) prevents infringement of right to environment in the implementation of Mega Economic Infrastructure Development Projects in Sri Lanka?

2. Research methodology

Through a comprehensive literature review, firstly the researcher aimed at recognizing the nature of environmental issues relating to the implementation of MIDPs through referring journals, books and other publications. Another momentous effort of the literature review was to list up the relevant regulatory agencies and to recognize their intervention according to the legislation. In that, especially Statutes and regulations were referred. With such recognition, a conceptual model was developed on the construction industry related violation of environmental rights and the intervention of regulatory Agencies in exercise of prevention.

In summarization the research approach used for the study will be analysis of secondary material on the concepts and rights discussed and primary data with regard to the implementation of MIDPs in Sri Lanka within focused interviews and in depth interviews. In that field information obtained from construction and development professionals, constructors who directly involved in the construction activities and professionals of the related regulatory bodies. Then they were subjected to in detailed interviews of unique nature, in examining the individual mechanisms revealed in the literature review to study their real world practice and also to discover the new mechanisms of intervention.

The model developed during the study was tested with the real world scenarios on the intervention of RAs in prevention of environmental pollution to compare their expected behavior by statutes with the actual practice. Subsequently, the recommendations were given on improving the intervention of RAs to prevent the environmental rights related issues by the construction industry. In the data collection stage, it focused on interviews in depth such as expert interviews

from environmentalists and professionals in construction field and semi structured interviews from higher level officials in environmental sector considered in the research.

3. Research gaps identified

Considering relevant literature identified to the research Constitution of Sri Lanka, Constitution aspects of other countries, relevant legislation and opinions of professionals in the field, following points were identified as gaps in the research which is considered as qualitative and it lead to violations of right to environment.

i Right to environment not explicitly recognized as a Fundamental Right

Many Constitutions different countries deeply recognize the **Right to Environment**. So the right to environment is enshrined in many national Constitutions. Such as Argentina, Congo, Korea, India etc. Even Though Sri Lankan Constitution, 1978 does not explicitly recognize the "Right to Environment" as a fundamental right. But there are few articles in Sri Lankan Constitution, like Article 27 (14) mention that "The State shall protect, preserve and improve the environment for the benefit of the community" and Article 28(f) stated that " The exercise and enjoyment of rights and freedoms is inseparable from the performance of duties and obligations and accordingly it is duty of every person in Sri Lanka to protect nature and conserve riches". Therefore it is clear that the 1978 constitution of Sri Lanka consist with principles of sustainable development under its directive principles of state policy and fundamental duties. But explicit recognition for Right to Environment is essential for concerning general public aspects. This loophole in the Constitution, effects people when their right to environment is violated from any single incident in their day today life. People face difficulties to claim against violation of right to environment of them. Also possibility to cause violation of any right to environment aspect will not be control by authorities unless they have reliable framework as limitation.

ii. The area can be researched more depth by Sri Lankan Environmentalists and jurists.

There is very few literature on this area is clearly identified under the chapter two. The right to environment and its perspective of RAs is not adequately discussed by the Sri Lankan experts. There is less interest of Sri Lankan authorities including environmentalists and jurists. Most of the time top of the higher authorities and judges involved in hearing

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environmental related cases are not much educated on the subject. Therefore percentage for legal coverage most of the time is very much lower. This situation will makes future generation also to avoid involving in environmental matters as well.

iii Different provisions for regulatory bodies.

Comparing to other countries one of major observation that Sri Lanka, there is no centralized controlling mechanism for regulatory agencies. Separate environment enactment for north western province, therefore north western province is independent from central environment authority to conduct projects.

The Provincial Environmental Authority of the North Western Province was established in 1990 under the "Provincial Environmental Statute No.12 of 1990" This Statute was enacted under the powers vested to Provincial Council by the 13thamendment to the constitution of the Democratic Socialist Republic of the Sri Lanka. Provincial Environmental Authority functions under the Chief Ministry of the Provincial Council of the North Western Province. The Provincial Environmental Authority of the North Western Province is the only Provincial Environmental Authority in its kind. The Authority empowered to manage the environmental Quality of the industrial sector discharges such as Smoke, Noise, Waste water Odor, etc. it has legal powers to manage and protect the natural environment of the province. Provincial Environmental Authority of the North Western Province has exclusive powers to issue Environmental Protection License (EPL) Environmental Site Clearance Certificates (ESCC) and carry out Environmental Impact Assessments on prescribed projects within the jurisdiction of the NWP.

This situation creates different conditions and policies, when approving a same project in NWP level and national level. Sri Lanka being a small Island, said conditions cannot be allowed because sometimes effects of approved projects by NWP might more seriously effect for neighboring provinces/ areas. Therefore consolidated powers must vest on CEA to control them centrally as CEA named as central environmental authority.

iv Inability to act regulatory agencies as independent bodies from the government (political influences) during their operations.

There has been a backlash against environmental regulation. Industrialists complain that environmental review has become a

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bottleneck that holds up projects that are urgently needed to generate employment. Indeed, the government has attempted to simplify or dilute the legislation and procedures in response. Given the difficult circumstance of the introduction of EIA and its sweeping scope, the EIA process has been a success in Sri Lanka.

The diluted EIA process is again and again politically disturbing in almost all projects taking place in Sri Lanka. In future also this situation will be occurred if relevant officials failed to take appropriate actions. Activists in environmental field have clearly identify that at least allowing to carry out proper process of current process better for the moment rather than finding a new process for the EIA. Legal actions against violations of EIA process and other aspects required during approval and implementation of development projects in Sri Lanka are not properly accept by jurists and courts. Most of the time people who are involving for these action discouraging by authorities under influences of politicians. There are several examples for petitions filed against projects are not called immediately; sometimes they were rejected in the courts due to influences of politicians or political goals. Therefore freedom to operate independently to regulatory agencies is needed to achieve right to environment based development in the island. Above mentioned situation, government needs to facilitate practically independent powers to RAs during their operations. Proper education, importance and responsibility on environmental protection should be given to higher officials in the field.

4. Analysis

Empirical findings proved that all the above stated environmental issues are addressed by RAs. Details gathered during interviews and confirmatory statements soundly analyzed. But there are not definite RAs in the field who specifically address the environmental rights issues of MIDPs. The research findings showed that the CEA and CCD play a highlighted role in this subject. Almost all other the RAs addressed the subject very generally. However in exploring the RAs for intervention, such RAs who are dedicated on Construction industry were CEA, CCD and UDA. This delegation had become vital importance to RA as reducing the workload. UDA also had been pointed as a PAA under NEA but it was recognized as serving to build environment as well as addressing the environmental sustainability of a development activity in a generic manner without specifying MIDPs. All used Environmental Clearances: EIA to control the MIDPs in the construction stage. CEA was observed to intervene to the environmental pollution by the Construction

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industry over directives in both phases. In the subject of CCD, in the construction phase; EIA was carried out by CCD as a sub process in the mechanism of permits. However, EIA was comparatively vast scope, in that it was worthy for individual address.

The intervention to the Construction industry related environmental pollution by RAs is highly structured. Each and every move is governed by the law; therefore the mechanism imposed by the law is exactly the happening in the real world. However this is rather good as all RAs are in common format when in procedures like EIA. But this structured nature makes the rigidity of the procedures without accommodating RAs to make an immediate response to the matters beyond the traditional frame. Overall efficiency of RAs can be accepted as high, as there were not many suggestions on that. But, In the process of Directives and Notices of Pollution CEA and CCD respectively should involve with LAs first, in taking actions against pollution. However this may lead to delays.

Another aspect that was raised in the empirical study was the behavior of Non-Government bodies involved in prevention of environmental pollution leads to violation of right to environment. Further they can involve to the EIA process at the stage of opening such report for public comments. But empirical findings revealed that, some NGOs without involving to the EIA process neither scoping process nor stage of public comments was found ting when a certain MIDP or another certain development activity is out to begin even after granting EIA. Such protests and objections were presented by NGOs as a mean of gaining the publicity in the representation of their active participation on the environmental protection. The international publicity allows them for range of benefits and it was certified on findings that, they can establish their future existence to the extent they have gained attention and popularity. However it was highlighted that, there are a number of NGOs who renders a praiseworthy job in prevention environmental pollution by MIDPs over informing a danger to the relevant bodies and coordinating such parties to prevent or minimize the environmental issues of a sudden event.

In evaluation of the approach and attention of RAs in intervening to the problem, it was realized that the RAs enter in to the problem without a specific plan. There is a common plan for overall environmental protection. However this plan is based on a mere consideration on experiences of past experiences without a systematic evaluation of the history of certain industries. The reason for such approach was clearly drawn out as the administrative delays in the government sector. In the other hand the

Authorities like CEA and CCD are stuck due to the financial deficiencies. Therefore, it is obvious that the financial resources of the government have not been balanced. The research intended to notify the internal weaknesses of RAs and the barriers that they had faced in intervening to the protection of right to environment by MIDPs.

It was revealed by the empirical study that all RAs have internal failures or loopholes of their procedures in intervening to prevention of right to environment by MIDPs. Basically loopholes were identified, as less coordination, less knowledge on the inter-divisional works and law, financial weaknesses administrative delays and mainly no consolidated provisions for regulatory bodies. In the subject of coordination it was very limited to the tasks like environmental scoping in EIA and the environmental pollution was not address of a coordinated attention. The less coordination as a reason has blocked the bridging of RAs in exchanging finance. Administrative delays were identified and inspired to RAs as a fundamental failure of the government sector. The extent of such inspiration runs deep in to the perception that anybody did not dare to have even future plans on positive imaginations of soon implementation of them. Regarding the external barriers that RAs faced, there were three, related to the attitudes of constructors, public participation and political changes. Research findings indicated that Attitudes of the most of constructors are not that positive on prevention of pollution which leads to Violation of right to environment combined with their own routines. The legal enforcement was identified as a major motive for Constructors to refrain from harmful actions towards nature. In the sense of public participation it was recognized that such participation is not in a considerable status and it is due to the fact that people have imprisoned within the complex life style. And another highlighted fact was that such participation is based on individual harm by a MIDP.

However there are cases in the real world that, such individual voice of a victim is influenced by MIDPs through granting financial or other benefits to him in the expense of the MIDPs as a mean of covering up. This is backed by preference of people to solve the problems in other means rather than through the legal system. In the other barrier for the intervention are the frequent political changes in the country that obstruct to the continuation of implementing planed works and consistency of strategic planning. The study findings concentrated on suggestions by RAs for the barriers identified. On less coordination, there were suggestions to plan and establish coordinative projects to address the right to environment by MIDPs as well as to make the staff at least the officers relevant to the subject- MIDPs aware on the importance of coordination. On financial weaknesses it was suggested that the government should allocate

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more capital and recurrent funds. Regarding administrative delays and Political changes there were not any suggestions by the parties.

Key finding of the research was that the existing level of violation of environmental right is high. The MIDPs retain the risk of fines and prefer to earn profits, although they were caught, they consider that the fine can be recovered through the profits. At the same time internal problems also takes part in this, such as, financial deficiencies, less coordination, administrative delays, less knowledge on procedures and no consolidated provisions for regulatory bodies. In that, although there are a number of mechanisms the depth it addresses is not that enough. The most of RAs; CEA and CCD were in the mind that their intervention is unsatisfactory on protection of environmental rights relating to construction industry. As all the RAs agreed that the existing level of pollution and is high, it denotes that more intervention is required. Therefore, this situation does not imply that their intervention is satisfactory.

5. Recommendations

Data received from primary and secondary data this Right to environment concept is not explicitly recognized in Sri Lankan Constitution. According to the articles 27 and 28 of the Constitution, obligations to protect environment is described. However, according to analytical data, inserting right to environment to the fundamental rights chapter to the Constitution is required for betterment of people of Sri Lanka as well as future generations. Present conditions make unawareness and lack of interest of constructors on right to environment concepts during their operations. Regulatory agencies are not always independent in their operations. Current procedure in Sri Lanka regarding implementation of projects is respectively better than some countries in Asia.. Several petitions filed against by various institutions and individuals also does not given due consideration by the courts.

Most of the time, teams who are conducting evaluations are not experienced or specialized in respective field. Sometimes social issues from these projects are not evaluated/ examined as required to the country. The applicability as well as successful operations of these projects in other countries as well suitability to Sri Lanka must consider rather than unplanned development. Right to environmental concepts must include in all environmental assessment procedures. Conduct of revisions for EIA findings for system improvements and review of adherence to compliance. Incorporation of environmental concerns, into project plans. An environmental assessment at-least at the level of IEE needs to be carried out at the project planning stage.

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No exact monitoring method in present procedure, during the implementation of such projects. Therefore approved conditions might violated by the constructors. The size range of projects must be clearly defined to decide for conduct evaluations. Also cover unnecessary loopholes of procedures when it is practically implementing. All concepts should consider in the Constitution and evaluation procedures without hindering humans right to development. Also government must introduce Strategic Environment Assessment (SEA) assessment process.

Proposed concept for the strategy/mechanism has developed under four main stages.

- 1. Governments' obligations to protect Right to Environment and Right to Development of citizens.
- 2. Process of planning projects.
- 3. Implementation of MIDP and supervision.
- 4. Consumption of facilities of MIDP and projection of suggestions for observations.

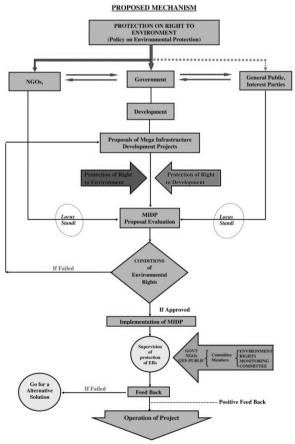


Figure1- Proposed concept for the strategy/mechanism

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6. Conclusion

The research findings indicated that there are no guaranteed protection for environmental rights in Sri Lanka. The violation of environmental rights had been recognized in both construction and operation phases of MIDPs. Both phases comprised from destructive impacts to environmental rights. The surrounding however even adding a commercial value to the MIDPs and the services but in this substitution to the nature there is a degradation of natural resources. However, the environmental pollution persists as MIDP undergoes in its operation phase due to the discharge of waste water, effluents and high quantities of regularly emitting domestic wastes as well as a certain portion of hazardous wastes. On both of the phases from the environmental issues noted, relating to air, water, soil and noise, in the MIDP water pollution was drawn out with a highest prominence.

Although the NEA was passed in 1980 none of the previous pollution control laws has been repealed. This has required a fresh perspective in dealing with the implementation and interpretation of these various laws. Each law is different in its approach, whilst the Code of Criminal Procedure is geared to remove or decrease a nuisance; the amendment (Act No. 56 of 1988) to the NEA seeks to control pollution and noise and lays down certain prescribed standards which need to be followed. The conflict with the right to environment and right to development is inevitable. In these situations, the public would gradually more turn to the courts, as the final authority of rights and responsibilities. The courts will have to not only offer redress however also set standards of manage the future guidelines. This may need innovative advance to analysis and new methods of enforcement. Scientific facts play a major role in environmental litigation. They are part of or form the basis of observations, site reports, tests, analytical reports, environmental assessments, studies on plants, animals and abiotic factors, projects and other activities. The research findings depicts that the right to environment is essential right to recognize as a fundamental right in Sri Lanka.

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GROUNDED THEORY AS AN APPROACH TO EXPLORE THE USE OF PUBLIC OPEN SPACES TO ENHANCE THE CITIES' RESILIENCE TO DISASTERS

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Abstract

Grounded theory is a popular research method in social science researches, yet comparatively unfamiliar in the planning and designing literature. However, the use of grounded theory in exploring new concepts and theories from the gathered data, allows to bring unique benefits to the research as well as many challenges and criticisms. Within this context, this paper explores the benefits, challenges and criticisms of using grounded theory as the research method within the research fields of urban planning and disaster resilience. Specifically, the paper analyses the use of grounded theory within the research of exploring the use of public open spaces to enhance the cities' resilience to disasters. First, the paper presents the factors effected to make the decision of selecting grounded theory as the research method in this particular research. Followed by the elements of the selected version of grounded theory. Then the discussion flows through the benefits, challenges and criticisms of using grounded theory within the research study. Finally, the findings suggest set of strategies that can be used to harness the potentials and to overcome the criticisms and challenges of using grounded theory as the research method within the field of planning and designing.

Keywords: Disaster resilience, grounded theory, public open spaces, urban planning, urban designing

1. Introduction

Grounded theory is a well-established research method in social science research. It allows the researcher to come out with new theories which emerge from gathered data. Although this research method is commonly used in nursing and health science researches, in recent years, it became popular in many other disciplines as a flexible and systematic approach for theory building when there is no theory exist (Achora and Matua, 2016). This emergence was ensued mainly due to the de-orientation of the original notion of the grounded theory towards more flexible approach which direct the inductive process starting from initial screening of literature, rich data collection, comparative analysis and inductive theory building. Mostly, the researchers who are interested in social and human centered issues tend to use the grounded theory as a helpful research tool to find out new theories and concepts (Compton and Barrett, 2016).

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However, the usage of grounded theory as the research method within the fields such as urban planning and urban designing, remains limited. This is mainly due to the nature of most of the urban research such as the complexity, dynamic nature, strong focus on the physical aspect of the urban environment and strong orientation on practice-base (Allen, 2017). Within this context, this research paper explores the usage of grounded theory within the research fields of urban planning and disaster resilience and its' unique benefits, challenges and criticisms, that can be brought to the research. Specifically, this paper analyses the usage of grounded theory within the research on finding out the use of public open spaces as a strategy to enhance the cities' resilience to Tsunamis. Accordingly, this paper first details the factors effected to choose the grounded theory as the research method in this study. Then the discussion flow through the questions on how the grounded theory was used in this particular study and how to get the maximum benefit to the research from the grounded theory approach and how to tackle some of the practical issues and challenges when using this method in urban planning and designing researches.

2. Grounded theory as the research method

Grounded Theory is a method in which theory is derived from a structured data set with or without a preliminary research question (Hunter and Kelly, 2008). This research method was emerged at a time when there was a tension between the qualitative and quantitative studies in early 1960s in the United States (Charmaz, 2014). At that time, most of the qualitative researchers did the field work, gathered large amount of data and presented demonstrating relationships, but not rather with analytical approach using analytical strategies as in quantitative studies. Within this context, Anslem Strauss and Barney Glazer discovered the grounded theory as a response to the 'extreme positivism' by publishing the book; 'The discovery of grounded theory' in 1967 (Charmaz, 2014). This discovery transferred the flow of qualitative studies towards more empirical findings through a systematic analysis and with systematic methodological strategies. Further, Glaser and Strauss (1967) introduced the grounded theory as an approach to discover an emerging theory, grounded in data, where the research problem emerges from the first level of primary data analysis.

2.1. DE-ORIENTATION OF GROUNDED THEORY

Glaser and Strauss subsequently disagreed over the application of grounded theory, which led to two different approaches of grounded theory. Glaser (as citied in Easterby-Smith, Graça, Antonacopoulou, & Ferdinand, 2008) establishes that there should not be a preconceived theory in mind, whereas Strauss and Corbin (as cited in Easterby-Smith et al., 2008) highlight the requirement for a theoretical statement to enable an explanation or prediction

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of theory. Glaser and Strauss both acknowledge that the researcher will not enter to the field free from ideas, but differ considerably in the role they see for the literature. Furthermore, the differences between the two versions can be summarized as follows.

Glazer & Strauss (Original Version)	Strauss and Corbin (Second Version)				
 There should not be a preconceived theory in mind Theory is derived from a structured set of data with or without a preliminary research question Inductive No use of literature prior to theory development 	 There can be theoretical statement to enable an explanation or prediction of theory Theory is driven by a preliminary research question Inductive/ Deductive Review of literature prior to study will identify any gaps in knowledge 				
 Coding: Open and selective 	 Coding: Open, Axial and selective 				

Table 1, Differences	hetween	the two	versions	of grou	nded theory
Table 1, Differences	Detween	the two	versions	or grou	nucu incory

Adding to the second version of grounded theory, Charmaz (2006) introduced the version of constructive grounded theory which further allows the researches to have a preconception theory and literature prior to the data collection. However, constructivists view that people gather knowledge through experiencing it and through the interaction of experience and their ideas. Within this view, Charmaz (2014) states that the categories of the theory and the theory itself is co-constructed by the researcher and respondent. This approach attends more to the language and action. However, much common in all these versions are all approaches direct the inductive process starting from rich data collection, comparative analysis and inductive theory building from data. Further, it can be noted that in current context, grounded theory works as a more flexible and positive research strategy to conduct qualitative research while allowing the researchers to use it in a more diverse and complex social research environment.

Yet, the selection of the most appropriate version of the grounded theory and the understanding of the elements and principles of the selected version is one of the most important tasks when using the grounded theory method. Further, this selection and the understanding should be guided by the type of the research, central focus of the research and the research time line. Therefore, prior to the discussion of the usage of the grounded theory in this study, it is imperative to get a grip about this particular research study which is an ongoing doctoral research study placed at the stage of analysis.

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2.2. OVERVIEW OF THE RESEARCH STUDY

The research study which is going to be focused of this paper, concentrate on finding out the use of public open spaces as an approach to enhance the coastal cities' resilience to Tsunamis. Currently, urban planners, designers and landscape architects use public open spaces as a mode to enhance the cities' sustainability from all its three counts; economic, social and environmental. Yet, lack of consideration has been given to use these public open spaces for disaster resilience (Hossain, 2014), as an agent of recovery, to provide essential life support, as a primary place to rescue, shelters and potential for adaptive response. Filling this gap, this research focuses on 'how to use the public open spaces to make cities resilience to disasters. This consideration is even more important in the context of coastal cities due to the growing disaster risks in coastal cities with the implications of climate change, impacts of growing human migration towards coastal cities and due to the challenges of rapid urbanization. Further, the usage of public open spaces to improve the disaster resilience in coastal cities may differ from one coastal hazard to another. Tsunami is one of the coastal hazards that can be considered as infrequent, but extremely destructive hazard. Therefore, it is important to increase the inherent capacity of the city to resist, absorb, accommodate and recover from the effects of a Tsunami. Accordingly, this study specifically answers to the research question of 'How to plan and design public open spaces as a strategy to make coastal cities resilience to Tsunamis?'.

2.3. SUITABILITY OF GROUNDED THEORY TO THE RESEARCH STUDY

Selection of the research method should be principally linked with the philosophical position of the researcher. Here, the researcher's ontological view is that the public open space is planned by the planners, urban designers and used by the public. Therefore, finding a new way to plan it, focusing on disaster resilience cannot be achieved without considering these social actors attached to it. It cannot be identified just by looking at the physical entities of the world. Accordingly, the researcher's view of this research study, which directs to answer this question can be placed at the subjectivism aspect of ontology. Epistemologically, the researcher believes that the reality is socially constructed, the truth about the socially constructed reality need to be discovered through the opinions, narratives, individuals and contexts rather than through the facts and numbers.

Further, with this philosophical assumptions, the researcher can establish the philosophical position towards the interpretivism. For the reason that, interpretivism highlights that the human is different from physical phenomena because they create meanings and interpretivists study these meanings (Saunders, Lewis, and Thornhill, 2016). Accordingly, the researcher view that

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the answer to the research question 'how can public open spaces be used to increase the cities' resilience to Tsunamis?', can be found through the responses of the participants. Further, to answer the research question, the researcher seeks to find the answer through the knowledge of local planners, coastal planning experts, disaster resilience experts and the local knowledge of community in Tsunami prone areas, rather than using urban morphological studies.

As Creswell (2007) and Charmaz (2014) state that grounded theory is identically useful when there is a need to obtain data from the ground and when there is a need to explore a social process. Accordingly, this research seeks to create resilience coastal cities using the data from the field (community & experts) and the research is associated with a social process which investigates the actions and interactions of people with the built environment. The use and functionality of public open spaces is associated with the social interactions and actions with the space. Within this view, grounded theory provides a good platform to the researcher to find the answer to the research question through an exploration of social process attached to the use public open space in an event Tsunami through both perspectives response and prevention.

In addition to that Saunders et al. (2016) inform that, the grounded theory usually takes inductive approach. In this particular research, there is no predeveloped theory to test. The reviewed literature introduces some of the potential uses of Public Open spaces for disaster resilience through past disaster events, but did not reveal how to plan and design public open spaces as a strategy to make cities resilient to Tsunamis. Therefore, there is no predeveloped theory to test or to evaluate a phenomenon. Instead, the theory need to be discovered through a series of data collection and analysis. Accordingly, the data collection is focused to achieve the research objective; to explore the methods and approaches that can be used to plan and design public open spaces as a strategy for Tsunami disaster resilient coastal cities. Therefore, the recommendations of Saunders et al. (2016) further justifies the use of grounded theory in this research as it takes the inductive approach.

Consideration of Grounded theory as a research strategy, Saunders et al. (2016), define the research strategy as the plan 'how the researcher will go about answering the research question'. When investigating the research question, review of literature prior to study is an essential task in doctoral research as it allows the researcher to identify any gaps in knowledge which need to be filled by the research and also in order to meet requirements of the progression monitoring point at the initial stage of the research. Therefore, the starting point of this research study was to review the literature related to central research question. As per the literature review, it was identified that current studies on the use of public open space for disaster resilience, mostly

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focuses on emergency evacuation, recovery and mitigation strategies. Focusing on mitigation strategies, most of the discussions are based on 'open space' with preservation and conservation perspective, nonetheless not looking at use of 'Public open space' that can potentially contribute for both urban development and disaster mitigation (Kubal, Haase, Meyer, and Scheuer, 2009), (National Tsunami Hazard Mitigation Program, 2001), (UNESCO, 2015).

Further, the literature review identifies that Public open spaces can also be used to facilitate the emergency evacuation and recovery (León and March, 2014), (Fuentes and Tastes, 2015), (Taubenböck et al., 2009). Yet, if the allocation is not well connected with the everyday life of the city, there is a high possibility to not to function well in an event of emergency and recovery (Allan and Bryant, 2010). Therefore, there is a need to find methods and approaches to plan and design public open spaces to function well both in emergency and non-emergency times. Apart from that, current strategies, identify the use of open spaces discretely, but not as interconnected system that can significantly increase cities' resilience to Tsunamis. This means, yet the role of Public Open spaces as a strategy for Tsunami disaster resilience cities has not been fully discovered and poorly understood in the current context. Denscombe (2014) describes that the grounded theory method is more appropriate when the phenomenon is poorly understood and further exploration is needed to increase the existing understating. Similarly, as explained above, the role of public open space in the context of coastal cities is poorly understood and further explanation is needed to identify the potential uses of public open spaces to make cities tsunami disaster resilience. Accordingly, it can be understood that, when the phenomenon is poorly understood within the existing field of study, grounded theory method provides a good platform to explore it. Scientific research studies always should be guided by a rational decision making process. Especially, the decision of research method selection need to be justified thoroughly with evidences. Accordingly, as explained in this section, the decision of selecting Grounded theory as the most appropriate research method for this research study was taken based on four main reasons; 1. Researcher's philosophical position towards the interpretivism, 2. The research explores a social process, 3. Inductive research process, 4. The phenomenon is poorly understood within the existing field of study.

3. Principles of Selected version

The emerging theory in this research is driven by the preliminary research question; How to plan and design Public open spaces as a strategy to make coastal cities resilience to Tsunamis. This preliminary research question enables an explanation of the emerging theory. In a doctoral research, having a preliminary research question is beneficial in many ways including when

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justifying the research proposal, when convincing the need of your research to the field and when showing the gap in knowledge. With this basis, this study adopted the principles of the second version of the grounded theory. Instead, if the researcher used the first version of grounded theory, the research problem would emerge from the first level of primary data analysis, which is challenging with the time frame of a doctoral study and also not convincing as the same can be achieved through the review of literature.

If the consideration is given to the usage of literature within the grounded theory context, Glaser's approach promotes that literature should not be reviewed prior to the study as it may lead to build a biased theory (Knight & Ruddock, 2009). However, Heath and Cowley (2004) argue that no one can be completely detached from their own experiences and readings in this process. They suggest that the literature can be used to support the developed theory. Further, Goulding (2005) suggests that literature can be used as part of the data collection. Apart from that, Strauss and Corbin (1998) and Cutcliffe (2000) suggest that review of literature prior to study will help to establish the knowledge gap. Accordingly, it can be understood that different authors suggest different approaches to review the literature within the theory building process. Authors such as Strauss and Corbin (1998) and Cutcliffe (2000) suggest prior to the study and authors alike Goulding (2005) suggest parallel to the data collection or after the development of the theory.

In this research, the literature is used at two stages of the theory development process. Firstly, as it was explained previously, the literature is used to establish the research gap which is an essential part of a doctoral study. This approach enables to identify the gaps in knowledge which need to be filled by the research findings. Further, this approach has provided a direction for the data collection and a prediction for the emerging theory. Secondly, literature will be used to support the emerging theory. This means whenever the emerging theory demand further clarification or support and when this cannot be achieved through interviewing the relevant groups, the literature will be used to support the emerging theory. Accordingly, it can be summarised that this research employs most of the principles from the second version (Strauss and Corbin's version) of grounded theory.

4. Benefits of using grounded theory

Grounded theory method has the potential to bring many benefits and also the challenges and criticisms to the research. Further, using this method in planning and designing field can bring extra set of benefits and challenges as well with the nature of urban research. Better awareness of these benefits and challenges will allow the researcher to get the maximum use of the benefits and act on challenges in a proactive manner. Accordingly, this section first discusses these benefits of using grounded theory within the field of urban planning designing.

As this research employs the second version of grounded theory, it allowed the researcher to review the literature prior the data collection. Accordingly, the researcher reviewed both planning and designing literature and disaster resilience literature in order to establish the research gap. This was very important task as this research traces two fields, as well as beneficial to the research as the existing literature tells you the story so far within the field. Yet, the data collection will not rely on literature. Accordingly, the review of literature identified that the current strategies use the open spaces for disaster resilience discretely, but not as an interconnected system that can significantly increase cities' resilience to Tsunamis focusing both on prevention and response. Also the review of literature identified that, the investigation of potential strategies should be well connected with the everyday life of the city to function well in both emergency and non-emergency situations. Accordingly, this review of literature provided an explanation or a prediction of the theory which can be achieved through the grounded theory method. This prediction covers that the theory which is the future framework need to enhance the use of public open spaces in a city as an interconnected system for tsunami disaster resilience enabling as a strategy to mitigate the Tsunami risk, as an agent of recovery, as a facilitator for emergency response and recovery while accommodating the everyday life of the city. Furthermore, before the application, the predicted framework need to be customised according to the needs of the diversified urban morphological and geographical characteristics of cities.

Further, Aldiabat and Navenec, (2011) state that grounded theory generates explanatory theories reflecting the complexity and the variability of the phenomenon. Planning and designing public open spaces with a focus on social process attached to the built environment is complex and dynamic as it involves many stakeholders and many aspects need to be considered. Achieving this task with a new focus on disaster resilience is even more complex and multifaceted. This study includes many perspectives with human aspects such as planning and designing of Public open spaces considering the way people behave in a Tsunami emergency situation, needs of displaced people in the recovery period and increase the public awareness through the planning and design features and so on. Also this study includes a technical aspect of disaster management as well such as consideration on disaster specific factors when planning for Tsunami disaster resilience including location, terrain qualities and capacity. Moreover, this study includes the

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coastal environment specific factors and urban planning trends and patterns as well.

Accordingly, it can be understood that the finding a planning and designing framework to use the public open spaces as a strategy for Tsunami disaster resilience, requires tackling many interlinked and overlapping themes, considerations and issues. Within this situation, grounded theory method allowed the researcher to go to the field with an open mind and excavate these many interlinked and overlapping themes, considerations and issues related to the phenomenon. Furthermore, as the theory emerge from the data (Knight and Ruddock, 2009), it addresses the real practical needs of planning and designing public open spaces for Tsunami disaster resilience rather than developing through an unpractical theory. Therefore, the results of this ongoing doctoral study which is currently at the analysis stage, will provide some practical solutions to the identified research question through the use of the grounded theory method. When the final theory is closely connected with the data, it is an added advantage to the researcher to defend the credibility of the final theory.

5. Challenges and criticisms of using grounded theory

However, one of the main criticisms for this second version of grounded theory, is that the problem of preconception. Classical grounded theorists criticize that having a preconception or preconceived theory in mind increase the possibility of having a biased theory and there is lack of space for the openness and the emergence of unbiased novel theory. Therefore, though the review of literature was used to establish the research gap and prediction of the future theory, it was not used to guide data collection or to develop a draft framework before the data collection. As per grounded theory the researcher needs to enter to the field with an open mind still stay within the central research question. This allowed the researcher to gather the new knowledge from the data with an open mind rather than limiting to a developed frame.

Then the challenge was how to select the participants as there is no guide for the data collection. Specially, in urban planning researches, the study field is exceptionally large and selection of participants may vary across disciplines disaster experts, planners, ecologists, geologists, sociologists, community, administrative bodies and so on. Therefore, researcher can easily get lost within the field when there is no guideline or a frame for the data collection. In this case, the initial review of literature was used to identify the initial participants to the research. Accordingly, four groups were identified; disaster resilience experts, coastal planners, urban planners and Tsunami effected communities. Particularly, disaster resilience experts, coastal planning experts and local planners were chosen as they can provide the views on current practices,

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challenges, potentials and future recommendations to use the public open space as a strategy to make cities resilience to Tsunami. Apart from that, the community who effected from the 2004 Tsunami is taken for the study as they can provide the views on how did they use the space in the event of emergency and before, how did they use the open spaces immediately after the Tsunami, within the recovery period and afterwards.

Despite of these benefits, still the argument can exist which the use of literature to guide the selection of initial participants, can result a biased theory. In this case, the researcher used the theoretical sampling method answering this criticism. This means through the theoretical sampling method researcher can select the further participants according to the need of the emerging theory. In this way, it was easier and less time consuming to select and conduct the interviews with specific amount of participants with a relevance to the research within the limited period of time. Apart from that, interviews began with an open-ended question with a focus towards how to use the public open spaces to enhance the cities resilience to Tsunamis. However, these open ended questions were used just to begin the discussion and then it flows as it goes, yet around the central research area. Interviewer just acted as a facilitator to keep up the discussion using some of the techniques such as eliminate any biased questions, always request more details and explanation for the answer and keep the participant on the subject. Further, the use of open ended questions without an interview guide allowed the researcher to open up the discussion into a wider area covering many aspects within the field of study. Another distinctive feature, that was used to manage the problem of preconception is the constant comparison. The constant comparison of the data analyses and re-analyses the data towards the final framework which is emerged from data. In this way, researcher makes sure that the theory is grounded and emergent through the data. Moreover, researcher searches patterns in the data avoiding the search of supporting codes for the preconceptions.

6. Conclusion

The selection of grounded theory and the selection of second version of it, brought many benefits and challenges to the study. Firstly, when the existing literature did not provide any strong theoretical statement to the study, grounded theory allowed the researcher to go to the field with open mind and investigate the query. Secondly, the selection of second version allowed the researcher to review the literature and identify the gap in knowledge before the data collection. Further, the initial understanding of the research problem through the initial literature review, guided the researcher to identify the initial participants to interview and directed the data collection process. This was further beneficial to the research as these urban projects involves lot of

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stakeholders and selecting participants without a literature framework can be an extremely critical task. Yet, the main challenge of this research was to manage the preconception in order to produce the unbiased novel theory. However, the awareness of this challenge, directed the researcher to use the literature review solely to identify the research gap rather than developing guideline or a framework before the data collection. Further, the researcher used the theoretical sampling, use of open ended question in interviews without an interview guide and constant comparative analysis, to manage the preconception and to avoid the criticism of developing biased theory. Further, it was identified this method is beneficial for the urban planning and designing researches when there is a strong focus on social process attached to the built environment. Furthermore, when understanding a complex and dynamic urban phenomenon, grounded theory allows the researcher to go to the field with an open mind and excavate these many interlinked and overlapping themes, considerations and issues related to the phenomenon.

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