



THE THIRD

NZAAR International Event Series on

NATURAL and BUILT ENVIRONMENT, CITIES, SUSTAINABILITY and ADVANCED ENGINEERING

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SGER 2017	<i>International Conference on Sustainability, Green Buildings, Environmental Engineering & Renewable Energy</i>
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KING ABDULLAH CITY FOR ATOMIC AND NUCLEAR ENERGY – DESIGNING A CITY FOR THE POST-PETROLEUM ERA

Professor Robert Powell*

*School of Architecture, Building and Design, Taylor's University Lakeside Campus, 47500 Subang Jaya,
Selangor, Malaysia*

**robert.powell@taylors.edu.my*

www.nzaar.com

From 2007 to 2014 the author was the Head of Eco-Masterplanning with the London-based practice of Llewelyn Davies Yeang – Architects and Planners. The firm produced a number of masterplans in Qatar, Libya, Turkey and India and in 2009 was invited to create an Ecomasterplan for King Abdullah City for Atomic and Renewable Energy.

The ruling family in Saudi Arabia, increasingly aware that oil is a finite product wished to explore ideas for a future city that would function when the country's oil wells run dry. They hired 12 international consortia paying each US \$1.2million to produce designs. LDY headed one of the consortia and elected to design a city for a population of 250,000.

This was not a move born out of immediate need for Saudi Arabia has proven reserves of 266 billion barrels according to government estimates submitted to the Organization for Petroleum Exporting Countries ('Annual Statistical Bulletin', OPEC, 2015). If these figures are correct, Saudi Arabia's reserves will last for another 70 years at an average production rate of 10.2 million barrels per day reported for 2015. Nevertheless it was regarded as prudent by the Saudi authorities to plan ahead.

Research Question

How would a city in Saudi Arabia function after the oil reserves of the country are expended?

Methodology

The methodology can be summarised as 'Research by Design'. A team of 55 specialists was assembled. LDY in London and Kuala Lumpur collaborated with Buro Happold Engineers in Riyadh and London. A team comprising 19 city planners, architects and 3D modellers was allocated to the project; 10 engineers from Buro Happold gave specialist advice on energy, water supply, transportation, security and waste. Eighteen academics from the architecture and engineering department of Umm al Qahr University in Mecca provided local knowledge. Specialist advice on landscape/ecology came from Dr. Mike Wells of Biodiversity by Design attached to the University of Bath UK while the UK National Nuclear Laboratory supplied expertise on a nuclear reactor. Michael Guerra, an expert on hydroponic food production was employed. Models were built in London and 3D animation was produced in Shanghai

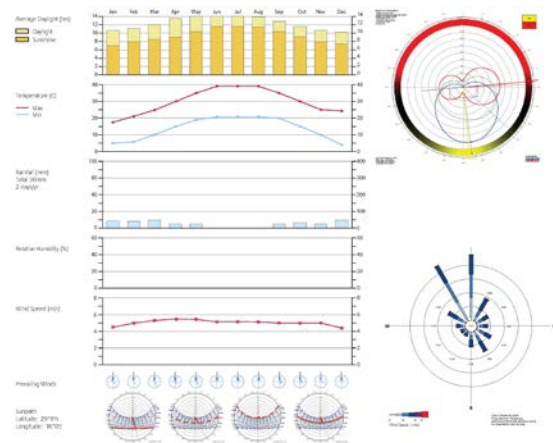
The Site

The site of the new city, to be known as King Abdullah City for Atomic and Renewable Energy (KA-CARE) was 30 km South West of the capital Riyadh and 800 Km from MECCA. The site is on the edge of the Greater Riyadh Authority Masterplan in an area designated as an Environmental Reserve

The Saudi Arabian landscape is typically sandy desert with rocky outcrops. There is heavy rain for a brief two-month period each year and landscape in the wadis (valleys) flourishes for a brief period.

Seemingly barren land bursts into flower in these two months. The site lies on the western extremity of the Wadi Hanifah catchment area

The topography shows a system of valleys running east from a high ridge. The valleys are dry for the greater part of the year and are eroded by torrential rainfall for a brief period.



The climate analysis is crucial. There is over six hours of sunlight every day, High daytime temperatures contrast with cool night time temperatures. It is extremely dry with rainfall only in December and March. Wind speeds are low and mostly from the north. The analysis indicates sufficient hours of sunlight for solar power, but wind speed is marginal for wind energy. Water supply is a problem. Taking all the data and analysis together the land that is suitable for development was identified.

The design team identified an optimum size for a city. We took a sample of cities around the world and used some subjective criteria. We asked what size a city must be to have a general hospital, a university, an industrial base etc. We arrived at the figure of 250,000. It is roughly the size of Oxford or Milton Keynes in the UK or the projected population of Putra Jaya in Malaysia.

LDY in London and sister company T.R. Hamzah & Yeang in Kuala Lumpur

pioneered an ecological approach to masterplanning which sees the process as the benign and seamless integration of four strands of eco-infrastructure into a system. These are categorised as: the green eco-infrastructure being nature's utilities and the creation of viable new habitats; the blue water-management infrastructure being close-loop water management and sustainable drainage; the grey engineering eco-infrastructure being eco-engineering systems and utilities; and the red infrastructure being the human society, lifestyles and legislation.

The design team next generated options. It was interesting to observe the methodology of the team members from different cultures, some seeking to follow precisely the analysis outlined above, others seeking to impose a formal plan on the landscape similar to Edwin Lutyens in New Delhi or the plan of Canberra in Australia by Walter Burley Griffin or indeed the masterplan for Putrajaya in Malaysia. Others sought to impose an orthogonal grid on the site in much the same way that colonial powers imposed grids on new cities.

Other options emerged most of them avoiding the deep valleys to the North West while some sought to cut and fill to create flat plateaus on which to build. In all 18 options were explored. The options were evaluated using EMAT (Eco Masterplanning Assessment Tool) devised by LDY. It awards points for each feature in the Green, Blue, Red and Grey Infrastructures. The Preferred Option was one emphasising ecological connectivity. It indicates a 7km long city along the ridge line with projections to the North West along smaller ridges, and on the flat terrain below the ridge to the south West.

A land use plan was devised to be achieved in seven semi-autonomous phases built on the high ridge, the lower plateau and on the

scarp slope separating the two. The Green infrastructure was developed – urban oasis habitats, urban pocket parks, areas where native habitats are restored and areas for crop cultivation. Learning from Wadi Hannifah, weirs and dams were proposed to capture water and reduce erosion.

Biodiversity targets were set in collaboration with the Institute of Biodiversity by Design at the University of Bath in the UK. Birds, mammals and butterflies were identified and vegetation designed to attract these species.

The size of a neighbourhood or district is determined by the distance a child can walk to school or an adult can walk to a market or mosque. The optimum distance is plotted on this plan and we eventually settled upon 45 neighbourhoods and eight neighbourhood centres.

Generally the dwellings are inward orientated to a courtyard with small openings on the public façade which conforms to a model for the hot dry climate in the Middle East. Recreation and leisure was considered in some detail again based on the principal that facilities should be within walking distance.

The economy of the new city is research based. The main ‘street’ of the city is a sheltered environment with electric powered vehicles and a Light Rail Transit System. The source of materials for the construction of KA-CARE was carefully considered with a view to reducing transport costs and with view to recycling materials.

The Energy Equation

The key question was how to create energy for the city without petroleum. Seven methods are employed.

- 1 A Solar Chimney
- 2 Solar collectors
- 3 Photo Voltaic arrays

- 4 Biomass or Waste to Energy
 - 5 Wind Turbines and
 - 6 Geo-Thermal Plant
- Plus a small Nuclear Power Plant.

The most obvious feature of the plan aerial view is a solar chimney where a 1 km radius array of reflectors directs the sun's rays to a tall chimney, heating it up and thereby ensuring wind speed at the base driving power-generating turbines in addition to providing domestic hot water.

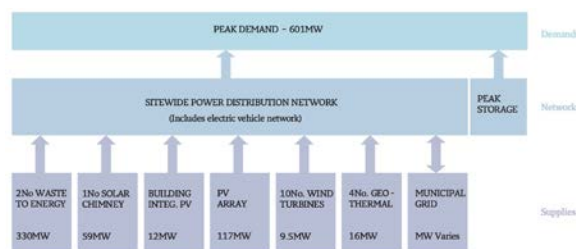


And the problem of car parking was addressed. There are to be no petrol-powered cars in the city and all cars that arrive at the outskirts are parked in deep silos at one or other of the four entrances. Residents of the city must then use public transport in the form of a rented electric car, an electric bus and electric light rail system is proposed – the latter being connected to the centre of Riyadh in the future. A logistic distribution system was evolved which also uses electric vehicles.

Buro Happold worked with the architectural team to supply the engineering solutions that would ensure the city will operate without petroleum. The proposed Nodal Split was – Private Hire Electric cars 20%, LRT 35%, BRT and bus 35% and walking/cycling 10%. This contrasts with the current situation in Riyadh where 89% of transport is by private car. The main transport entrances

to the new city were the locations for parking silos. Petrol driven cars are parked in one of the four silos at the entrances to the city. Cars are parked and retrieved automatically. An LRT system connects the principal entrances and the central concourse.

All waste is collected by a pneumatic waste system. 3,500 tonnes of waste is collected weekly and used for waste-to-energy. There is a 73% reduction in landfill. In simple terms 2 No. Waste to Energy plants produce 330 MW, One solar chimney produces 59 MW, Building Integrated Photo Voltaics produce 12 MW, PV Arrays produce 117 MW, 10 No. Wind Turbines produce 9.5 MW and 4 No. Geo Thermal plants produce 16 MW. The Peak Demand is 601 MW.



A small nuclear reactor is embedded in the research complex. The nuclear reactor is based on a similar reactor at Halden in Norway. But nuclear energy has not been counted in the calculation and is regarded as a bonus.

Water supply for the city comes from stored rainwater, recycled water and ground water. Careful management of water systems ensures that requirements will always be met.

The total construction cost of the city was estimated by Davis Langdon to be 193

Billion Saudi Riyals. The design team presented the masterplan at a three-day event in Riyadh. All twelve teams were able to witness the different solutions. It was a learning experience and LDY's methodology and solution was highly commended.

KA-CARE did not proceed. On 25 January 2011 President Mubarak of Egypt was deposed. In March 2011 the insurrection against President Assad's regime in Syria began and it continues to this day. On 20th October 2011 President Muammar Ghaddafi of Libya was captured at Sirte and executed. The whole Middle East imploded with the rise of ISIL (The Islamic State in Iraq and the Levant) and the invasion of Iraq culminating in the setting up of a caliphate in Mosel. The Saudi government turned their attention to other matters and KA-CARE was put on hold.

But the lessons learned are of global significance. The vital question is what will the world do when oil runs out? What plans are being made to live in a world without petrol? What will Malaysia do when there is no petrol to power cars. Some estimates suggest Malaysia has oil reserves that will last until 2040 (just 23 years).

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RED-YELLOW-GREEN-GREENEST BUILDING-THE TROPICAL ADAPTATION OF THE PASSIVE HOUSE APPROACH IN THE LIGHT OF GREEN CERTIFICATION

Professor Karl Wagner*

Business School, University of Kuala Lumpur, 1016 Jalan Sultan Ismail, 50250 Kuala Lumpur

*[*karlwagner@unikl.edu.my](mailto:karlwagner@unikl.edu.my)*

www.nzaar.com

Over the past decade, a high-tech developing country like Malaysia has become sensitive and proactive towards green solutions for the built environment which is responsible for slightly more than 1/3 of the country's greenhouse emissions. Based on the Paris Agreement, 2016 Malaysia has pledged to a 45% reduction in its greenhouse emissions by 2030, and cut 32 million tonnes of carbon emissions by 2020.

Malaysia, on the spearhead of the development in the region, can embark on viable environmental survival strategies to turn green ideas into practice. The so-called developed countries in the north, most of them with their energy potential being far more restricted, have already devised a wide variety of energy regulations and according renewable

technologies that might be adaptable to green & energy efficient buildings. This contribution focuses on the adaptation of the Energy Performance Certificate (EPC) deriving from the European Union and the implications for a tropical country. Derived from the Passive House design at its extreme green end, it comes up with a simple scientific colorful rainbow tool kit not only to measure the CO₂-emission. The speech sketches a case-study related staggered procedure how to save CO₂ according to the thermal comfort needs and affordability of its inhabitants. In its specifications, its distinctive elements and benefits compared to common certification tools will become visible, as the Tropical) EPC can go into a business model increasing the market value of real estates.

COOLING KL CITY AND WAY FORWARD

Nasrin Aghamohammadi*

Department of Social and Preventive Medicine, Faculty of Medicine, University of Malaya, Malaysia

*[*nasrin@um.edu.my](mailto:nasrin@um.edu.my)*

www.nzaar.com

Urban Heat Island (UHI) phenomenon and Seasonal Haze Episode (SHE) are two main challenges for Greater Kuala Lumpur (GKL). Recent studies and researches show new opportunities for the upcoming studies to evaluate the other unexplored factors of UHI and SHE in the local framework. Beside of assessing the influence of vegetation on urban temperature reduction, future studies need to be more focused on examining the feasibility of other remediation technologies in the context of GKL. Health effects of heat waves and toxic pollutants in haze are not well introduced to urban planner, stakeholder, governors and policy makers. By addressing such gap, this talk aimed to highlight the Knowledge, Attitude and

Practice (KAP) of the communities towards a greener better Kuala Lumpur by 2020 (Greater Kuala Lumpur Initiative under the National Key Economic Area-NKEA). This talk suggests that attention should be drawn to a systematic site characterization and inclusion of timely data to elucidate the current UHI magnitude for the land use changes in this region. The needs of public shall be the main concern to move towards KL as sustainable city by 2030. Lastly, the incorporation of UHI phenomena and SHE in local policies are also essential to mitigate their adverse impacts via more urban climate-friendly practices by urban planner, stakeholder, governors and policy makers.

EMBEDDING URBAN DESIGN VALUES IN AN ARCHITECTURAL DESIGN STUDIO

Anamika Mishra*

Abu Dhabi University

*anamish@gmail.com; anamika.mishra@adu.ac.ae

www.nzaar.com

Abstract

The global sustainability mandate has meant that built environment professionals are increasingly engaged with efforts to create a thriving future. Within the Arab Gulf, the discussion on sustainability has expanded to include urban design values of place-making, public realm and well-being. However, despite the inclusion of urban design as a course in architectural curricula, most students continue to demonstrate a heightened focus on the design object with relatively lesser regard to its role in place-making and creation of sustainable environments. This paper documents the experience of a mid-level architectural design studio in Abu Dhabi, wherein specific efforts were taken to embed urban design thinking within the design studio through site selection, development of design brief and other aspects of the design process, adopted towards this aim. Patterns in student responses, practical teaching strategies, student designs and post-course reflections are also discussed with a view to optimize the outcomes of studio teaching.

Keywords: Design Studio, Urban Design, Architectural Education

1. Introduction

As societies across the globe, endeavour towards a low carbon footprint and sustainable development, built environment professionals find themselves with increased responsibility towards this mandate. The recent past has seen several Arab Gulf cities develop Vision documents with a strong focus on sustainability. The discussion and research on sustainable design has progressed to include urban design values of place-making, public realm and well-being and built environment professionals are expected to be responsive towards these. However, student designs continue to indicate a pattern where greater attention is provided to the design object as opposed to the design process. The role that the design object plays in place-making and prospective sustainable development of the context assumes a lesser significance. While this pattern may be influenced partly by the architectural icons which dominate the media and landscapes of the Arab Gulf, design education, and the manner in which is imparted, also play an instrumental role. The site selection, choice of building typology, development of design program,

formulation of submission requirements and structuring the design process carry several messages and are critical to informing the students' value system. Various patterns in student preconceptions, reactions and teaching attitudes that are common in architectural design studios may present potential barriers to effective integration of urban design thinking.

Mounting pressures to cover course content in architectural curricula, limitations of time and other resources along with students' keen focus on high grades creates a tendency to insulate design education from the context. The high premium on the final design product and the centering of the design process around the student designer encourages the production of signature styles. Hence various aspects of design education contribute towards a disconnect with urban design thinking.

Since architectural education is tasked with the aim of preparing architects for the changing needs of the profession, there appears to be a scope for introducing modified strategies in design studio

teaching. Guided by this aim and informed by previous experiences in teaching design studios, the author had the opportunity to explore strategies to embed urban design values in a mid-level architectural design studio at a University in Abu Dhabi, UAE. This paper documents and reflects on this experience.

2. Literature Review

This section reviews salient themes regarding architectural design education, shortcomings and areas for improvement. Bandini (1997)ⁱ discusses the education of an architect and how the manner in which it is taught, distances itself from the people. Jarett (2005)ⁱⁱ summarizes various 'blind spots' in the design studio caused by isolation of the design programme. These blind spots lead to studio seclusion, propagate abstraction, reinforce the production of signature objects and detach the student from the context. He further describes the example of a studio (LASS Project), where efforts were taken to engage with the city.

Morrow (2005)ⁱⁱⁱ advocates for more inclusive design and identifies the barriers to the mainstream adoption of inclusive design as choice of sites, design programmes, representation of spatial experiences, complacency in understanding implicit role of users in the design and misunderstanding the importance of analysis and its relation to design.

Frampton (1991)^{iv} discusses the preoccupation with new and exotic as a prevalent theme in design studios which gains precedence over everyday issues. The 'abstract way of thinking and a media-oriented justification for any type of design' is also a subject for discussion by Salingaros and Masden (2010)^v.

Tenbrink et al (2006)^{vi} discuss the user perspective and suggest various ways in which architects may consider it (participatory design, role play, providing

rich and detailed descriptions of an idealized user, observation and ethnographic research and the reliance on cognitive walkthroughs). Till (2009)^{vii} discusses the relation of architecture with the real world and how architects consider the user as an intrusion / contaminant corrupting the pure designed environment. Salama (2009)^{viii} discusses the need to integrate creativity and social responsibility and also presents international paradigmatic trends on Arab architectural education and highlights contextual issues in education and pedagogy in the Arab world.

3. Studio Methodology

This studio was a part of the Bachelors in Architecture program at a University in Abu Dhabi, UAE, offered in the fall of 2016 as a mid-level studio. Informed by key themes that emerged from the review of literature and with experiences from having taught the same design studio in the past, key objectives were identified to encourage a more context-sensitive approach to design which integrated urban design thought.

These objectives were addressed through adaptations in the following areas: Selection of building type, Site selection, Development of the program and the Design Process.

4. Discussion & Conclusion

Key exercises introduced in each of the four areas identified for adaptations in studio methodology were documented, along with student responses and evidence of learning. Key findings from the studio experience and post-course reflections have been discussed under various themes.

- Student reactions to fish market as a building typology
- Avoiding abstraction by reinforcing student engagement with the design problem
- Flexibility in interpreting requirements and developing the program

- Alternative methods of representation

While many other opportunities (role-play, user participation in pin-ups, possibility of considering adaptive reuse) could not be explored due to paucity of time, these small incremental changes supported many positive outcomes. Student designs showed a wide diversity in design approaches with a greater awareness and discussion of the role of the design in the larger context. The process of design development also

demonstrated enhanced responsiveness of user requirements and activities.

Studio teaching plays an instrumental part in the pedagogy of architectural education. At the same time, it is frequently seen as the most expensive and least understood component of architectural education. The benefits of studio teaching need to be optimized in order to prepare students as future professionals who can better serve the sustainability agenda.

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PERCEPTION ON SCENIC BEAUTY OF TROPICAL RECREATIONAL FORESTS

Mohd Kher Bin Hussein*, Mohd Nazri Bin Saidon & Suhardi Bin Maulan

Department of Landscape Architecture, Faculty of Design and Architecture, Universiti Putra Malaysia,
43400 UPM Serdang, Selangor, Malaysia

[*mohdkher@upm.edu.my](mailto:mohdkher@upm.edu.my)

www.nzaar.com

Abstract

The landscape beauty of a recreational forest refers to its landform and geology; plants and animals; the historic and other cultural heritage as well as the design incorporated to enhance forest beauty. Beauty is the quality that gives pleasure to the mind and it relates to the harmony of forms, colors, textures, artistic excellence, truthfulness, and originality. Beauty is the main category in aesthetics as it is the quality which gives pleasure to the senses. People can experience and appreciate landscape beauties from recreational forest. The recreational forests in Peninsular Malaysia received many visitations from local and international visitors who seek to find landscape beauty in them. Recreational forests provide outdoor activities and scenic views for people to enjoy. However, human interference in a recreational forest can affect the landscape beauty and lead to scenic degradation. Managing the beauty of recreational forest is essential for quality outdoor experiences and their sustainability. The aim of this study is to understand the importance of landscape beauty for outdoor activities in Peninsular Malaysia's tropical recreational forest. The main objective of this study is to examine people's perception towards the landscape beauty of tropical recreational forest. Two recreational forest sites were selected for this study. They are Sungai Chongkak Recreational Forest and Ampang Recreational Forest located in Selangor. The results show that both parks still maintain the existing natural landscapes in a pristine condition that enhances their beauty. However, urgent action needs to be taken on the matter of maintenance and cleanliness aspects. A comprehensive management plan in these sites is vital and should be aware of the main factors that cause degradation of natural landscape beauty.

Keywords: Landscape Beauty, Landscape Architecture, Recreational Forest, Outdoor Activity

1. Introduction

A recreational forest is an area designated for visitors' pleasure in the natural environment. It is a place for recreational activities such as jogging, jungle tracking, camping and other activities as well as providing opportunities for visitors to enjoy and experience the beauty of the forest environment [21]. Beauty is the quality that gives pleasure to the mind or senses that relates to harmony of forms, color, artistic excellence, truthfulness, and originality [26]. Beauty also is the main category in aesthetics as it is the quality which gives pleasure to the senses [28].

Recreational forests in Peninsular Malaysia have been designated for public recreational uses since the First Malaysian Plan [23]. In pursuant to the National Forestry Act, these forests are continuously being developed in each of the five-year Malaysia Plan (Table 1) [12]. The goals of their establishment are

to provide places for the public to relax and carry out outdoor family or group activities; to create awareness among the public on the importance of maintaining the environment for better life; to enhance individual performance and to escape from the stress of work and busy city life; to provide opportunities for the public to explore forest areas and enjoy its natural beauty; to function as open laboratories for conducting research and education; and as ecotourism attractions for additional revenue to the Country [8]. Currently, there are 125 recreational forests that had been established in Peninsular Malaysia [16] (See Table 1).

Table1: Number of Recreational Forests in Peninsular Malaysia

Malaysia Plan	Year	Recreational Forests Developed
First	1966 – 1970	3
Second	1971 – 1975	1
Third	1976 – 1980	14
Fourth	1981 – 1985	28
Fifth	1986 – 1990	27
Sixth	1991 – 1995	22
Seventh	1996 – 2000	19
Eight	2001 – 2005	7
Ninth	2006 – 2010	4
Total		125

Source: Forestry Statistics Peninsular Malaysia, 2007

Recreational forests are unique and rich with natural resources that contribute to their own beauty. It has spectacular natural features such as mountains, rivers, waterfalls, water catchments, reservoirs, lakes, islands, coastal areas, mangroves, and hot springs [15]. It is also rich in plant and wildlife diversity. It is estimated that there are 2500 species of trees, 200 species of mammals, 600 species of birds, 110 species of snakes, 80 species of lizards and thousands of insects in these forests [8]. These resources have attracted visitors to come seeking to renew or heighten physical, mental and spiritual experiences as well as for outdoor activities such as for relaxing, education and health [1]. Therefore, there is a need to protect these resources to prevent them from being damaged leading to loss of recreation opportunities for the people.

The scenic beauty of recreational forests has attracted many people to spend their leisure time by carrying out passive activities such as sightseeing and visiting scenic attractions in the forest. At the same time forest also provides fresh air, peace and quiet, and ambience conducive in promoting physical and psychological regeneration. Being outside in a green space such as forests can promote mental well-being, relieve stress, overcome isolation, improve social cohesion, and alleviate physical problems [2]. A classic study carried out by [30] for people experiencing anxiety or stress,

revealed that exposure to an outdoor green environment reduces stress faster than anything else due to exposure to viewing nature. The study found that significant recovery or restoration from stress can be achieved within three to five minutes of viewing nature.

Forests landscape beauty is also important to the tourism industry. Thus, appropriate landscape management practices must be adopted in order to maintain the visual attractiveness of these natural forest areas [13]. Recreational forest management needs to focus on preserving and caring the landscape beauty of the forest where people are likely to use them. At the same time they also must provide for different types of enjoyment; from walking and jogging to bird-watching and environmental education. On the other hand, man-made elements such as shelters, benches, and picnic tables must be in visual harmony with the existing forest environment.

2. Recreational Forest Landscape Beauty and Outdoor Activities

Malaysia defined recreational forest as an area in Permanent Forest Estate used for leisure, sports, research activities, and education as well as for conserving flora and fauna [15]. These forests serve as areas for urban dwellers to escape from the hectic and stressful city life [8]. These forests are also equipped with constructed facilities to attract visitors [33].

The beauty of tropical recreational forest landscape depends on their natural assets. These include vegetation, soil, topography/landform, geology, fauna and water bodies. Furthermore, man-made elements such as bridges, litter bin, walkways, and shelters also contribute to provide convenience as well as in many cases enhance the forests' landscape beauty. Natural asset and man-made elements need to be in harmony with one another to maintain the quality of landscape

beauty and the visual attractiveness of these special forests.

Vegetation found in tropical recreational forests are diverse depending on their location and site characteristics such as altitude. For instance, forest floor of montane ericaceous forest (above 1,500 meters altitude) are mostly dominated by species from the Ericacea family while lowland Dipterocarp forest are dominated by Meranti and Balau (*Shorea* spp.) and Kapur trees (*Dryobalanops aromatic*). In mangrove recreational forest areas, *Rhizophora* spp with their unique root system known as stilt roots and pneumatophores as well as thick leaf structures dominates the area. The diverse vegetation found in the recreational forests provide interesting opportunities for nature-based outdoor activities such as nature study, camping, and conservation work. These forests are kept in their pristine conditions and provide a resource for people to enjoy natural beauty and serenity.

Landforms also contribute to landscape beauty of recreational forests. Landform can influence the observer in how they visually enjoy recreational forests. When viewing a landscape the eye tends to look around a scene and this applies, in particular, where landform is the dominant landscape influence [10]. Wonderful features such as waterfalls and mountainous terrain become attractions that contribute to make recreational forests interesting and enjoyable. Besides visual appreciation, the uneven terrain provides them with challenging experiences such as mountain biking, mountain climbing and hiking.

Geological features such as limestone and rock outcrops (granitic rock and megacrystic granite) displaying varied textures also attract public to the recreational forests. Water flows on the hard geological surface of granite rocks and falls from the hills and rapids make the landscape in recreational forest very

attractive. Waterfalls are very popular in recreational forest for bathing and swimming [20]. Caves found in hilly areas also provide opportunities for people to enjoy. This is seen in the case of Bukit Kubu Recreational Forest in the northern state of Perlis. These nature's gifts are priceless and require special care and attention from everyone because they tell the story of the earth's formation.

Water elements such as rivers, streams, waterfalls, and lakes increased the beauty of recreational forests. According to [14] the attractiveness of forest landscape is influenced not only by the number but primarily by the character of watercourses and water reservoirs. According to Smoleński 2007 as cited in [14], large diversity of ecotypes that determine watercourses as natural corridors and water reservoirs are visually one of the most attractive elements of forest landscape. This diversity also means contrasts in the natural landscape that, according to many authors, is an important criterion in choosing a place for recreation. Therefore, the most preferred places for forest recreation are places located near watercourses and water reservoirs [14]. Consequently, the quality of the water in recreational forests needs to be preserved.

Finally, the variety of wildlife in the recreational forest area has provided enjoyment to forest recreationists. Their activities include observing wildlife, participating in outdoor activities such as bird watching, insect collecting, photography, hunting and fishing [31]. Among the insects that can be found in recreational forest are dragonflies' such as *Orchithemis pulcherrima* and *Neurothemis fluctuans* [32]. It was recorded that 107 Odonata species were documented from Terengganu [4]. They can be found along the habitat permanent gradient ranging from permanent running waters and lakes to small temporary rain pools [5]. Forest mammals such as monkeys, otters, deer,

rodents and rabbits are the most recognized of these wildlife. Meanwhile birds add color, movement and sound to the forest and play crucial roles in the forest ecosystem by dispersing seeds, pollinating plants, and by eating insects and rodents [31].

3. Managing Recreational Forest Landscape Beauty

Forest landscapes are fragile and can be disturbed by human activities. Therefore, any development within these forests needs to consider its impact on the beauty of the forest. This is because those who visit forests for recreation often forms perceptions of a place based on what they see and experience from an aesthetic point of view [11]. He asserted that scenic resource management has become an important part of managing forests for multiple values and protecting the landscape beauty. Scenic resources are those landscape patterns and features that are visually pleasing, including, but not limited to trees, rock outcroppings, and historic buildings that contribute to landscape beauty. Therefore, a proper management of the beauty of recreational forest are vital to ensure their sustainability. These include natural resources, facility design, site-planning and forest maintenance.

The beauty of recreational forest was believed to depend on their natural resources. Forest vegetation must be kept well and maintained as naturally as possible. This is to ensure that the vegetation growing on and around the recreational forest park are desirable and that they provide the features expected as well as they can be sustained well into the future. An organized plan to replace lost trees must be carried out to avoid environmental degradation and reduce the area's functionality and attractiveness. [29] suggested that good management and maintenance can adapt landscapes to keep pace with evolving human needs and demands.

Forest landscape beauty can be managed also in through design. It can be done when the design of facilities and other human made elements, for instance picnic table and buildings, are designed harmoniously into the forest landscape. These will cause minimum impact and will not compete with or dominate natural park features. The facilities also need to be visually pleasing in their simplicity through proper forms, colors, and materials. Properly designed facilities that harmonize well with the forest surroundings is one of the main reasons for visitors to choose spending their recreation and vacation time in or near forest recreation areas. Properly designed forest facilities can provide positive experiences and encourage revisits. Design must also take into account other issues such as landscape degradation, preservation of natural processes, and protection of biological diversity [34].

The beauty of recreational forest can also be managed with good planning. Proper planning should include the formulating of good landscape master plans and resource management plans. Recreational forest planning should involve experts in landscape architecture, forestry, wildlife management, and other relevant experts. Management actions must be consistent with the ecological capability of the forest, optimizing forest health, and maintaining or enhancing the recreational, aesthetic, and other social aspects of the area. At the same time, the health of local communities must be sustained so as to provide economic, social, and ecological benefits to present and future generations.

Meanwhile forest site planning should recognize the intrinsic character and beauty of the site and they must be included in the strategic policies for the conservation and enhancement of the natural environment including landscapes. Landscape character assessments should be prepared to help understand the character and local distinctiveness of the landscape and identify

the features that give it a characteristic sense of place. All planning policies and decisions should be based on most current principles and information about the natural environment and other characteristics of the area.

Forest landscape maintenance plays an important role in keeping the beauty of the recreational forest and their sustainability in the future. Proper landscape maintenance can enhance park's quality as well as increase user experiences. Appropriate and detailed landscape maintenance can enhance the beauty of the landscape; reduce environmental destruction, increase quality of life, and enhance users' experiences. Users are more sensitive towards improper landscape maintenance in recreational forests, especially when it relates to landscape beauty and the quality of life. It is essential to have proper recreational forest landscape maintenance and management system with well-defined goals and objectives in order to achieve quality recreational forest landscape [25].

Thus, the aim of this study is to understand the importance of landscape beauty for outdoor activities in recreational forests. The objective of this study is to understand landscape architecture students' perceptions towards landscape beauty of recreational forest. Two recreational forest sites were selected for this study. Both Sungai Chongkak Recreational Forest and Ampang Recreational Forest are popular forest recreation destinations located in Selangor, Peninsular Malaysia (Figure 1). Both parks are popular for outdoor activities of Klang Valley residents as well as tourist attractions.

4. Research Methods

This study is divided into two stages. The first stage is based on systematic

observation of the study sites. The second stage is a survey using a photo-questionnaire with photographs as surrogates of the actual environment. Final and third year students studying landscape architecture (BLA) in Universiti Putra Malaysia volunteered as respondents for the study. They were selected because they have been exposed to evaluating and understanding landscapes. They were trained to observe and judge specific landscape attributes based on the principles of art, design, resource management, and ecology.

4.1. Site observation

A systematic observation was carried out to observe, record, and analyse landscape features within these two parks. The observation was done by going round the park and looking at the overall existing physical condition of the environment; the landscape (natural and man-made), natural settings, facilities, buildings, and environmental conditions (degradation, pollution, etc.). During this observation, photographs were taken in order to record the beauty and the elements of the park. The elements recorded were natural landscapes including flora, water bodies (river/stream), and man-made landscape elements such as buildings, park furniture, parking facilities, pedestrian facilities, drainage, and signage. Any environmental impact on the site was also recorded to get clear pictures relating to the destruction of the beauty of the sites. Table 2 presents the sample of the photographs, while Table 3 groups the landscape beauty variables into the five beauty parameters.

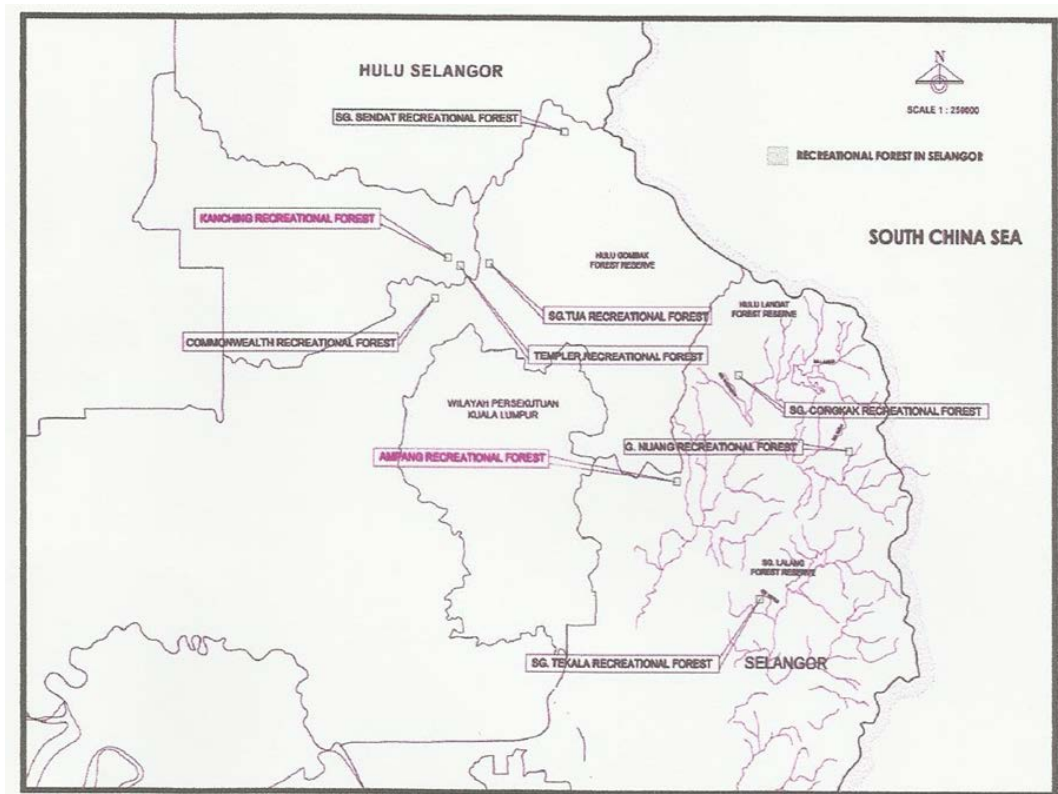


Figure 1 Location of Sg. Chongkak and Ampang Recreational Forests

Table 2 Sample Photographs of Scenes Classified into 5 Beauty Parameters

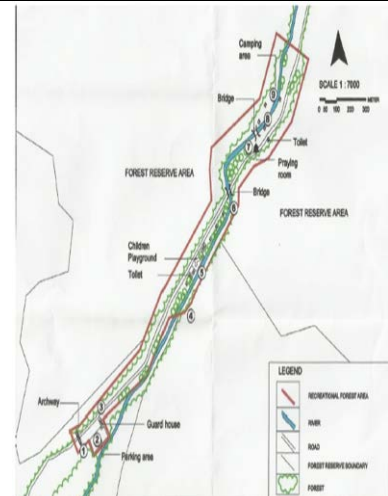
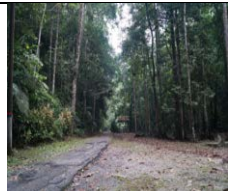
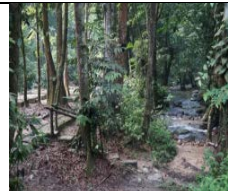
1. Natural Landscape				
				
Vegetation	Soil	Topography	Geology	Water
2. Design				
				
Building	Playground	Shelter	Bridge	Lamp post
3. Planning				
 Layout of Sungai Chongkak Recreational Forest		 Layout of Ampang Recreational Forest		
				
Respect to nature – scale/size	Respect to nature – location	Respect to nature – color	Respect to nature – form/shape	Respect to nature – material
4. Maintenance				
				
Vegetations	Barbeque grill	Camp site	Pergola	Signboard
5. Cleanliness				
				
The dry leaves swept	Road surface	Grass cutting	Pathway cleanliness	Water quality

Table 3 Landscape Beauty Parameters

Landscape Beauty Parameters	Variables
Natural Landscapes	Vegetation, Soil, Topography, Geology and Water
Design	Facility and Accommodation
Planning	Layout and Respect to nature
Maintenance	Natural elements and man-made elements
Cleanliness	Site condition

4.2. Photo-questionnaire survey

The questionnaire is divided into four sections. These are personal particulars, landscape beauty managing score, opinion and, degradation implications of landscape attributes to outdoor activities. Personal particulars are needed for respondent's background data. To know how student perceive the landscape beauty that enhances outdoor activities in the recreational forest, a set of photographs representing the beauty aspects natural landscapes (vegetation, soil, topography, geology, water), facilities (benches, toilets, wakafs, etc.,) and site layout and maintenance were collected and presented to them. A Likert scale (5 = very good; 4 = good; 3 = normal; 2 = bad; 1 = very bad) were used to measure respondents' perception. The photographs were taken from the study site during a fieldwork on existing conditions. All photographs were taken using a digital camera with a lens set on 50 mm, horizontal view, and proper angle (balance, depth, focus and panoramic). All photographs were taken at the eye level. The resulting photo-collection was reviewed to remove poor quality and inappropriate photographs.

The questionnaire also attempted to elicit degradation implications of landscape attributes on outdoor activities in the parks if the management fails to manage the park properly. A Likert scale (5 = very high; 4 = high; 3 = moderate; 2 = low; and 1 = very low) was used to measure respondents' perception towards this implication.

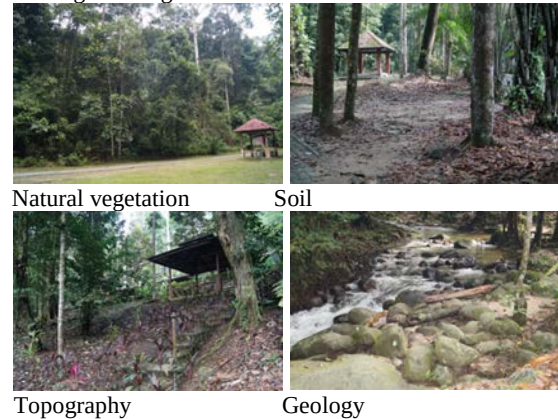
5. Analysis & Results

5.1 Site Observation

Sungai Chongkak Recreational Forest and Ampang Recreational Forest still maintain the existing natural landscapes in a pristine

condition that enhances their beauty (Figure 2: A,B).

A: Sungai Chongkak Recreational Forest



B: Ampang Recreational Forest

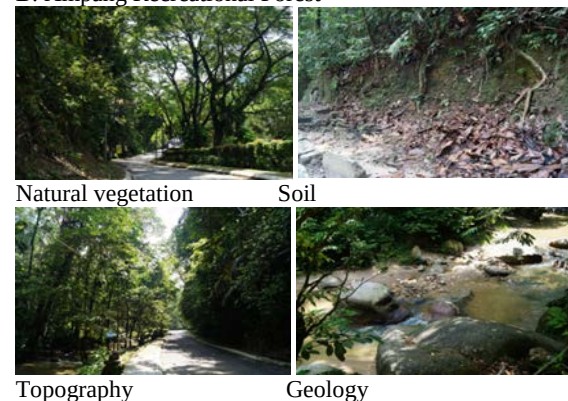


Figure 2(A, B): Both parks Maintained Existing Natural Landscape that Enhances Their Beauty

Both sites still have large and tall trees and thick enough of a lowland and hill dipterocarp forests to shade the users from the sun. There was no serious soil degradation such as compaction and erosion seen on both sites. The managements of both parks also keep existing geological features such as hard sandstone and granite in the original states. The geological element contributed to the park beauty and attracts public to the parks. Furthermore, the water is clean and flows on hard granite

rocks and makes the water features in both recreational forests still very attractive. A study carried out by [19] also agrees that the water of Sungai Chongkak (Chongkak River) is clean and suitable for recreation. Meanwhile, [22] reported that the water of Ampang Recreational Forest is also clean.

During the observation, it was noticed that Ampang Recreational Forest did not provide accommodation such as chalets for visitors to stay overnight unlike the Sungai Chongkak Recreational Forest. The design of accommodations in Sungai Chongkak is categorized as harmonious with the surrounding environment and did not degrade the park beauty. In terms of facilities, both recreational forests parks provide basic facilities such as bridges, pedestrian walkways, toilets, and playgrounds. Those facilities have been designed to integrate with the existing environment and help in conserving the beauty of both parks.

Both recreational forests have linear layouts where their facilities and accommodations are constructed along a river or stream. These facilities have been built close to water sources that give convenience to the user. There are no cut and fill work applied during construction. This shows that the management of both recreational forests consciously protects and preserves existing sites' topography. These enhance the beauty of the parks and increased their visual quality.

A neat and tidy recreational park is very important in augmenting park beauty. Both parks suffer from less than satisfactory maintenance, especially for man-made elements such as gazebos, toilets, playgrounds, bridges, pedestrian walkways and other structures. Many of these structures were in bad conditions that reduced the parks' beauty (Figure 3). Some of the structures require repainting and parts replacement such as screws for playgrounds. However, in terms of

cleanliness both parks were reasonably cleaned.

A: Sungai Chongkak Recreational Forest



Barbeque

Shelter



Signboard

Building

B: Ampang Recreational Forest



Shelter

Bridge



Pergola

Children playground

Figure 3(A, B): Both Parks Need Priority on Maintenance Aspects

5.2 Landscape Beauty of Recreational Forest

A total of 52 respondents took part in this study. All of them were from the landscape architecture program in Universiti Putra Malaysia's Serdang Campus. The demographic breakdown is as shown in Table 4. There were more or less equal number of male (46.2%) and female (53.8%) respondents and most (86.5%) were in the 22-24 age group. The ethnic backgrounds of the respondents were Malay (75%), Chinese (15.4%), Indian (3.8%) and other ethnic groups (5.8%).

Photographs of existing recreational forest scenes were used as stimulus materials to gauge respondents' perceptions towards the sites landscape beauty for outdoor

activities. There were 69 photographs chosen and used in this photo-questionnaire survey (39 photographs of Sungai Chongkak Recreational Forest and 30 photographs of Ampang Recreational Forest). These images depict Natural-looking Settings (27 photographs), Design Elements (14 photographs), and Maintenance Aspects (14 photographs). The layout plans of the study sites representing Site Planning were also attached to the survey instrument.

Table 4 Respondents Background

Respondents	Total	Percentage (%)
Gender:		
Male	24	46.2
Female	28	53.8
Age (year):		
19 - 21	1	1.9
22 - 24	45	86.5

	25 - 27	6	11.5
Ethnic:			
Malay	39		75.0
Chinese	8		15.4
Indian	2		3.8
Others	3		5.8

Table 5 shows respondents perception of the attributes of landscape beauty of the study sites. Half of the respondents (50%) perceived the vegetation in Sungai Chongkak as normal while more than half (57.7%) thought that the vegetation in Ampang as good. They rated the soil in Sungai Chongkak and Ampang as normal (Sungai Chongkak 63.5% and Ampang 55.8%). And for the topography of the sites, respondents rated both as in good conditions (Sungai Chongkak 44.2% and Ampang 50%). The geology found on the sites was found to be normal for both

TABLE 5 Perceptions towards Landscape Beauty of Recreational Forest for Outdoor Activities in Sungai Chongkak and Ampang Recreational Forests

Subject	Very Good		Good		Normal		Bad		Very bad		Mean Score	Std. Deviation
	Total	%	Total	%	Total	%	Total	%	Total	%		
Sg. Chongkak Recreational Forest												
Natural Landscapes: Vegetation	1	1.9	20	38.5	26	50.0	5	9.6	-	-	3.33	0.68
Soil	-	-	13	25.0	33	63.5	6	11.5	-	-	3.13	0.60
Topography	2	3.8	21	40.4	23	44.2	6	11.5	-	-	3.37	0.74
Geology	2	3.8	21	40.4	29	55.8	-	-	-	-	3.48	0.58
Water	3	5.8	26	50.0	19	36.5	4	7.7	-	-	3.54	0.73
Design: Facility	-	-	10	19.2	24	46.2	18	34.6	-	-	2.85	0.73
Accommodation	-	-	10	19.2	32	61.5	10	19.2	-	-	3.00	0.63
Planning: Layout	1	1.9	18	34.6	25	48.1	8	15.4	-	-	3.23	0.73
Respect to nature	1	1.9	23	44.2	23	44.2	4	7.7	1	1.9	3.37	0.74
Maintenance: Natural elements	1	1.9	12	23.1	27	51.9	12	23.1	-	-	3.04	0.74
Manmade elements	-	-	9	17.3	32	61.5	10	19.2	1	1.9	2.94	0.67
Cleanliness	-	-	9	17.3	27	51.9	15	28.8	1	1.9	2.85	0.72
Ampang Recreational Forest												
Natural Landscapes: Vegetation	2	3.8	30	57.7	18	34.6	2	3.8	-	-	3.62	0.63
Soil	2	3.8	15	28.8	29	55.8	6	11.5	-	-	3.25	0.71
Topography	1	1.9	18	34.6	26	50.0	7	13.5	-	-	3.25	0.71
Geology	2	3.8	19	36.5	25	48.1	6	11.5	-	-	3.33	0.73
Water	1	1.9	20	38.5	22	42.3	9	17.3	-	-	3.25	0.76
Design: Facility	1	1.9	20	38.5	27	51.9	4	7.7	-	-	3.38	0.65
Accommodation	-	-	-	-	-	-	-	-	-	-	-	-
Planning: Layout	-	-	23	42.3	28	53.8	2	3.8	-	-	3.38	0.57
Respect to nature	-	-	24	46.2	22	42.3	6	11.5	-	-	3.35	0.68
Maintenance: Natural elements	2	3.8	20	38.5	26	50.0	4	7.7	-	-	3.38	0.69
Manmade elements	1	1.9	19	36.5	25	48.1	7	13.5	-	-	3.27	0.72
Cleanliness	-	-	28	53.8	19	36.5	3	5.8	2	3.8	3.40	0.77

Sungai Chongkak (55.8%) and Ampang (48.1%). With regards to water quality, respondents felt that Sungai Chongkak water was of good quality (50%) as

compared to water found in Ampang which they rated as only normal (42.3%).

These can be taken to indicate that the park management had put good efforts in maintaining the natural landscape's

beauty of both sites. Both sites have clear and clean water quality. Many of their natural settings (including plants, animals, insects, etc.) were retained in good condition as captured by many of the images presented to the respondents. The positive perception of the respondents might have been influenced by the richness, diversity and variety of the vegetation as well as the existence of water that they can see in the given photographs.

The design aspects of facilities (including accommodation) were also being perceived as normal (Sungai Chongkak 46.2%; Ampang 51.9%) by the respondents. This result may indicate that the design of these facilities is well integrated with the surrounding natural features. This contributes to give aesthetically pleasurable experiences to users and compliment the sites' beauty. As for the parks' layout plans, respondents perceived them as normal settings (Sungai Chongkak 48.1% and Ampang 53.8%) and have respect for nature (Sungai Chongkak 44.2% and Ampang 42.3%).

However, with regards to site maintenance and cleanliness, only half of the respondents perceived them to be under normal condition for natural elements (Sungai Chongkak 51.9%; Ampang 50.0%) and human-made elements (Sungai Chongkak 61.5% and Ampang 48.1%). Half of the respondents also perceived cleanliness as normal for Sungai Chongkak (51.9%) and good for Ampang (53.8%). Urgent action needs to be taken by the management on this matter because this situation can adversely affect users' experiences and affect their overall experiences of the parks [17; 7].

The overall results portray the efficiency of management planning [17]. On the other hand, the management of the park need to be aware that the number of respondents perceived the park environment as beautiful is less than 60%. This means that the current

park environments need careful planning and management in the future in order to protect the park beauty. These areas are sufficiently sensitive to visual alteration to warrant special consideration in the strategic and operational training. Otherwise, the park beauty will be degraded and people will not revisit the parks.

5.3 Implications of Landscape Beauty Attributes Degradation to Outdoor Activities

Table 6 shows respondents' perception on the implications faced by the parks if the beauty aspect is being ignored. Most of them perceived that it will give a moderate impact on user satisfaction (59.6%). This is the result of the interaction between a respondent experience and the expectation he/she has about Sungai Chongkak and Ampang recreational parks. This also indicate that visitor satisfaction has close relationships to natural and environmental friendliness of forests recreation parks as noted in other studies [27; 24; 3].

Table 6 shows respondent perceptions on the implications of landscape beauty attributes degradation on outdoor activities in the parks. Most of the respondents (57.7%) perceived that the degradation to the attributes will reduce decrease the visual quality and the number of users. The other half of them perceived that it will increase travel difficulty, reduce user experience and increased restoration costs (55.8%). Half of them also perceived that it will degrade the aesthetics value of the park and users will feel unsafe (53.8%). However, only half (50%) of the respondents perceived that it will give a high impact on user mood. These results have similarity with the findings of [18] study on users' perception towards selected recreational forest landscape maintenance in Selangor, Malaysia. This situation arises because maintenance is highly correlated with maintaining the high quality of landscape beauty. Thus, it is clearly seen from the results obtained that landscapes beauty evidently matter to

people and shape their everyday experiences, social interactions, wellbeing, and quality of life.

TABLE 6 Effects of Degradation of landscape Attributes on Outdoor Activities

Subject	Very High		High		Moderate		Low		Very Low		Mean Score	Std. Deviation
	Total	%	Total	%	Total	%	Total	%	Total	%		
Reduce user satisfaction	1	1.9	17	32.7	31	59.6	3	5.8	-	-	3.31	0.61
Change user mood	5	9.6	26	50.0	21	40.4	-	-	-	-	3.69	0.64
Reduce in number of user	-	-	20	38.5	30	57.7	2	3.8	-	-	3.35	0.56
Users feel unsafe	3	5.8	15	28.8	28	53.8	6	11.5	-	-	3.29	0.75
Decrease visual quality	1	1.9	19	36.5	30	57.7	2	3.8	-	-	3.37	0.60
Reduce user experience	1	1.9	19	36.5	29	55.8	3	5.8	-	-	3.35	0.62
Increased travel difficulty	-	-	20	38.5	29	55.8	3	5.8	-	-	3.33	0.59
Degraded aesthetics	2	3.8	18	34.6	28	53.8	4	7.7	-	-	3.35	0.68
Increased restoration costs	1	1.9	19	36.5	29	55.8	3	5.8	-	-	3.35	0.62

6. Conclusion

Managing the beauty of recreational forest is a very important issue. The efforts should be geared towards appreciating beauty and aesthetic values, architecture, and the overall ecology of forest recreation parks. Furthermore, park management should ensure that the high quality beauty of these parks, are maintained to give great pleasure to both users and tourists. At the same time the efforts also contribute to protect landscape resources as the nation's valuable heritage for the present and future generations.

Natural landscapes are important resources for people. Thus, park managements need to reduce impacts on the resources while at the same time providing quality outdoor recreation opportunities to visitors so that they can have quality outdoor recreation experiences in the park. Managing and keeping recreational forest beautiful will bring environmental, social, and economic benefits. Comprehensive management plan for these sites are vital and should be sensitive to the main factors that contribute to the degradation of natural landscape beauty.

Recreational forest landscape beauty plays an important role in providing good experiences to users when they do outdoor activities in the park. Therefore, it is important to conserve and preserve the existing physical characteristics of the

recreational forests so that they can offer benefits such as escape from busy city life, meditation, education, etc. for those who are currently in need of them and also for future generations. It is also important to have recreational forests that provide harmonize facilities and accommodation with the existing forest environment so that it can enhance the park beauty and convenience to the users. Indirectly, this can enrich their quality of life and wellbeing.

It is suggested that the Peninsular Malaysia Forestry Department creates more recreational forests near to residential areas in urban settings that can provide outdoor activities to the urban populations. Forest managers need to manage, plan and conserve the beauty of recreational forests in providing a positive outdoor activity experiences such as nature learning and jungle trekking.

This study, however, is limited to a small number of respondents who were students of landscape architecture. It is suggested that a similar study be extended to landscape architecture professionals to understand their perception of recreational forest landscape beauty.

7. Acknowledgement

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of recreational forest for outdoor activity in Peninsular Malaysia carried out in June 2016.

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A SWOT ANALYSIS OF RESPONSIVE SHADING SYSTEMS WITH UMBRELLA CONCEPTS

Naglaa Megahed*

Architecture and Urban Planning Department, Port Said, Egypt.

[*Naglaaali257@hotmail.com](mailto:Naglaaali257@hotmail.com)

www.nzaar.com

Abstract

The aim of this research is to analyze and to explore the responsive components, mechanism, and design parameters of responsive shading systems associated with umbrella concepts. In this context, a SWOT analysis has been carried out to identify situational strengths and weaknesses, as well as broader opportunities and threats, which hoped to generate further discussion about the prospects of responsive umbrella-like structure.

Keywords: Mechanism; Responsive; Sustainable; SWOT Analysis; Umbrella

1. Introduction

In the context of rapid technology development, solutions for responsive facades can offer more flexible architectural solutions providing better use of natural light and contributing to saving energy. This kind of thinking is deeply embedded in various sustainability rating systems [1, 2]. In this context, the buildings envelopes became the locus of technological innovations, in which buildings are increasingly supported by the application of sensors and actuators as well as the mechanisms that control and activate an intelligent response to the physical environment and to a different pattern of use [3-5].

This could theoretically be buildings envelopes consisting of movable systems that respond automatically to various conditions. The purposes of these systems vary, as do the technologies adopted and the motivations of exploration. Therefore, if we accept that sustainable design is one of the main necessities in today's architecture, this paper investigates how this issue can be properly responded by use of responsive systems. However, responsiveness as a general approach can be achieved at different scales. To limit this broad scope, the paper explores the potential of

responsive shading systems with umbrella concepts to create a form of architecture that responds and adjusts itself to its occupancy and the environment. While responsive shading system is successful in capturing the core of recent research practices, it does not provide us with details needed to understand the situational strengths and weaknesses, as well as broader opportunities and threats associated with these emerging classes of building. In this context, this paper investigates this knowledge gap by applying a SWOT analysis, which hoped to generate further discussion about the prospects for responsive umbrella-like structures.

2. Background Research

The earliest thought of responsive architecture was born in the late 1960s. In the mid-70s, the term 'responsive architecture' was coined by Nicholas Negroponte when spatial design issues were beginning to be explored, mostly due to advances in cybernetics, artificial intelligence, and digital technologies [3, 6-7]. A lot happened in the next two decades, William Mitchell in 1995 argued that these technologies decomposed traditional building types and predicted that the future of architecture will witness a growing domination of software over materialized

form [8]. With more consideration being paid to energy use of buildings, the building envelope have begun to utilize sensor-based automated response to environmental conditions [3].

As architects before responsive systems are implemented, the biggest challenge is to design responsive architecture that achieves the design aims by choosing an alternative that suits the design parameters. These parameters let the designer decide how responsive systems can change their configurations in real time by reacting to environmental changes, avoid monotony, and retain a high degree of novelty. Based on the design aim, design parameters are covered: a) visual performance in the form of illuminance, distribution, glare, and directivity; b) energy saving related to lighting energy and thermal comfort; c) energy harvesting in the case of integrated building concepts with other renewable wind or solar technologies; and d) visual comfort including outdoor view, social performance, and appearance. By customizing these parameters, responsive architecture can decrease energy usage, improve comfort, and increase the sustainability of the built environment [3, 9].

Recently, ever-increasing architectural designs are trying to apply responsive shading systems, especially with umbrella concepts due to their efficient mechanism in terms of various designs and performance parameters. Before the study investigates SWOT analysis associated with responsive systems, certain architectural applications of the umbrella concepts are presented in the following section.

3. Responsive Shading System with Umbrella Concepts

Growing interests in sustainable design have led architects in the direction of utilizing umbrella concepts in their shading systems. In addition, Selkowitz and Lee [10] suggested that manual process of

shading systems might work effectively in small projects. But in a larger building with many occupants and the integration of façade and lighting systems, more reliable automated controls are essential.

On later construction practices, several responsive structures attempt to apply automated shading systems with umbrella concepts (see Table 1). In the expressions of the designers, they came up with the idea from umbrellas, which are those practically basic methods utilized for shading and protection. This category includes a change in the geometric morphology of the envelopes by making them adaptable to be reconfigured to meet changes. This is the case with the automated shading system of the Surya shading screen, Conjoined Media Towers, Al Bahar Towers, CJ Research Centre's Kinetic, and the new façade of Madrid Pavilion. In addition, the folding of different membranes is also evolved from the umbrella concept; a fine case is the adaptable cover of the courtyards of the Prophet's holy mosque, Kingdom of Saudi Arabia (KSA) [11-16].

Ideally incorporating the umbrella concept with building envelopes requires design to be integrated across various disciplines. Based on Hathaway [17], the determination for curtain walls, shading devices, glass, and windows systems requires critical analyses of the buildings site and the solar orientation, in addition to the weather, wind, and context within its built environment.

The analysis of the mentioned case studies equipped with umbrella concepts is given in Table 2. The objective of this analysis has been to collect information about the responsive shading systems. It focuses on responsive building elements, especially an overview of umbrella materials, components, mechanism, and supportive systems.

Considering this analysis, it found that pattern system and features of umbrella concepts have evolved quickly in the last decade. The introduction of new materials and technology has allowed designers to propose effective responsive solutions that could be shown within the six case studies. Much of this success is due to the introduction of innovative materials such as technical fabrics, composite materials, but especially to the use of smart materials and technologies. This is the case of using PTFE (Polytetrafluoroethylene), which was used in two cases—the honeycomb shell of Al Bahar Towers and the large umbrellas for the Prophet's holy mosque. In addition to the other effective materials which used or fabricated specifically in other cases. These materials are self-cleaning, lightweight, highly flexible, and enables everyday opening and closing.

Another very interesting aspect in the evolution of umbrella concept is its integration with lighting technologies. The integration of umbrella materials with LEDs represents another step forward towards design research for enhancement of expressive possibilities of architectural elements and thus of the architectural practice. A significant example is REX Designs Conjoined Media Towers.

Finally, architects have always used umbrella screening as an architectural element to be mounted on a surface or a facade. However, from an urban perspective, this umbrella concept can able to qualify an urban-scale sculpture and to make an aesthetic contribution to its surroundings, this is the case of Surya shading screen.

Table 1: General information and mechanism analysis of the responsive shading systems with umbrella concepts. Adapted from [11-16]

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Category	The Surya shading screen, USA.	Conjoined Media Towers, Middle East.	Al Bahar Towers, Abu Dhabi, UA E.	CJ Research Centre's Kinetic, South Korea.	Madrid Pavilion, Shanghai Expo, China	Prophet's holy Mosque, KSA
Building type	Urban-scale sculpture	Office	Office	Office	Office	Religious/ Mosque
Climate	Hot-humid	Hot-arid	Hot-arid	Humid-continental	Humid-subtropical	Hot-desert
Mechanism	Comprising of variably dimensioned umbrellas that generate a series of unique flourish pattern.	Responsive sunshades can quickly be deployed from the cavities embedded between floors within minutes.	Series of transparent umbrella-like modules open and close in response to the sun's path.	Depending on a single linear actuator that accumulates the pleated membrane like an umbrella.	The idea is to make each umbrella controllable by a pulley to allow people to adjust the light levels.	12 large umbrellas provide shading during the day and ventilation and cooling during the night.
Design parameter	- Shading oriented strategy - Blocking glare and reflections	- Solar shading - Filtering light - Media wall - Iconography	- Solar shading. - Reducing glare. - Improving daylight	- Solar shading - Light filtering -Reducing glare	- Solar shading - Improving daylight - Blocking strong wind	- Solar shading for the Muslim pilgrims - Visual comfort

Table 2: Analysis of the responsive components in the case study buildings. Adapted from [11-16, 18]

Category	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Sitting	Elevations	External facades	External facades	External facades	External facades	Translucent ceiling
Pattern (system & features)	Staggered repetition of scaled rectangular shields.	Radial repetition of semi-triangular shapes.	Repetition of crystalline honeycombs shell system.	Repetition of steel strips shading system.	Repetition of steel star-sticks with aerodynamic shape.	Repetition of equal bell-shaped suspension-tensioned membranes.
Materials	Giant aluminium sunscreen	LEDs integrated material	Stretched PTFE panel	Perforated pleated metal	Perforated Corten steel	Stretched PTFE membrane
Supportive structure	Umbrellas' stems supported by ring-shaped frame which reinforced by intervention cantilevers above the street through a giant tripod.	The building's elevations are clad in large retractable umbrellas supported and installed between the floors of stone-clad towers.	The honeycomb shell operates as a curtain wall, sitting two meters outside the buildings' exterior on an independent steel frame.	Each unit is set between floors in groups of three ribbons, allowing the windows to be fully covered or exposed.	Aluminium framing system supported between floors to allow each umbrella to be controlled by a pulley operable from the inside.	There are two different heights of umbrellas affixed to freestanding columns which allow overlapping and covering the entire area effectively.

In addition, this responsive umbrella-like structure is not a fixed idea, but an evolving concept to be redefined with changes in environmental situations. Concerning design parameters attained from those analyses, umbrella-like structures achieve a good performance-based design, particularly for external building envelopes with an interesting façade, an efficient shading system, reducing solar gain, reducing glare, and providing privacy. The investigation of the umbrella concepts reveals how architects, engineers, and other industry professionals can achieve more responsive architecture with integrated collaboration and recent technologies. Dependent upon these developments, umbrella-like structures can provide architects by the means to produce more sustainable ideas. However, to form a clear analysis about the responsive shading systems with umbrella concepts, there is a need to look at the other sides of these technological innovations. In the following

section, potentials and limitations of responsive umbrella-like structures are presented.

4. A SWOT Analysis of the Current Practice of Responsive Umbrella-like Structures

How have responsive architecture become? Below a SWOT analysis has been carried out to help identify some of the key factors, which hoped to generate further discussion about the prospects for responsive umbrella-like structure.

Strengths. Architects should realize that responsive systems have altered the course of architecture. Incorporating cutting edge technology, responsive umbrella-like structure can adapt to its surrounding. The brain of the responsive system can be programmed to learn how to do this based on the different control mechanisms.

In the absence of the users, even for a short period, the intelligently responsive shading system can operate the physical building automatically for maximum efficiency, even when it is unoccupied [19]. As shown from the case study analysis, it is important to passively decrease heat loads in the building– suitably controlled solar shading is one of the most effective solutions. This is the most significant issue especially in hot climate architecture. Besides offering effective shading oriented strategy, umbrella-like structures have other related strengths as:

- Providing the basic functions of shelter and privacy, while reducing glare and improving daylight penetration.
- Resulting a piece of responsive architecture that both radically cuts carbon emissions and presents an elegant new aesthetic.
- Producing buildings that reflect the technological and cultural conditions of our time.
- Enhancing visual comfort, the umbrellas work as blooming flowers programmed to fold and unfold in minutely delayed sequence to avoid collision between their moving parts.

Weaknesses. The following discussion concerns potential weaknesses of responsive umbrella-like structures in relation to the extra time, experience, cooperation, and resources which are generally required in such structures. The most significant beings are:

- There is a general lack of experience in different operation and management processes. High standard of building construction management is required for these structures.
- Poor cooperation among the design team. In this context, the different members of the design team need to understand both the embedded responsive systems and the role of different professional fields.

- These structures always associated with higher costs, first costs including installation and operating costs including maintenance during the lifetime of the building. These costs should be included in any economic considerations. On the other hand, the energy saving potential should be considered as a competitive alternative.
- Risks about the increased loads of supportive frames and structures.
- Optimization problems, implementing responsive systems requires continues optimization based on experience, measurements, and simulations.
- There are concerns that some systems may contravene current noise regulations.
- Lack of occupant training, education, and responsibility.

Opportunities. As stated throughout this study, the opportunities offered by innovations in science and technology and the demands for sustainable buildings will continue to produce more intelligently responsive architecture. In this context, the major two opportunities are:

- The sustainable opportunities raised by umbrella-like structures that can respond to sunny, shady, hot, or cold conditions would suggest that these structures possess the means to produce spaces that respond to environmental conditions.
- There is another opportunity related to architectural practice. While architecture does not readily require technical expertise, it may be evident that architects are interested in such experience to take place. Consequently, this practice changes when the opportunity to access real-world data collected by responsive technology presents itself to the discipline. This shift empowers architects to conceptualize a new architecture that could tie user needs and environmental situations directly to the architectural form. In this context, responsive technologies provide architects with important aesthetic opportunities,

allowing the new formal and performance-driven behavior to become a part of an architect's formal vocabulary. However, this shift has included further weight to the architectural profession [7, 20- 22].

Threats. Barriers to the implementation of responsive umbrella-like structures arise from several factors, technological and non-technological. Inquiries to the construction community allow the identification a set of barriers, especially in non-advanced countries, as the following:

- Risks about physical environmental conditions of building surroundings as well as wind loads and pressures.
- Lack of specific construction regulations, standards, and laws.
- Poor availability of reliable performance data concerning both energy and comfort issues due to the unexpected failure of sensor technologies or simulation programs.

After a SWOT analysis, the final decision will be made after extensive studies and discussions among investors, designers, users, and other stakeholders who possess different cultural and scientific backgrounds.

The requirements for a successful application include not only the technical ability to achieve responsiveness but also effective in dealing with people's needs and the environmental conditions. These requirements seem to be more important than the technical ones. Furthermore, to increase the benefits of such an approach and to reduce human intervention, a responsive space must act on its own; it must have the ability to sense and respond to a variety of stimuli without human intervention [23].

5. Conclusions and Future Perspectives

Although scientific research and development work in this important area of architecture is still in its infancy, an

examination of the present responsive umbrella concepts reveals many advantages in the realization of more sustainable buildings. Producing buildings that reflect the technological and cultural conditions of our time. However, novel design and construction strategy are needed to ensure that architects and engineers can guarantee, comfort, security, and safety concerns of employees, customers and other users of these emerging classes of building. A responsive umbrella concepts may easily provide flexibility for a variety of uses, but it must also keep its occupants safe while performing their tasks. In this concern, it is of great importance to carry out detailed SWOT analysis after extensive studies, researches, and discussions among different professionals. This study just highlights the umbrella concepts and encourages conducting more comprehensive analysis about their potentials and limitations, which hoped to generate further discussion about the prospects of responsive umbrella-like structure.

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STUDY ON NEW ARCHITECTURE TRENDS FOR HOUSE DESIGN IN KOREA

Hwaryong Lee*

Kongju National University

*hlee@kongju.ac.kr

www.nzaar.com

Abstract

This study aims at searching the new architectural trends for house design in Korea. It will establish a theoretical basis for changes in habitation behavior and housing patterns responding to the low-childbirth and high technique society. It will research into the population structure and social changes in South Korea and the architectural technical changes for Korean housing through survey analysis. In the end, it will propose the Korean housing design trends and their application technique.

Keywords: New Trends, House Design, Architectural Technical Changes

1. Introduction

Demands for housing types and residential spaces are bound to change along the stream of times. Thanks to the dazzling economic growth after the industrialization in the 1960s, South Korea brought about qualitative improvement in the standard of living. As individuals' life patterns have been diversified, houses suitable for individuals' life patterns have been selected. In particular, population decreases and changes in population structures resulting from low fertility led to the diversification of housing pattern resulting in obvious changes in demand for houses.

As the investment value of apartments that had been regarded to be the best investment targets has dropped due to the slowdown in the real estate market since the financial crisis in 2008, the meaning of housing has been shifted from the targets of investments to true houses where family members make their memories.

Therefore, the purpose of this study is to trace recent changes in house types and residential spaces in order to analyze new trends thereby conducting an a priori study of future houses.

2. Analysis of factors for changes in housing culture

A. Concept and meaning of housing

Whereas houses are physical objects that mean the spaces per se, housing is defined as a place where humans lead their lives as main agents. Therefore, housing is a concept that includes the psychological and cultural aspects formed between the emotional inner side of humans and spaces, which are physical objects.

According to clause 1 of article 2 of the Housing Act, houses refer to all or part of buildings where the members of households can lead independent housing lives for long periods of time and the appurtenant lands and are divided into detached houses and apartment houses.

B. Factors for changes in housing culture

The beginning of housing is the simple shelters prepared by humans to protect their bodies from dangers in nature such as winds, rain, and coldness and attacks by fierce animals. However, as human wisdom developed, needs for housing have been diversified and improved so that housing has been developed into diverse forms of housing as residential spaces for family life units with diverse functions by modern times instead of the concept of simple shelters.

Recent housing culture and forms have been diversely changed according to population structures, industrial structures, urban and regional environments, and demand for house.

(1) Factors for changes in house culture in the aspect of population structures may include population decreases, rapid increases in the elderly, changes in family members, females' advancement into society, and rapid increases in the number of foreigners.

(2) In the aspect of industrial structures, shortening of working hours, increases in leisure time affect changes in housing culture.

(3) Among elements of urban and regional environments, state-of-the-art housing environments, the importance of indoor/outdoor and urban environments, communities, and convenience are included in the factors.

(4) In the aspect of demand for houses, changes in the idea of settlement, decreases in the number of family members, increases in demand for diverse forms of houses, and increases in demand for renewal of buildings affect changes in housing culture.

C. Changes in future populations and population structures

(1) Changes in populations

According to data from the National Statistical Office (NSO),¹ the total population will decrease from 51.01 million in 2015 to 49.02 million in 2065, 50 years later. The population growth rate is expected to switch to negative in 2032 and become -1.03% in 2065. The elderly population is expected to increase from 6.54 million in 2015 to over 10 million in 2025 and to 18.27 million in 2065.

(2) Future household estimation

According to future household estimates² of the NSO, among the ratios of households by

the number of household members in 2015, the ratio of one person households was the highest as 27.2% followed by that of two person households as 26.1%, that of three person households as 21.5%, and that of four person households as 18.8%. However, by 2045, the ratio of one person households is expected to increase to 36.3% followed by that of two person households as 35%, while the ratio of four person households is expected to decrease to 7.4%.

3. Changes in house types in response to changes in population structures

Recent low fertility and changes in population structures have brought about decreases in number of household members, increases in the number of one person households, increases in elderly populations, and the diversification of family structures to greatly affect housing culture and house types. New trends of recent house designs are reviewed as follows.

A. Increases in the preference for detached houses

In South Korea, the ratio of apartments is still shown to be high. According to the 2015 data from the NSO, whereas the ratio of detached house was 24.3%, the ratio of apartments reached approximately 60%. However, unlike the prices of apartments that have been continuously falling, the prices of detached houses and multi-household houses have been rising and the transactions of these houses have been increasing³ indicating that new changes are occurring in the house market. Recently, the Korea Research Institute for Human Settlements surveyed houses where people were currently residing and houses where people wanted to reside in future in comparison with each other from 1590 people and according to the results, although 64.1% of the respondents were currently residing in apartments, only 28.7% of the respondents wanted to reside in apartments 30 years later. On the other hand, whereas

¹ National Statistical Office, future population estimate:2015-2065, 2016.12

² National Statistical Office, future household estimate:2015-2045, 2017.4

³ KB Financial Group Inc., management research report, 2012.

the ratio of the respondents currently residing in detached houses was 14.7%, the ratio of those that wanted to reside in detached houses was high as 41% indicating that preference for detached house will gradually increase.

B. Preference for small scale houses and increases in elderly persons' town house⁴

As populations have decreased and households have been divided due to the effects of low fertility, the number of one person or two person households has been increasing and demand for small house has been maintained. In particular, one person households residing in downtown areas are highly likely to choose small rental houses because they are low in age and income. Therefore, the development of a variety of small-sized urban multi-family houses mainly in the metropolitan area and metropolises is becoming an alternative.

Recent sociodemographic characteristics can be said to be countermeasures against increases in elderly populations. In 2013, the proportion of populations aged 65 years or older in South Korea was close to 14%, which is the criterion for aged society, and it is expected to exceed 20% in 2026 so that South Korea would become a super high aged society⁵. Town houses are charged housing complexes that are equipped with complex facilities such as facilities and service functions necessary for the elderly and provide a variety of living services. Town houses are equipped with composite facility complexes dedicated to the elderly including diverse service functions such as recreational facilities, hospitals for the elderly and elderly communities. Recently, town houses have been increasing mainly in

the metropolitan areas such as the silver town houses in Geumgok-dong, Bundang-gu, Seongnam-si.

C. Increases in prefabricated houses

With the decrease in the number of family members, along with reduction of house sizes, the number of consumers who prefer prefabricated houses made utilizing wood and containers is rapidly increasing. Since prefabricated houses not only can be freely moved to other places but also enable the reutilization of 80% of the facilities, they reflect the recent trend of housing that is switching from the existing concept of housing, which is something to be owned by buying it, to a new concept of housing, which is a place where people live.

Wooden houses with light weight wood framing systems have already been recognized as environment-friendly houses in advanced countries such as Europe because these houses provide good environments to people with atopy or weak immunity as humidity can be controlled in these houses because of the nature of wood. According to the Korea Agency for Infrastructure Technology Advancement, the prefabricated house construction market is expected to grow from KRW150billion in 2012 to KRW940-1,700 billion in 2020.

D. Emergence of diverse forms of houses

(1) Share House

Following the decrease in the number of family members and the changes in population structures, house types are being diversified. Share houses are a type of housing where many people live in one residential space. That is, while private spaces such as bedrooms are used separately, the living room, toilet, and kitchen are shared. Share houses are a sort of jointly owned and shared houses, and there are other similar types of jointly owned houses named such as collective houses, group house, and cooperative houses. Recently, the diversification of house progressed further from housing

⁴ Yoon Min-Woo and four others, A Study on Changes in the Housing Market and Future Housing Types, Korea Institute of Construction Engineering and Management, collection of papers presented in conferences, 2012.11, pp.257-280

⁵ Gyeon Jin-Hyeon and one another, A Study on the Urban Elderly Welfare Housing linked to Services to prepare the Super-Aged Society by Baby Boomers, Journal of the Architectural Institute of Korea vol. 18, no. 5, 2016, pp.45-54.

communities and houses have been diversified into forms of houses where people with the same areas of interest such as dilettante life live together.

(2) Ddang-kong House⁶

The ddang-kong home house is a house system in which buildings where two households can live in one lot of land and the yard is shared. Two households jointly buy a lot of land and build buildings of two households side by side. It is also called duplex home or duplex house.



Figure 1. An example of duplex homes in South Korea

4. Increases in environment friendly sustainable houses

A. Increases in zero energy houses

A zero energy house is defined as a house that minimizes the energy load required for buildings and minimizes energy consumption by utilizing new energy and renewable energy.⁷ Zero energy houses refer to houses where energy consumption is reduced compared to existing house complexes using passive design technologies and at least a certain level of the energy consumption is supplied using active technologies so that the yearly total energy balance is maintained at '0' or higher (The produced amount of energy exceeds the energy consumption).

⁶ Lee Yun-Ji, A Study on the Floorplan Types and Characteristics of "Ddang-kong House" in Korea, Thesis(master) of Seoul National University, 2012.

⁷ Clause 4 of article 2 of the Green Building Formation Support Act



Figure 2. Conceptual diagram of zero energy houses

B. Emergence of net zero energy houses

The net zero energy house means a zero energy house into which a system that enables the selling and buying of electricity remaining after use in the maintenance of the building out of the energy produced by utilizing new and renewable energy was introduced.



Figure 3. Concept of Net Zero energy building

C. Forest influence area house

The forest influence area house means a house focused on 'comfort' that enables taking a rest while enjoying nearby green areas, parks, and mountains. In the recent situation where the basic trend of low growth of domestic economy has been prolonged, daily lives are under pressure, and many things are modernized, the nature and resting spaces, which cannot be replaced by anything else in everyday life, are more preferred. Forest influence area houses will be the most important factor to be considered in future housing options. In particular, retirement preparers are choosing

6. Conclusion

The purpose of this study is to analyze the social, economic and sociodemographic factors that affect house culture and to trace the new trend of recent house design.

This study set changes in populations and the forms of households, nature-friendly living culture, and the development of IT technology as factors that have the greatest effects on recent South Korean house designs. Following the changes in population structures, preference for detached houses and small scale houses, increases in houses for the elderly and prefabricated houses, and the emergence of diverse houses (share house, Ddang-kong house, etc.) were identified through investigation.

The diffusion of environment-friendly culture can be seen in new house trends such as increases in zero energy houses, the emergence of net zero energy houses, and forest influence area houses, etc. Finally, advances in IT technology are adding new technical elements to house equipment. For example, equipment systems utilizing the Internet of things, the spread of Internet-enabled equipment, smart home platforms, and personalized smart services will be diffused so that houses gradually become smart and performance as devices will be required from houses hereafter.

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- [7] Clause 4 of article 2 of the Green Building Formation Support Act

STUDY AND EVALUATION OF INDICATORS INFLUENCING THE LIVABILITY CASE STUDY: FAMAGUSTA, NORTH CYPRUS

Mehrdad Chahardowli*

*mehrdad_chahardowli@yahoo.com

www.nzaar.com

Abstract

As one of the novel concepts in urban planning, livability is concerned with the appropriateness of urban environment for humans to live. In recent years, a number of liveability and benchmarking indices and studies have been published to assess the relative position of various global cities against each other in various categories. These liveability measures are typically used as a tool to make comparisons between cities with various outcome scores receiving widespread media attention. However, none of the existing indices take the perspective of the ordinary man living in that city and model this ordinary person as having multi-dimensional sensibilities towards issues like economic well-being, social mobility, personal security political governance, environmental sustainability, and aesthetics. The current study aims at defining the concept of livability, recognizing related physical components and evaluating indicators which effect on livability. Through the current article, physical components are extracted through document and library studies and observation. Having combined these criteria using the resulting weigh of ANP model and using of SWOT model for predicts strategies and policies.

Keywords: Livability, Livability Indicators, ANP Model, SWOT Model, Urban Planning

1. Introduction

The advent and development of the idea of livability can be traced back to America. In 1970, with the hope of getting their hands on urban planning ideas they had in mind, National Endowment for the Arts coined the term livable cities copied by other research centers such as Us Environmental Protection Agency who has done extensive research on the most livable cities of the US. After that influence, the term made his way to the literature through William Martins's writings in 1975 about livable places printed in magazines such as Saturday Review and Christian Science Monitor. In Europe, related studies to define a livable city goes back to 1975 when Landscape Architecture magazine published some short essays of academic practitioners on livable cities, although none stated the term livable directly. Each trying to come up with a based-on-personal-ideas answer to the question "what makes a good city?" (Larice, 2005, P.120), the articles delineated current urban issues and the ways to convert a metropolitan into an attractive place inserting lively nature in a jungle of concrete. Livability and livable society are characterized by a group of different issues

that are underpinned by a set of common guiding principles including accessibility, equity and participation. Infrastructures (transportation, communication, water and sanitation), food, clean air, appropriate housing, meaningful employment, parks and green space are perceived as what the citizens' quality of life is dependent upon. In a dwelling, occupants' engagement in decision making to meet their needs is an indicator of livability of the place. Related to concepts such as sustainability, quality of life, quality of place and proper communities, livability is a general idea. Although livability is defined differently in different societies, it is possible to use social planning goals to develop local criteria for it. It is often employed to define different aspects of society and experiences that create it. Livability focuses on human's experience of place and takes it into account in a certain time span and place.

2. Literature Review

Livability is divided to three interdependent dimensions: economic, social and environmental. Essential to people's health, economy provides people with jobs and income (food, clothes, housing), it also enables meeting needs of

higher levels such as education, health care and recreation. The way economy takes advantage of environmental resources must ensure preserving enough resources for present and future generations. However, social wellbeing needs equity: social and spatial fair distribution of economic and environmental resources and governments who take every citizen into account. Social wellbeing has personal freedom and equal opportunities as its key components. As an infrastructure, environment is the provider of natural resources, waste disposal capacity, and the relationship between human and natural surroundings. Malfunction of any of these three results in deteriorated human inhabitation, its outcome being population reduction, poverty, social conflict, increased health and environmental problems. On one hand, planning in response to post-industrial society's needs as it strongly seeks wellbeing and quality of life and on the other hand, threats to today's urban life highlights the importance of livability of cities even more. As a concept, livability can, given the field it is defined in, be either stretched or limited, nevertheless, central to it is the quality of life in any place which includes variety of measurable indexes having density, transportation, security and sustainability as their constants (Perogordo, Madrid, 2007, P.40). People and place are two faces of livability. Evans in *Livable Cities*, states: "the coin of livability has two faces, Livelihood is one of them. Ecological sustainability is the other. Livelihood means jobs close enough to decent housing with wages commensurate with rents and access to the services that make for a healthful habitat. Livelihood must also be sustainable. If the quest for jobs and housing is solved in ways that degrade the environment of the city, then livelihood problem is not really being solved (Cedar Hill Municipality, 2008, P. 5-1). In his study in California, Wheeler (2001) demonstrates different threats destroying quality of urban life in the form of rapid

population growth, lack of open spaces and unaffordable housing, heightened discrimination, undermined community identity, sense of place and social life. In addition, a raised awareness of unsustainability of urban patterns and urban consumption and recognizing them as neither healthy nor sustainable leading to decreased potency of environmental resources to support the population on planet earth is a reason to additional importance put on livability. Livability is not an easy concept to clearly define and explain or measure, but surely it has great effects on the works of those whose job is to plan or in the field of management and/or programming. Also, the key concepts it provides are highly valuable. In the literature of urban regeneration, the definition of livability for an urban center is meant to do with how capable the center is in terms of maintenance and improvement of viability and vitality. According to Carlos J. L. Balsas. 2004, these two terms determine the capacity of investment in the center to keep it alive. Livability is defined as the human's wellbeing in the environment where he lives and works. It can be affected by the physical design and how the system and processes in the cities perform. These indicators can be considered as proxies that help us to measure or make judgments on how livable a city or an area is. There are also indicators that help measure the quality of life like how well transportation covers mobility in the city or how affordable houses are can also contribute to the proxies to measure livability. Therefore, livability can be put in short as how much contribution is done by the environment to give people a good quality life (Urbis. 2008). Mitchell (1996) offered a 4-step methodology for the use of indicators in the projects: (1) define the problem and decide on the variables; (2) categorize and select important issues; (3) define the indicators; (4) evaluate the collected data. Hollander (2002. pp. 3) added some other criteria: using data that

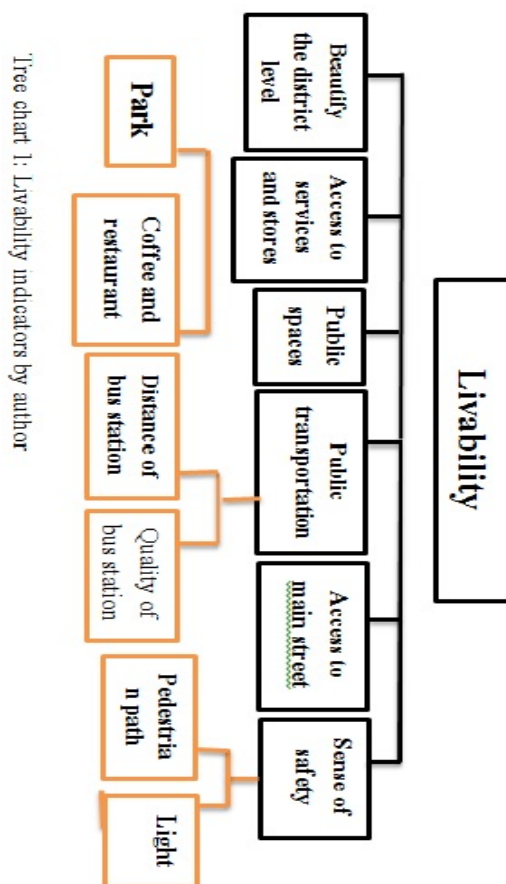
can stay reliable and consistent through time, data can be collected from the community, collecting the data should not be costly and finally data should be general enough so that it can be used for comparisons. The World Health Organization firmly believes in the relationship between livability of a city and the sense of place. The four elements referring to sense of place are: high-quality environments, sustainable ecosystem, and access to wide variety of experiences and resources connections with the past and city form (Duhl and Sanchez. 1999.pp 23-24). Density is another main factor. It not created by idiosyncratic urban design considerations. However, it is to do with the spatial structure of the city and the interaction between Government action (regulations, infrastructure investments and taxation) and the real estate market. Another thing which plays an important role in the livability of a city is transportation. Issues like reducing pollution and global emissions to promote sustainability are of matter (Henrik Gudmundsson. 2003. Making Concepts Matter: Sustainable Mobility and Indicator Systems in Transport Policy, International Social Science Journal). Level of safety of the transportation in the city is another important point of discussion. As an example, aesthetic streetscape treatments are encourages for better livability. However, conventional transportation safety practice is not in agreement with roadside features such as street trees as fixed-object hazards. In fact, there is a strong disagreement on this matter (Eric Dumbaugh .2005.Safe Streets, Livable Streets). Physical health is another significant issue to be addressed. It is expected from the governments to build sidewalks and bike paths especially on the roads with heavy load of traffic. Residential areas have to have sidewalks (Jackson, Richard J., C. Kochtitzky.2001.Creating a Healthy Environment: The Impact of the Built Environment on Public Health). Most

importantly, residents have to feel safe, so creating the sense of safety and security is a crucial element of livability. Research shows that people are so concerned with safety and security that they would choose to live in an age-restricted, gated community if they had sufficient income. The Economist Intelligence Unit has a purpose of quantifying the factors that can measure livability and help to compare different locations. These factors are set in five main categories including stability, healthcare, culture and environment, education and infrastructure. There are over 30 qualitative and quantitative factors which rates the relative comfort of a city. Quantitative factors are measured by questions and calculations of data sets and qualitative factors are measured by in-house analysts or in-city contributors. Key performance indicators (KPIs) can be necessary to improve and develop a city center. The provide an image of what is going on in the city center at a certain time or over a period of time and can contribute to the success of marketing works. It can give the investors reliable facts about where to base their investments (Cox et al..2000. pp. 14).

3. Research Methods

In this research we used ANP (Analytic network process) and SWOT model which in ANP model we can comparing and finding weights of indicators and finding the relationship between indicators and sub indicators with defining degree of importance for indicators. In next step with designing a matrix we can find weights of indicators and sub indicators. So we can find the major indicators which effect on livability of case study and after that with SWOT model we can define strengths, weaknesses, opportunities and threats that can help us for predict polices and strategies. The initial phases of the project involved analyzing the present status of the livability indicators in the Salamis Road in Famagusta. Personally visit Saliamis and qualitative and quantitative data collected by observation. Since we needed some

pictures, we choose converting data collection and after analyzing pictures we could find some indicators which effect on livability on Salamis street like sense of place, access to main street, public transportation, public spaces, access to services and stores and beautify the district level. In addition some of indicators which we choose had some sub indicators that effect on livability. In first step for using ANP model we should design a tree chart for finding relationship between indicators and sub indicators.



After this part in second step we start to use ANP model for analyzing indicators and sub indicators and finding the relationship between them. In ANP model after designing tree chart we should finding relationship between indicators and specify weight of indicators whit using matrix which in first step we should design degree of importance table that we use of these degrees for analyzing indicators. After that we should comparing indicators

to each other and finding their proportion and after calculating finding their weight.

Definition	Grade
Equal importance	1
Equal little importance	3
More important	5
Much more important	7
The absolute importance	9

Livability indicators matrix:

Table 1: calculation of indicators

	Sense of safety	Access to main street	Public transportation	Public spaces	Access to services and stores	Beauty the district level	Weight of indicator
Sense of safety	1	1/3	1	5	1	1	0.174
Access to main street	3	1	1/3	3	1/3	1	0.161
Public transportation	1	3	1	1	1	1	0.192
Public spaces	1/5	1/3	1	1	1	1/3	0.087
Access to services and stores	1	3	1	1	1	1	0.192
Beauty the district level	1	1	1	3	1	1	0.192

After calculation and finding weight of indicators know we can predict main indicators which can effect on livability and after that on next step we should find sub indicators weights.

	Light	Pedestrian path	Weight
Light	1	3	0.752
Pedestrian path	1/3	1	0.248

Table 2: calculation of indicators

	Distance of bus station	Quality of bus station	Weight
Distance of bus station	1	5	0.833
Quality of bus station	$\frac{1}{5}$	1	0.167

Table 3: calculation of indicators

	Distance of bus station	Quality of bus station	Weight
Park	1	$\frac{1}{5}$	0.167
Coffee and restaurant	5	1	0.833

Table 4: calculation of indicators

Now we can find every indicator and sub indicators weight. As was anticipated three of sub indicators like light, distance of bus station and coffee and restaurant have main role on improving livability in Salamis.

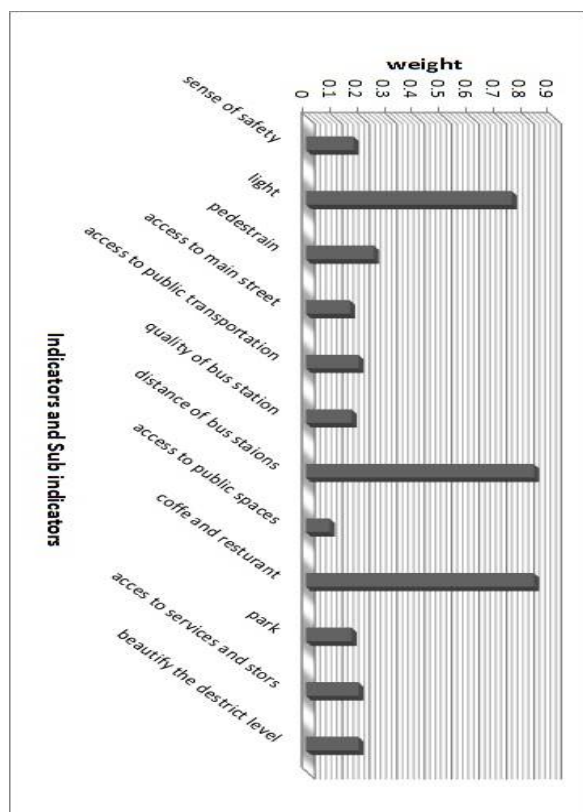


Diagram 1, by author

4. Analysis & Results

Field study:

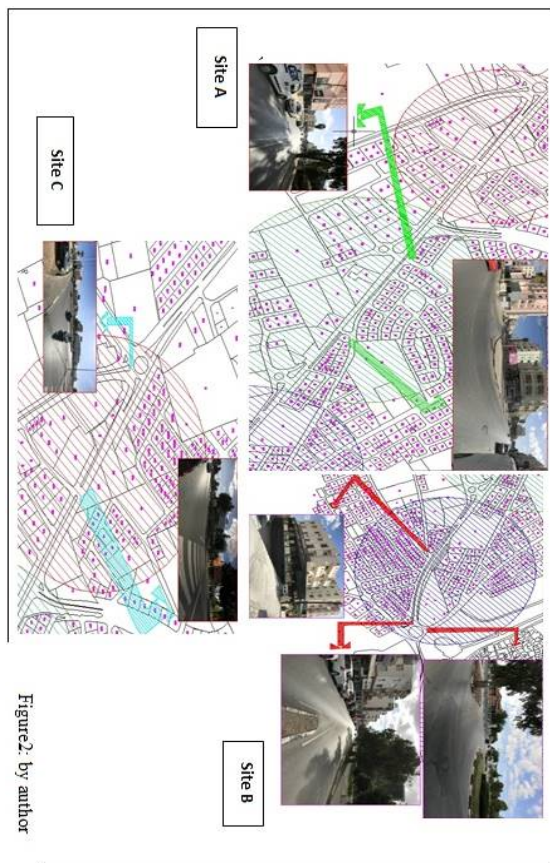
Salamis street is the main street or in other words its urban center in Famagusta in Cyprus which we choose it for case study because its cover our subject and we want know about level of livability in this area and propose strategies for its.

Data collection:

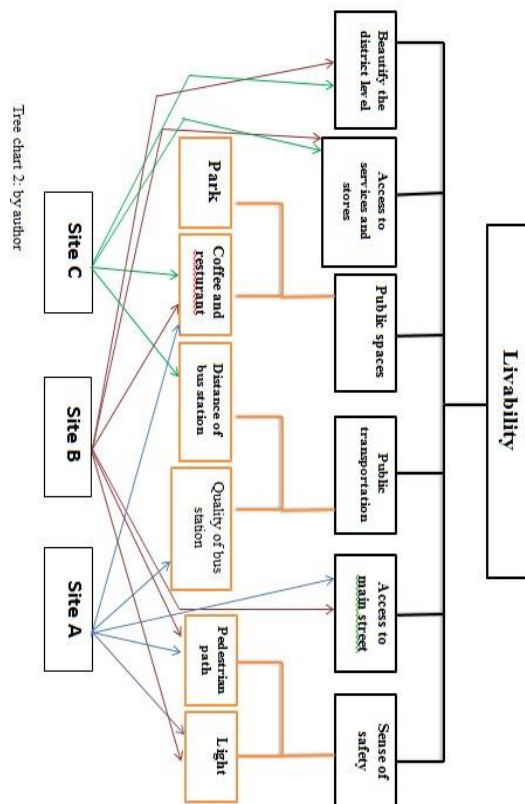
After a general observation we found that indicators which we mentioned were not cover all Salamis street so we dividing Salamis to 3 parts A, B and C. Part A start from main gate of EMU university to Coffee Mania, part B start from Coffee Mania to Lemar store and the last part (C) start from Lemar to end of the street.



After 2 weeks in three times observation and collecting data we found relationship between indicators in site A, B and C.



After this dividing, we start examined indicators and relationships between these area and indicators:



In this part we want find major indicators which effect on each site and find their weight so we should use ANP model and design matrix for them.

Site A

	Light	Pedestrian path	Access to main street	Quality of bus station	Coffee and restaurant	
Light	1	5	3	1	1	0.314
Pedestrian path	$\frac{1}{5}$	1	$\frac{1}{3}$	1	1	0.104
Access to main street	$\frac{1}{3}$	3	1	3	3	0.258
Quality of bus station	1	1	$\frac{1}{3}$	1	1	0.147
Coffee and restaurant	1	1	$\frac{1}{3}$	1	1	0.147

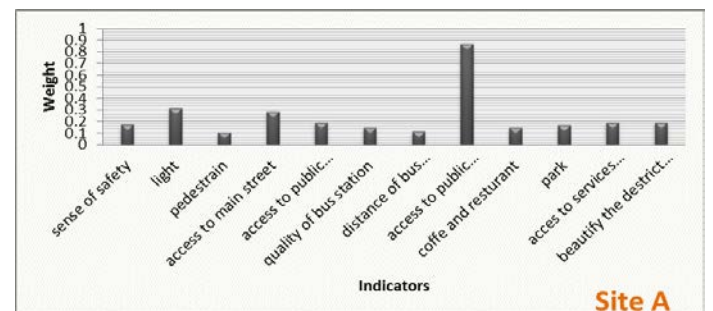


Diagram2: by author

Site B

	Light	Pedestrian path	Access to main street	Coffee and restaurant	Access to services and stores	Beautify the district level	Weight
Light	1	3	3	1	1	5	0.275
Pedestrian path	$\frac{1}{3}$	1	$\frac{1}{3}$	1	5	1	0.136
Access to main street	$\frac{1}{3}$	3	1	$\frac{1}{3}$	3	3	0.178
Coffee and restaurant	1	1	3	1	1	5	0.231
Access to services and stores	1	$\frac{1}{5}$	$\frac{1}{3}$	1	1	3	0.115
Beautify the district level	$\frac{1}{5}$	1	$\frac{1}{3}$	$\frac{1}{5}$	$\frac{1}{3}$	1	0.062

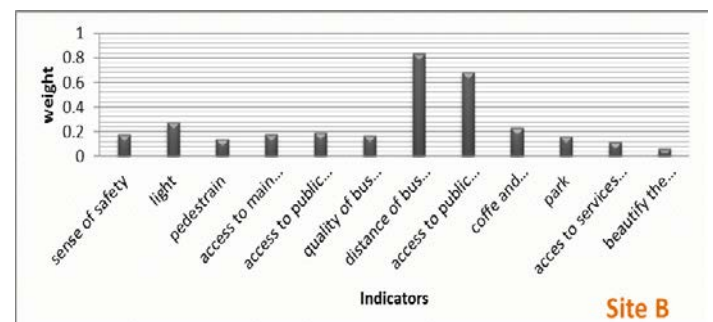


Diagram3: by author

Site C

	Distance of bus station	Coffee and restaurant	Access to services and stores	Beautify the district level	Weight
Distance of bus station	1	1	1	1	0.211
Coffee and restaurant	1	1	$\frac{1}{3}$	1	0.160
Access to services and stores	1	3	1	1	0.278
Beautify the district level	1	1	1	1	0.211

Table7: calculation between indicators and sub indicators

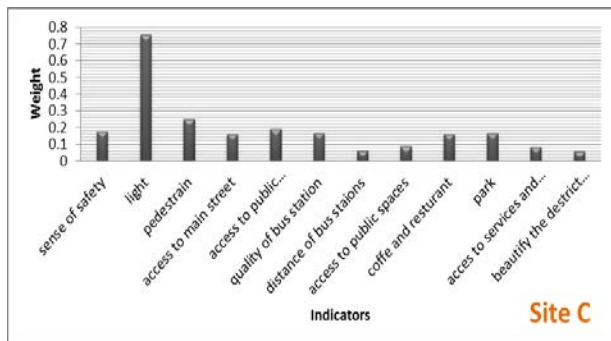


Diagram4: by author

5. Discussion & Conclusion

The effect of indicators on livability in site A shows us which access to public spaces, access to main street and light can improve level of livability in this area. In the other hand distance to bus station and access to public spaces can improve level of livability in site B. in addition light has more effect on level of livability in site C. Now we can find the major indicators which effect on each site and in last part of article with SWOT model finding strength, weakness, opportunity and threaten of livability indicators and presenting strategies and polices which can improve level of livability in Salamis street.

DIGITAL TECHNOLOGIES FOR INCLUSIVE URBAN PLANNING

Stéphanie Hasler*

CEAT, EFPL

[*stephanie.hasler@epfl.ch](mailto:stephanie.hasler@epfl.ch)

www.nzaar.com

Abstract

Rapid urbanization, climate change, resource depletion, the wish for a more sustainable development and the widespread use of the Internet and mobile phones all represent a great challenge for urban planning. While the smart city model is seen as a means to cope with these challenges, it is often reduced to an amalgam of technologies. Citizens are usually left outside the planning process, although they produce a massive amount of data related to how they live and use the city. Applying the smart city model demonstrates that digital technologies deeply change urban management systems. These technologies also create an opportunity to reshape the planning process by generating new forms of interaction between urban planners and city dwellers, which become useful tools for sustainable and responsive planning. This research explores how these new tools can be harnessed to enhance citizen involvement in the planning process.

Keywords: Digital Participation, Urban Data, Responsive City, Smart City, Sustainability

1. Introduction

Providing shelter to more than half of the world population, cities are the place in which to act for a more sustainable future. The smart city vision has been presented as an answer to the sustainable city challenge for two decades [1]. But smart cities focus mainly on optimizing urban systems management, such as traffic control [2–5]. In smart cities, the role of citizens, even if deemed as important, is often not clearly defined and remains peripheral [3,4,6–9]. While technological innovations have improved city dwellers' everyday life by helping them make better informed decisions, the data thus produced are hardly ever taken into account by urban planners. Yet planning for citizens, based on their behavior and their way of living is a key to a more sustainable development of cities [2,10].

The main objective of this research is to analyze how digital technology can help overcome these shortcomings by improving urban planning process, using data pertaining to inhabitants' needs and practices. More precisely, the aim of this study is to show that digital tools can open a way for more inclusive and data-driven

planning through data exchange and production.

2. Literature Review

The smart city concept has no clear definition, but the one constant feature is the massive use of information and communication technology to create a more livable, efficient and sustainable city [1,11,12]. However, researchers have criticized this vision of the smart city and pointed out the importance to shift focus from technology to people [3–5,9,13].

In contrast, participatory urbanism is not new and extensive literature already exists on this subject [14]. With the widespread use of smartphones, internet and social media, everyone can easily express their opinion. Thus, participatory planning has become even more relevant as these wide-read sentiments cannot be ignored. Indeed, digital technologies are seen as a solution to cope with the shortcomings of participatory planning processes. Many studies have started to focus on the opportunities of ICT-based participation [15–22]. They all agree on the fact that digital technologies display great potential for positive implication in participatory planning. Citizens' role is

changing, as the latter gradually transform from information receivers to data producers. Yet how citizens and urban planners are to produce and use data remains to be defined.

3. Research Methods

This research seeks to identify how to harness digital participatory processes to generate and exchange data for future planning. To this end, the method applied consists in identifying examples of digital participation projects which have been carried out around the world. Each case has been analyzed based on the type of data generated, data sources, the type of interaction, the project's implementation, as well as data use and outcomes. Documentation on these platforms and apps was collected through Google requests, web portals such as Planetizen and Engaging Cities, literature review and the app or web platform itself.

4. Analysis & Results

The collected data were classified depending on the mode (active or passive [see 10]) and the type (information, consultation, contribution and collaboration [inspired by 23]) of involvement of the participant. These data were then summarized in a table to allow comparison. The analysis focuses on two aspects regarding data, namely its production and utilization.

Digital participatory platforms and apps “amplify” data production possibilities. This concept is borrowed from E. Einstein in her work about printing [24] and has been taken up by D. Boullier [25] to explain how digitalization expands a process or a phenomenon. These projects allowed more people to participate and produce input, and diversified data type and format. On the other hand, they also increased in complexity with the diversity of the contributions. This poses the question of which information should be taken into account and what is the most relevant data.

As there is generally no room for debate, it is difficult to prioritize inputs. Voting or feedback systems can emphasize most accepted or controversial issues. Research shows that data produced through these types of practices are seldom representative, as participants generally remain anonymous.

This study also pointed out that the use and outcomes of data issued from digital participation practices are often unclear. In many cases, it wasn't possible to identify how the produced data were employed in the urban planning process. Nevertheless, in some instances, it was used as a base for on-site participatory meetings and discussions. Possible reasons to explain this absence of connection to the actual planning include: a lack of competences and resources to process, analyze and use the data; a failure of the implemented strategies to meet the needs of experts and / or that of citizens; insufficient flexibility of the planning policies and processes.

5. Discussion & Conclusion

Based on the number of projects, there is no doubt that digital planning holds great promise in data collection. But the limitations underlined in this research demand to rethink the entire planning system from communication and information exchange between stakeholders, to urban planners' own competences. Digital planning requires different tools and knowledge to be implemented efficiently and deliver the expected result. To this end, the role of the urban planner should be redefined, from expert taking top-down decisions to facilitator achieving the synthesis between bits of relevant input. Furthermore, citizens, as local experts, should be considered as sources of relevant data. City dwellers are also data consumers in a planning process as they need to be informed about what happens. In that sense, urban planners become data producers as well. Information

should flow back and forth to achieve the goal of creating a sustainable city.

New issues emerge from the data produced and collected through digital participation interfaces. It is important, however, to know which information is needed and how it shall be analyzed and used before collecting it in order for it to be fruitful.

This research was able to determine some of the limitations that prevent the smart city model to move towards a more data-driven and inclusive planning and hence responsive city, as well as identify some levers for change.

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MID-BLOCK CROSSING BEHAVIOR: A STUDY OF PEDESTRIANS AND VEHICLES INTERACTION ALONG URBAN STREETS IN MALAYSIA

Walid A Al Bargi^{1*}, Basil David Daniel² & Mohamed M Muftah³

^{1,2}Faculty of Civil and Environmental Engineering, University Tun Hussein Onn Malaysia (UTHM)

Beg Berkunci 101, 86400 Parit Raja Batu Pahat Johor, Malaysia

³Engineering Technology, University Malaysia Pahang, Malaysia

*walidalbargi@gmail.com, basil@uthm.edu.my, moo1983hed@gmail.com

www.nzaar.com

Abstract

Gap acceptance behavior of pedestrian is significant to Safety and crash of pedestrian. The issue of gap acceptance by pedestrians is relevant for road safety. It is novel to analyze the gap acceptance behavior and the effects of selected factors based on observation survey. Many studies examined the mid-block crossing behavior of pedestrians in the developed country. In contrast, this study is one of the first to analyze and model the crossing choice behaviors of pedestrians within an entire Malaysia. However, the main aim of this paper is to investigate and model non-compliant pedestrians' traffic gap acceptance at unsignalised pedestrian mid-block crossings in Malaysia. For this purpose, a field survey was carried out using videotaped data. Gaps size accepted, number and size of the rejected gaps are examined against pedestrians' and traffic attributes, using statistical analysis (SPSS.22) and modeling approach (Multiple linear Regression and Binary logit regression). In addition, Critical gap were determined using Raff's method. The results revealed that seven factors that influence the pedestrian crossing behaviour in terms of accepted gap size in seconds. Results showed traffic speed, pedestrian waiting time, vehicle size, pedestrian gender, crossing distance, age group, and pedestrian number are the significant factors for accepted gap size of pedestrian in Batu Pahat. Pedestrian waiting time was found to have negative impact on gap size acceptance while the remaining factors showed positive influence on the gap size acceptance. In the development of crossing choice model in Batu Pahat, traffic speed, driver yield, pedestrian number and pedestrian age group are the significant influencer for pedestrian choice. Raff's method result shows the critical gap size value is approximately 12.5 seconds, which is quite similar to reported in previous studies. These outcomes would be recommended to use in the evaluation of unprotected mid-block crosswalks and designing of new crosswalk facility in Malaysia..

Keywords: Pedestrian, Gap Acceptance, Multiple linear Regression, Binary logit regression, Critical Gap Raff's method, mid-block, unprotected

1. Introduction

Road accidents, including pedestrian accidents have become a main safety issue all over the world [1] Safety studies on pedestrians crossing has been widely conducted in many countries due to huge number of pedestrian casualties in traffic accidents [2]. The pedestrian behavioral researches are covered as one of the scopes related to pedestrian safety. This is because the pedestrians crossing behavior, particularly for the time of the performance of road crossing is a significant factor in pedestrian safety related matter [3], [4].

In the developing country pedestrians facing difficulty when they are attempting to cross the street due to the driver behavior

towards to them. Pedestrians usually waiting for a long time until finding a volunteer who stops for them to allow them cross safely otherwise they wait until there are no more vehicles This phenomenon, perhaps due to lack of awareness on the rule of the right of way in such situation [5].

The traffic on Malaysian urban streets is considered as heterogeneous. Amongst of the numerous pedestrian crossing facilities, unsignalized midblock crossing locations are critical because barely hard any vehicle slow down to pedestrians there, even though in the presence of signs that shows gives priority to pedestrians over vehicles at unsignalized midblock locations. Therefore, pedestrians must wait until a

proper gap is accessible in the conflicting mix traffic stream. At crossing locations on multi-lane streets, pedestrians usually cross in stages, taking decisions for each conflicting vehicle. Decision to reject or accept gap size is influenced by several variables. All the above discussion underlines the need to understand crossing behavior of pedestrian, gap acceptance at uncontrolled mid-block crossings locations in the presence of mix traffic condition. More analysis and explanations of different aspects of heterogeneous traffic by [6]–[9]

Several researches investigated the pedestrian's gap acceptance behavior in developed countries. They discovered an effect of some factors such as gender, pedestrian waiting time, frequency of attempt, grope crossing and type and speed of vehicle, etc. On the other hand, very rare stud has been carried out for developing countries. In this paper, binary logit and Multiple liner regression models were developed to predict the probability of reject or accept a given gap size for pedestrian from traffic at mid-block location considering a number of potential influence variables.

2. Literature Review

Past literature discussed several forms of pedestrian's gap acceptance are presented in this context a study by Papadimitriou, E et al. [10] investigated binary logistic “discrete choice models” to analysis pedestrian's crossing decision while crossing a street section [11], [12] employed a lognormal regression model to evaluate the influence of various factors on pedestrian gap acceptance. Based on results showed by Sun. D et al. [13] and Chu, X. [14] making crossing decision pedestrians to cross the street depends on the distance between pedestrian and the coming vehicle. [15] and [16] found that the distance between the pedestrian and the vehicle is significant predictor variable of crossing decisions. Brewer, M et al. Brewer, M et al. [17] Concluded that pedestrians speed is a

factor influencing gap acceptance for pedestrian. A study by [18]to understand pedestrian waiting time while crossing, its influences on pedestrian behavior. Zegeer, C. V et al. [19] carried out a study on safety effects of unmarked and marked mid-block crosswalks locations. The research done by C. M. Dipietro et al. [20] notice that pedestrians crossing in segregated accept longer gaps size than that pedestrians in group. A thorough appraisal of pedestrian gap acceptance have need of an understanding with the different types of gaps that are come across. However, There are gaps defined by site characteristics such as critical gaps and adequate gaps) and it is important to mention that gaps dependent on the situation present when the time pedestrians intending to cross road stream [17] .

The critical gap defined by Highway Capacity Manual as the duration below which pedestrians won't try to start crossing a road [21], [22] defined the duration in seconds headway between vehicle and another vehicle in one direction as the pedestrian's gap acceptance to cross the street. Another definition given by Raff Critical gap is the lowest value gap size in second that is acceptable to a pedestrian, wants to cross a conflicting road stream. Critical gap considered as the most significant factor in gap acceptance behavior.

The main objective of this research is to investigate mid-block crossing of pedestrians' traffic gap acceptance at urban street in Batu Pahat under mix traffic condition. The influence of traffic, situational and some important variables were studied to model their effects on pedestrian's gap acceptance. Variables that were not considered in other previous studies in Malaysia but were considered in this study in order to make a better understanding about crossing behavior of pedestrians along urban streets in Malaysia.

3. Research Methods

To achieve desired objectives for this research, video camera were installed to collect and observe the pedestrians behavior characteristics and attitude toward traffic movement while crossing road stream at uncontrolled mid-block location. A total of 380 data samples were collected randomly. at Jalan Rughaya during a fixed period of time. All observations lasted 2 hours and took place either during the morning (10:00–12:00 p.m.) or the afternoon (4:00–6:30 p.m.) over a 3-weeks period excludes weekends. This period of times were chosen because they are the duration during which most pedestrians outdoor. All observations were taken in a good weather conditions. 14 variables were involved in the study of mid-block crossing patterns at Batu Pahat area as described in Table 1. From the table, gap size and gap acceptance are the dependent variables while the remaining 12 variables are independent variables. In addition, gap size is a scale dependent variable to gauge the time gap between two incoming vehicles at the crossing spot in the unit of second; while gap acceptance is a dichotomous variable that measures whether pedestrian crossed (code = 1) or did not cross (code = 0) the road. For independent variables, traffic speed measures the speed of vehicle at the crosswalk (km/h), pedestrian waiting time measures the time used to wait at the crossing area (seconds), frequency of attempt measures the number of attempt made to cross the road (frequency), driver yield measures whether vehicle driver slowed down for pedestrian (0: no, 1: yes), crossing distance measures the crossing distance of road (meter), vehicle size measures the size of vehicle (0: small, 1: big), illegal parking measures presence of illegally parked vehicle along the road side (0: no, 1: yes), gender measures the pedestrian gender (0: female, 1: male), gap type measures the distance between pedestrian and the gap (0: near, 1: far), pedestrian number measure the number of pedestrian waiting to cross the road,

pedestrian baggage measures whether pedestrian carrying baggage to cross the road and lastly, age group measures the pedestrian age (1: young, 2: middle, 3: elder).

Table 1: List of variables

Variable	Type	Unit	Description
Gap Size.	Continuous	sec	Gap between two incoming car at the crossing spot
Gap Acceptance.	Discrete	0: Reject 1: Accept	Whether pedestrian is crossing the road
Traffic Speed.	Continuous	km/h	Speed of vehicle at the crosswalk area
Pedestrian waiting time.	Continuous	sec	Time spent waiting at the crossing area for suitable gap
Frequency of attempt.	Continuous	Count	Number of attempts made by pedestrian before accept the vehicular gap
Driver Yield.	Discrete	0: No 1: Yes	Driver reduces speed when pedestrian is trying to cross
Crossing Distance.	Continuous	m	The crosswalk width that pedestrian need to cross
Vehicle size.	Discrete	0: Small 1: Big	Size of vehicle
Illegal Parking.	Discrete	0: No 1: Yes	Presence of illegally parked car
Pedestrian Gender.	Discrete	0: Male 1: Female	Gender of pedestrian
Pedestrian Number.	Continuous	Count	Number of pedestrian in the group
Gap Type.	Discrete	0: Near 1: Far	Distance between pedestrian and the gap
Age.	Discrete	1: Young 2: Middle 3: Elders	Visual appearance of pedestrian
Pedestrian Baggage.	Discrete	0: No 1: Yes	Pedestrian carrying baggage or not

4. Results & Discussion

4.1 Descriptive Analysis Of Variables

To study the mid-block crossing behavior in Batu Pahat, Descriptive analysis was

conducted on the data using mean, standard deviation, minimum, maximum, frequency and percentage, in which the results are as presented in Table 2 and Table 3 both discrete data and continuous data respectively. Analysing the table of discrete variable, study discovered that 70.3% out of 380 samples crossed the road at Batu Pahat by accepting the gap size. As for the vehicle driver driving behaviour, data showed that 66.1% of the driver actually slowed down their speed to accommodate the pedestrian driving. Data also showed that there were about 29.5% of the road crossing happened in Batu Pahat accompanied by illegal parking along the road side. Further, study found out that majority of the samples were male, accounted for 60.5% of total respondents. As far as gap type is concerned, 53.4% of road crossing attempt happened when gap were near to the pedestrian, while 46.6% happened when gap were far from the pedestrian. Results showed that the age groups of pedestrian distributed almost equally, in which young group accounted for 30.3%, middle group made up 37.6% of total samples and elder group consisted of 32.1% of total samples. In Batu Pahat, majority of road crossing accompanied by small vehicle (80.5%) while large vehicle only accounted for 19.5% of total samples. In addition, it was also found that only minority of respondents carry baggage with about 9.2% of them. As for the continuous variable, gap size showed mean time value of 24.51 secs with range of 4 to 55 secs, while traffic speed showed mean value of 42.29 km/h with range of 28 to 60 km/h. Then, the mean of pedestrian waiting time is 24.98 secs with range of 6 to 59 secs, the mean frequency of attempt was 0.18 with range 0 to 1 times; while the pedestrian number showed mean value of 1.29 with range 1 to 5 person.

Table 2: Descriptive statistic for discrete variables

Variables	Frequency	Percent
Gap Acceptance		
Reject	113	29.7

Accept	267	70.3
Driver Yield		
No	129	33.9
Yes	251	66.1
Illegal Parking		
No	268	70.5
Yes	112	29.5
Pedestrian Gender		
Male	230	60.5
Female	150	39.5
Gap Type		
Near	203	53.4
Far	177	46.6
Age Group		
Young	115	30.3
Middle	143	37.6
Elder	122	32.1
Vehicle size		
Small vehicle	306	80.5
Large Vehicle	74	19.5
Pedestrian Baggage		
No	345	90.8
Yes	35	9.2

Table 3: Descriptive statistic for continuous variables

Variable	Mean	S.D.	Minimum	Maximum
log_gap	1.09	0.236	0.6	1.74
Gap Size	14.51	9.545	4	55
Traffic Speed	42.29	8.938	28	60
Pedestrian waiting time	24.98	11.588	6	59
Frequency of attempt	0.18	0.384	0	1
Crossing Distance	9.26	0.438	9	10
Pedestrian Number	1.29	0.528	1	5

4.2. Pedestrian Behavioural Model

To study the pedestrian road crossing behaviour, study employs multiple linear regression (MLR) model to explain the influence of some factors on the pedestrian accepted gap size (log_gap). It is important to understand that study filtered out those rejected the gap size, i.e. those who do not cross at the recorded road section. Furthermore, study utilised stepwise

method for model estimation to remain only significant factors/ predictors and the results were shown in Table 4. The stepwise regression computation resulted in a significant 7 predictors or factors model ($F_{7, 259} = 166.271$, $p \approx 0.000$) where were able to explain 81.8% of the changes in the log gap size that were accepted by pedestrian at Jalan Rughaya. To assess the multicollinearity of regression model, study examine the VIF values and noticed that there was no multicollinearity potential since all VIF values were lower than 10. Based on the model, it seems that traffic speed, pedestrian waiting time, vehicle size, pedestrian gender, pedestrian number, age group and crossing distance were the significant factors for log gap size at 0.05 significance level. Traffic speed was found to have positive influent on gap size with B value of 0.011, meaning that if the vehicle was found to approaching the crossing zone at higher speed, the pedestrian will more likely to accept wider gap size which is much safer for them to cross. A unit increase in traffic speed (km/h) will increase the accepted log gap size by 0.011 seconds or gap size by 1.025 seconds. Pedestrian waiting time is the only factor that was found to have significant impact on the accepted log gap size with B value of -0.006, suggesting that the longer the pedestrian waiting time, the more likely they will get impatient and accept narrower gap size. A unit increase in pedestrian waiting time (sec) will decrease the log gap size by 0.006 seconds or gap size by 1.014 seconds. For vehicle size (0: small, 1: big), it was found to have significant positive effect on accepted log gap size with B value of 0.095, indicating that pedestrian tends to accept wider gap size when they are facing larger vehicle. In general, when facing large vehicle, pedestrian accept 0.095 seconds wider log gap size or 1.244 seconds wider gap size as compared to facing small vehicle. Pedestrian gender (0: male, 1: female) showed positive B value of 0.058, suggesting that female pedestrian will likely to cross the road with longer gap size

compared to male pedestrian. In general, female accept 0.058 seconds for log gap size or 1.143 seconds for gap size longer than that of male pedestrian in Batu Pahat. As far as pedestrian number crossing the road in group is concerned, positive B value of 0.049 indicated that if the pedestrian were to cross the road at larger group, they tend to accept wider gap size. A person increase in pedestrian number (group crossing), will increase the log gap size by 0.049 seconds or 1.119 seconds. For age groups, results revealed a positive impact on gap size acceptance with B value of 0.041, suggesting that the older the pedestrian, the wider the gap size acceptance. As for the crossing distance, study discovered that it has positive impact on the accepted gap size of pedestrian in Batu Pahat with B value of 0.054, indicated that the wider the crossing gap, the wider the accepted gap size. With that, a unit increase in crossing gap (meter), will increase the log gap size by 0.054 seconds or gap size by 1.132 seconds. To study the relative strength of each factors, the BETA values were assessed, in which high absolute value of BETA indicates greater influence toward the gap size acceptance. Based on the results, clearly traffic speed and pedestrian waiting time have the relatively highest impact to gap size acceptance compared to other factors, both with absolute BETA value of 0.294 and 0.297. In addition, vehicle size was found to have relatively strong influence towards gap size acceptance compared to other remaining factors with absolute BETA value of 0.176. Lastly, pedestrian gender, number, age group and crossing distance were deemed to have competitive strength of influence and were relatively weaker as compared to traffic speed, pedestrian waiting time and vehicle size.

$$\begin{aligned} \text{Log gap_size} = & 0.243 + 0.011 \text{ TS} - 0.006 \text{ PWT} \\ & + 0.095 \text{ VS} + 0.058 \text{ PG} + 0.049 \text{ PN} + 0.041 \text{ AG} \\ & + 0.054 \text{ CD} \end{aligned} \quad (1)$$

Table 4: Regression weight statistics

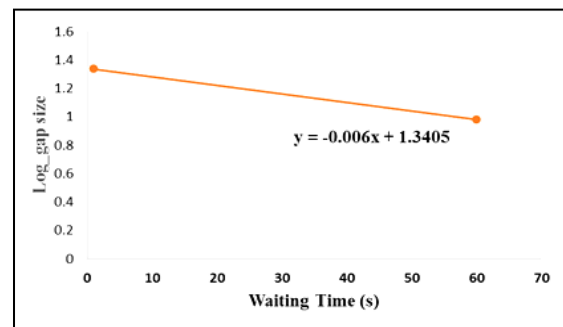
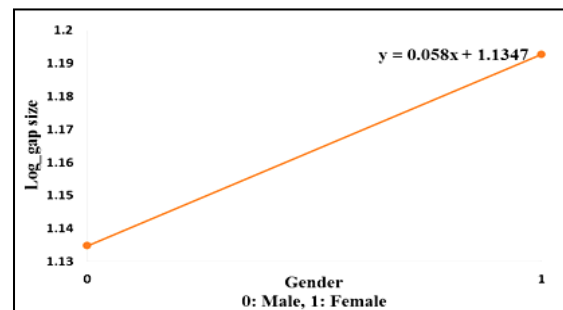
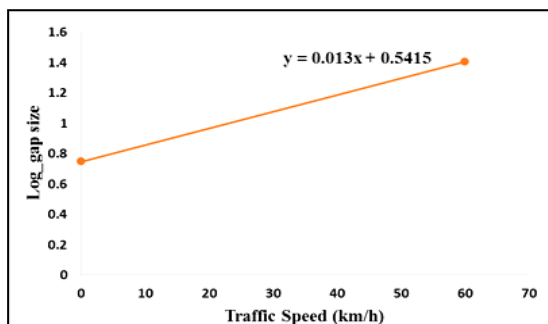
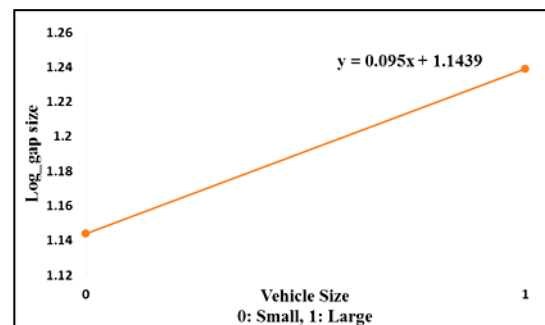
Variable	B	Beta	t	P-value	Tolerance	VIF
(Constant)	0.243		1.665	0.097		
Traffic Speed*	0.011	0.294	7.992	0.000	0.518	1.929
Pedestrian waiting time*	-0.006	-0.297	-9.696	0.000	0.749	1.335
Vehicle size	0.095	0.176	5.13	0.000	0.596	1.678
Pedestrian Gender	0.058	0.136	4.061	0.000	0.625	1.6
Pedestrian Number*	0.049	0.125	3.462	0.001	0.54	1.85
Age Group	0.041	0.113	3.498	0.001	0.675	1.481
Crossing Distance*	0.054	0.121	3.353	0.001	0.542	1.845

DV: Log_gap, $R^2 = 0.818$, $F(7,259) = 166.271$, p value ≈ 0.000 , *continuous variable

Equation 1 was used to plot the relationship graph as in Figure 1 to Figure 7 using the constant mean values as in Table 5. From the graph, factors that showed inclining line suggest positive impact while factors that showed declining line showed negative impact on the accepted log gap size.

Table 5: Mean statistic for variables

Variables	Mean
Traffic Speed	37.74
Pedestrian waiting time	29.75
Vehicle size	0.19
Pedestrian Gender	0.47
Age Group	1.3
Pedestrian Number	1.62
Crossing Distance	9.34

**Figure 2: Relationship between waiting time and log gap size****Figure 3: Relationship between gender and log gap size****Figure 1: Relationship between traffic speed and log gap size****Figure 4: Relationship between vehicle size and low gap size**

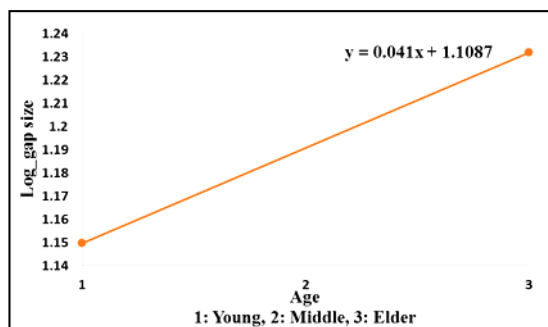


Figure 5: Relationship between age and log gap acceptance

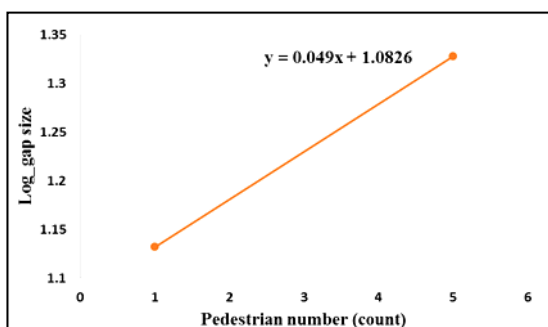


Figure 6: Relationship between pedestrian number and log gap size

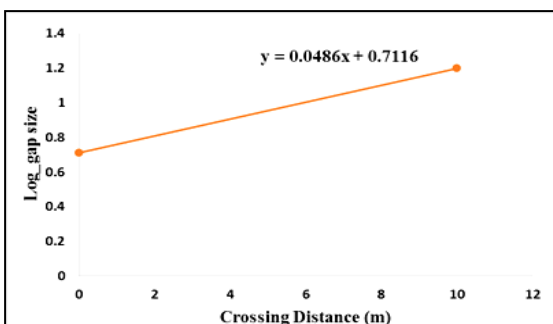


Figure 7: Relationship between crossing distance and log gap size

4.3 Choice Behaviour Model

Binary logit model was employed to analyse the choice opportunities for pedestrian road crossing behaviour at uncontrolled mid-block location in Batu Pahat. For this section, data were randomly divided into calibration set (n=304, 80%) and validation set (n=76, 20%). Calibration set of data will be used to calibrate the logit model for gap acceptance while the validation set of data will be used to calculate the predictive power of the model.

Based on the result in Table 6, the final binary logit model can be written as:

$$U_i = 34.602 - 0.549 TS + 4.811 DY + 4.772 PN - 7.204 AG \quad (2)$$

From the binary logistic regression, study found out that there were four significant factors namely, traffic speed, driver yield, pedestrian number and age groups for the gap acceptance (0: reject, 1: accept) among the pedestrian at Batu Pahat. From the results, traffic speed showed negative B value of 0.549 meaning that if the vehicle approaching at higher speed, the likelihood for pedestrian to reject the gap will be higher. The $\exp(B)$ value of 0.577 suggests that each unit decrease in traffic speed (km/h), the probability of pedestrian accepting the gap will increase by a factor of 1.73. As for the driver yield, B value of 4.811 indicates that if vehicle driver slowed down their speed near the crossing zone, pedestrian are more likely to accept the gap size. In addition, $\exp(B)$ value of 122.798 indicates that if vehicle driver were to slow down their vehicle, the probability of pedestrian crossing the road would increase by about 122 times. Next, B value of 4.772 for the pedestrian number clearly showed that pedestrian are prone to accept the gap if they were to cross with larger group. Looking at the $\exp(B)$ value of 118.136, it tells us that each unit increase in the pedestrian number in the crossing road, the likelihood of them accepting the gap will increase by 118 times. Moreover, age groups showed negative B value of 7.204 showing that older pedestrian has lower probability of accepting the gap compared to younger pedestrian. Each unit decrease in age group (i.e. from older to middle, from middle to younger) will increase the chances of pedestrian accepting the gap size by 1000 times.

With the calibrated model, study validate the model by calculating the probability of crossing as follows:

$$p(i) = \frac{e^{34.602 - 0.549 TS + 4.811 DY + 4.722 PN - 7.204 AG}}{e^{34.602 - 0.549 TS + 4.811 DY + 4.722 PN - 7.204 AG}} \quad (11)$$

Study used the threshold value of 0.5, meaning that if the calculated probability of crossing (accept the gap) were greater than 0.5, study then predict the sample chose to cross the road in Batu Pahat. From Table 7, the calibrated model showed overall accuracy of 99.3% and the model validation showed accuracy of 97.4%, suggesting that the binary logit model has good predictive power using 4 predictors, namely traffic speed, driver yield, pedestrian number and age groups.

To better explain the impact of traffic speed, driver yield, pedestrian number, and age groups on pedestrian crossing choice model, study plot the probability versus predictor graph as in Figure 81 to Figure 11. The predictor were plotted one at a time, with the remaining predictors held constant at value of 35 km/h for traffic speed, 0 for driver yield, 1 for pedestrian number, and 3 for pedestrian age group. Based on the graphs, clearly traffic speed and age group have reverse impact on the crossing probability while driver yield and pedestrian number have direct impact towards the pedestrian crossing probability.

Table 6: Regression weight for binary logistic regression

Variable	B	S.E.	Wald	df	P-value	Exp(B)
Traffic Speed	-0.549	0.184	8.875	1	0.003	0.577
Driver Yield	4.811	1.787	7.244	1	0.007	122.798
Pedestrian Number	4.772	1.853	6.633	1	0.010	118.136
Age Groups	-7.204	2.935	6.026	1	0.014	0.001
Constant	34.602	12.075	8.212	1	0.004	1.1E+15

Cox & Snell R Square = 0.692, Nagelkerke R Square = 0.979

Table 7: Model accuracy statistic

Gap Acceptance (p)	Correct %

		Reject	Accept	Partial	Total
Gap Acceptance (o)	Calibrated	Reject	91	1	98.9
		Accept	1	211	99.5
	Validated	Reject	20	1	95.2
		Accept	1	54	98.2

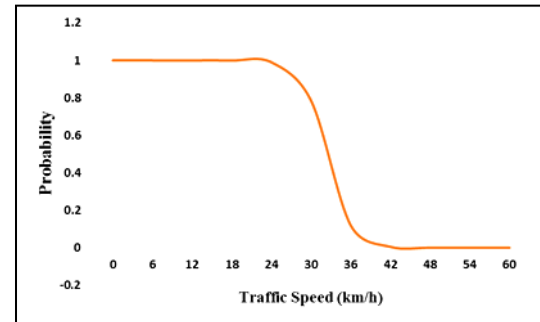


Figure 8: Traffic speed and crossing probability

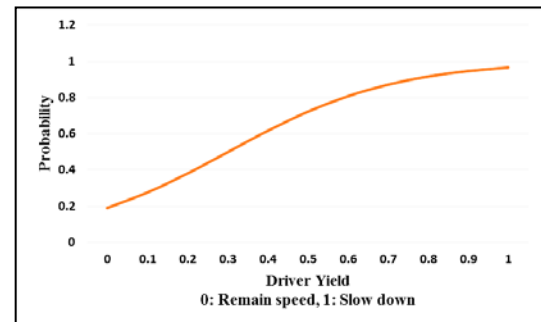


Figure 9: Driver yield and crossing probability

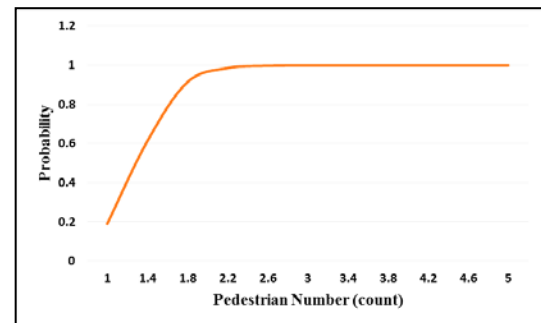


Figure 10: pedestrian number and crossing probability

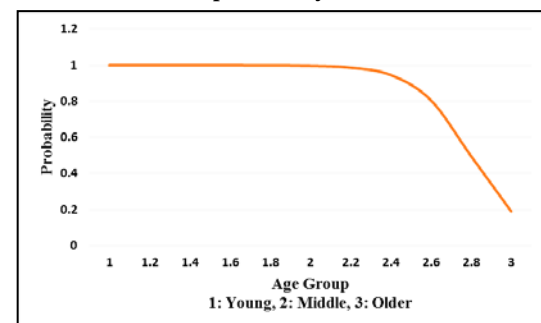


Figure 11: Age group and crossing probability

4.4 Critical Gap Size

Study employed Raff model to determine the critical gap for pedestrian crossing at Batu Pahat. Raff defined the critical gap value as the value at which the cumulative distribution functions (CDFs) of the accepted gaps intersects with the cumulative distribution of the rejected gaps. At this interception, the probability of a pedestrian rejecting a gap becomes less than that of accepting a gap, thus it is the critical gap value. Based on the CDF graph plotted (Figure 12), the critical gap size is approximately 12.5 seconds.

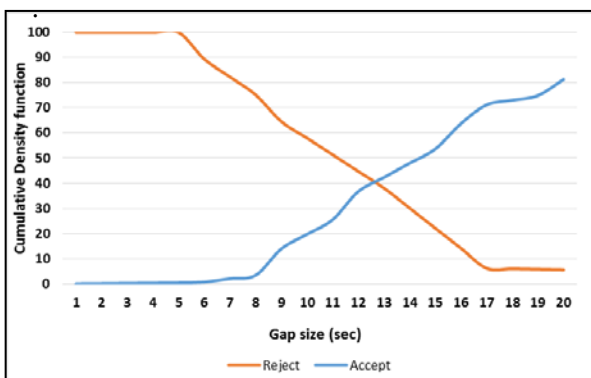


Figure 12: CDF of gap size rejection and acceptance

5. CONCLUSION

In Cyberjaya mid-block crossing data, study found seven factors that influence the pedestrian behaviour in terms of accepted gap size in seconds. Results showed traffic speed, pedestrian waiting time, vehicle size, pedestrian gender, crossing distance, age group, and pedestrian number are the significant factors for accepted gap size of pedestrian in Batu Pahat. Pedestrian waiting time was found to have negative impact on gap size acceptance while the remaining factors showed positive influence on the gap size acceptance. In order words, a pedestrian that facing higher traffic speed, lesser waiting time, bigger coming vehicle, being a female, crossing longer distance, older age, and crossing in larger group will more likely to accept longer gap size. In the development of crossing choice model in

Batu Pahat, traffic speed, driver yield, pedestrian number and pedestrian age group are the significant influencer for pedestrian choice. Results showed that slower traffic speed, driver reduce vehicle speed, pedestrian crossing with lager group, younger age group tends to promote higher probability of crossing the road compared to situation where the traffic speed is faster, no vehicle slow down, crossing with lesser group and older pedestrian.

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ETHNOGRAPHY OF ABU DHABI CORNICHE

Hadia Alhaddad*

Architect, United Arab Emirates University

*201470236@uaeu.ac.ae

www.nzaar.com

Abstract

The present research documents the social impact of Abu Dhabi Corniche development, seeking to identify the social value of the Corniche for local users and residents of the city. The social aspects of urban life continue to be central to urban planning and development. Waterfront areas, in particular, are significant contributors to urban sociality. That is particularly the case for Corniche developments, as these are explicitly oriented to social and recreational activities supporting the needs of urban residents and, increasingly, tourists. Significant issues include competition for limited space along the waterfront, questions involving the definition and demarcation of water edge boundaries, the celebration of the aesthetic values of the thresholds between city and sea, and the concerns over tensions between environmental and conservation imperatives, on the one hand, and typically intensive recreational uses of natural bodies of water and the land areas adjacent to them, on the other. This research considers issues related to public access, resource provision, activity support, urban public identity and other social implications of Corniche planning and development. The research takes a broadly ethnographic approach which includes site documentation, photo recording, field notes, direct in-person observation and in-depth interviews. Triangulation across these data collection techniques are used to test and reinforce the study's conclusions. The analysis concludes with a discussion of the value of Abu Dhabi Corniche for various categories of users and considers the general role and effects of Corniche type development on the social life of areas adjacent to urban waterfronts.

Keywords: Waterfront Activities, Social Value, Abu Dhabi Corniche, Urban Ethnography

1. Introduction

The city of Abu Dhabi is facing significant/ major challenge in Corniche area. The waterfront of the city, which is located in the city center of Abu Dhabi, is gradually growing and developed with responding to the surrounding urban environment. Some concerns were raised regarding the usage of waterfront areas among Abu Dhabi's multi-nations population, the future needs, required spaces of the city, and the future value of Corniche.

The social aspects of Corniche's studies refer to the different ways of using and experiencing the city edge of the waterfront to have a clear understanding of their use, quality, value, and importance to the community. This type of research is demonstrated by defining the underlying social behavior and analyzing some design features and their value in the current

Corniche planning model (Sairinen & Kumpulainen, 2006).

Further development and urban planning alternative options could be utilized for the increasing number of population and required for enlarged waterfront activities area. These options could include proposing an expansion of Corniche in its current location; however, it will generate an environmental issue of pollution for the natural elements ecosystem of the sea. Having alternative Corniche space in a different area of the city edge that contains the public's activities would be another option for any further requirements of increasing Corniches' spaces.

Many attention has been given to the understanding and the analyzing of Corniche and waterfront designs in the world due to several reasons, such as being the main sense of a city's image, the impact on the economy, and its effect on

the social activities and human behaviors. Additional to that, the physical activities are affected by the Corniche design (Sairinen & Kumpulainen, 2006). Many social issues could be avoided by having a well-planned pattern of the Corniche design. Furthermore, major safety and security issues could be solved with public areas planning. Additionally, the layout and the design of Corniche is one factor towards having a healthy living social community within its environment.

In this research, the social behavior in the Corniche is the main focus of the research topic. The study will be limited to UAE due to the lack of information and studies pertaining Corniche design. The research is focusing on understanding the Corniche design and identifying its value. The term ethnography to be studied not only the meaning that represents the behavioral factors, but also includes the social interaction, cultural, behavior, meaning, and identity values as well.

Selecting an appropriate research approach is essential to provide an organized direction to fulfill the objective and aim of this study. The method that been used in this research is ethnography approach. The proposed research plan divided into several phases starting with defining the research, collecting information, investigating, interviewing and finally concluding the research with highlights concerning the importance of design impact on the use of Corniche and Corniche design guidelines. The data collection for this study is based off several ways, including site based fieldwork, in-depth Interviews, personal observations, and photo recording.

Such study on the waterfront and Corniche design has not been investigated before for a population consists of group of multi-nationalities in one area, with frequently changing of demography over the years, and with having different visitors and tourists attraction in the city.

This research represents the value of Abu Dhabi Corniche from the perspective of different categories of population, and the role and effects of the waterfront on the social life in the urban environment. This work helps in defining the use of the Corniche in Abu Dhabi and it shows the activities held within this long waterfront. Additional to that, the study represent the different use of the Corniche for different reasons and the value of the Corniche in such environment including its aesthetic and quality value. It gives an understanding of how the Corniche been utilized by the different group of people of various ages. Also, this study helps in highlighting the main design feature that been used within the Corniche area and shows the role of Corniche in the quality of social aspects in Abu Dhabi city on how the Corniche design affect the social interaction.

The gathered information also helps in increasing the awareness of the planners, developers, decision makers and the community about the impact of the waterfront development in the economic, politic, and social aspects. In general, the main question is investigating the relationship between the natural environment, the social life, and the human activity. It is essential to integrate the impact of different aspects of life such as the social, ecological, and economical on the planning and developing process of an area.

This research is not a typical research that having specific questions to be asked, as in this research several issues are being addressed to identify and understand the people behavior in the Corniche and are as follows:

- The value of Corniche among the users
- The social aspect of Corniche design
- The benefits of Corniche for the population of Abu Dhabi city

- The utilization of Abu Dhabi Corniche design

Abu Dhabi Corniche Background

The Corniche is located in Abu Dhabi city on the western side of the main island. The Corniche was extended between 2002 and 2003, as the land regained from the sea. It is spreading across eight kilometers of public waterfront that consists of public plazas; children play areas, multiple lanes for pedestrians and cyclists, restaurants and cafes, and access to the beach. Corniche forms a wide curve path designed with fountains, park areas, and public facilities (UPC,2009).

Abu Dhabi Corniche is considered a public recreational and leisure space for the community of Abu Dhabi. It is providing a special experience for young and families with all of the supportive activities of walking, cycling, and sports facilities such as skateboarding, beach football, and volleyball. Additional to that, it enhances cultural activities and environmental events.

The development of Abu Dhabi Corniche has converted the Corniche into a family and community safe environment, with high interactivity along with facilities, such as restaurants, cafes and beach shops. The availability of such services helps to attract and serve both local and international visitors, with outdoor and indoor choices of seating, to enjoy the unique amenities of the Corniche. The Corniche is designed to have convenient access from various areas along Corniche road, with having full support for the pedestrian mobility like providing tunnels and walkways. (UPC,2009)

2. Literature Review

Waterfront as Urban resource

Waterfront is not an additional urban element to the city, as it is considered one of its valuable resources due to its unique character, and its value. The value of the

Corniche is derived from its unique location of being the borderline between the land and water, which capture exceptional location advantages of containing and viewing both movements on the water and the land.

Traditionally, the waterfront was considered as an unimportant urban element and had several issues, such as pollutions, accessibility, and urban disorder. However, like most of the urban spaces, the waterfront development has started to be considered as a mandatory option to develop the city with its economy and image.

The development of the waterfront includes highlighting the essential natural spaces, architectural designs, and infrastructure. A development that helps in introducing and contain new functions for different users, a development for local, visitors, and tourists as well, a place to be appreciated with all its users and viewers. The understanding of the specific value of the waterfront development has extended from being a border element between water and earth to have a significant impact on the social behavior of the people and the economic sector of the city.

The waterfront between city and port

Many of cities that are adjacent to water areas are often using the port as the primary resource for their economy. The waterfront acts as the central connection area between the city and the port that is getting more attentions from developers and urban planners for the value that the waterfront location has. (Bruttomesso, 2006)

With the modern planning and the consideration on the human behavior and peoples need as the mean consideration for the urban development, relocating the port activities away from the heart of the city is one of the main strategies to enhance the livability of the waterfront area, and

develop the waterfront design to be a place that serve the city and the people's needs. The waterfronts development is seeking to have a balance between the needs of the people and the movement requirements in the port area, which leads to building a mix used waterfront area which serve as port and as a social space for the peoples activities, allowing citizen and tourist to move freely and enjoy the connection between the land and water, and to be one of the attractive destination in the city for tourists. (Bruttomesso, 2006)

Waterfront (Corniche)

The idea of waterfront started as a focal point for port activities, and its connection between water and public functions.

In the past, ports have served as a transportation method for the city, and as economic drivers. Similarly, to how cities have been changed and developed over the years, its waterfronts and ports have followed as well.

Waterfront in the new developments represents and serves several functions. Examples of such includes the economic strength of localities, public spaces, promote positive city image, connect water to land, recreation area, leisure space, place marketing, tourist attraction, creating open green spaces, creating a focal point, urban residential, and increase access to cultural and natural facilities.

Defining the boundary of the waterfront is usually unclear due to several aspects, including its linkage and mixed with abandoned areas, commercial points, and residential sectors.

Waterfront design refers to the activities that help in creating a space that will balance living, working, recreational functions of individuals.

Waterfront categories

There are several categories of waterfront functionality, and each category has its character and preference design, the following are the main categories for the waterfront: (Gospodini, 2001)

- Commercial oriented waterfront- where many businesses activities take place and aim to expand the waterfront to be as a financial and working districts
- Leisure and entertainment waterfront- where the design is aiming to direct the waterfront to be more recreational areas with having all the leisure activities, sea activities, and sports. Commercial center- with having shopping centers, business districts with all of the required conference facilities.
-
- Residential district waterfront- where all of the luxury housing are expanding along the waterfront.
- Environmental waterfront- which includes providing walkways, land and marine parks and aquariums.
- Cultural waterfront- locating theaters, historical buildings, restaurants and hotel along the waterfront, which aim to transfer the waterfront into tourist and historical area.

Waterfront challenges

All around the world, port areas are facing several challenges in developing the urban waterfront planning in order to create economic, tourist, recreational and residential attraction environment.

Transforming the port area and seaside edges of the city from industrialization environment and way of transportation and good exchanging to a tourist attraction and urban public spaces has widely occurred around the world. (Doorne, 1998; Hutton, 2009).

The transformation occurred in the seaside cities have several effects on many aspects. These effects include, but not limited to, the changing on the political matters, effecting the economic frameworks of the city, altering the urban revitalization, design and planning, the character of heritage and history in the generations, the transformation of land-use in waterfront districts. Additionally, it affects the environmental and ecological matters regarding the waterfronts. (Gordon, 1999; McCarthy, 2004).

In general, there are two main types on waterfront development projects from the perspective of tourism planning design. The first type is converting the waterfront edge into a tourist attraction, which means planning for the tourist required activities, behavior and preferable design elements and leisure functions. In this model tourist are becoming the main and prime users of the waterfront renewal. The aim of such tourist oriented waterfront environment is generate a high standard esthetic marketable area, improve the historical awareness of the area, and promote the cultural attractions by hosting multi urban activities and festivals. (Craig-Smith, 1995).

While the other waterfront development type of is concerning on conserving the local needs and the original uses of the waterfront area with integrating tourism and leisure aspects. Diverse models of waterfront renovation emerge as a result, as few of them produce gentrification, while the others concentrate more on the heritage and community culture. (Hoyle, Pinder, & Husain, 1988).

The social aspect of waterfront

The assessment of the social impact of the urban waterfront planning studies the several options of utilizing and living the edges of the seaside's, and have a clear understanding of their planning qualities

on the social behavior and community. (Sairinen and Kumpulainen, 2006)

The objective of such analysis helps in raise the awareness of different people such as the planners, governor, and decision makers on the effects of the waterfront planning design proposals on the social behavior. furthermore, it increases the community awareness about the cultural and social aspects of the waterfront areas including the recreational aspects, physical, cultural, and social interaction between the waterfront and community.

Based on different studies pertaining the waterfront, the social trait of the urban waterfront development is defined by several categories that include social status, identity and resources, activities and access, and the experience of waterfront. The aim of these categories is to analyze and identify the social effect of the urban waterfront areas. (Gordon,1996)

Numerous categories of the social effects on the waterfront planning design can be analyzed according to the different users,; the importance of water needs for the social life; and the influence due to the interests of people and their involvements in the waterfront development.

The first category is the people who utilized the waterfront areas as their residence spot, working place, or recreation areas integrated with waterfront sites for industrial use, housing, transportation, commercial, and a wide range of recreational activities and leisure facilities.

On the other hand, the second category of people who use waterfront environment as a viewing area and treats it as an urban public space. This class is concerned about the utilization of the waterfront and its quality regardless if they might not directly benefit or utilize this area, as they see the

waterfront area as an environmental and recreational attractive resource. (Sairinen and Kumpulainen, 2006)

3. Research Methods

There are several methods used to conduct a research, depending on its nature, the type of questions, the answers that the researcher is looking for, the culture of the studied area, the availability of materials, the accessibility of the materials and the quality of the gathered data.

Ethnography qualitative method is used in this research. The Ethnography methodology is implemented where the focus is on particular people and behaviors in considerable depth. The study is conducted via observing a group of people that shares a common culture and behavior, which is the use of Corniche. The studied group were observed in its natural setting for a long period of time, and the focus is on investigating the daily behavior of the people in this group, for example their interaction, language, activity, etc. (Sherman, 2001)

In this research, the selected method used is the interviews with the people, analyzing and observing the people. The followings tools were used in this research method:

- Analyzing the urban design of the selected Corniche,
- Face to face interviews performed with 10-15 participants using and visiting the Corniche
- Field observations within the selected investigated Corniche.

Research Design

Urban design and planning is a very broad area to study and analyze. Within this area, there are many focused issues to investigate. One of these areas is the Corniche design with social behavior where a further study and research to be conducted.

The study focuses on understanding in particular the Corniche design and identifying its value. The term ethnography to be studied not only the meaning that represents the behavioral factors, but additionally it includes the social interaction, cultural, behavior, meaning, and identity values as well.

Even though that such research have been conducted over wide and around the world, yet the result and research outcome are mostly beneficial for the regions that the research was done within it, and in many cases focuses on the economic factor of the Corniche. Therefore, this research focus is essential in our area in order to have clear data and information about the Corniche design. Ethnographic Corniche study is the understanding of the overall social behavior and design pattern, the character of a particular area, its effect on the human behavior, and its relationship to the social aspects, how it affects the cultural values, and its emphasis on the interaction between people.

Several research questions could be raised in order to understand the social behavior of an area; these items are usually interrelated to each other and complete the research purpose. Such questions include: How the Corniche has been designed? How has it been evaluated? What are the evolution stages of the Corniche design? In which direction? To which extend? How do people adopt with it? What are the principles of Corniche design? What are the factors that affect the Corniche design? What makes a social Corniche? How does cornice design affect human behavior? All of these items to be studied and identified under the ethnographic Corniche design.

Data Collection

The data collection methods help in identifying the answers for the research issues. With analyzing the Corniche design pattern we could have a clear understanding about the overall Corniche

planning and zoning, the different areas such as the public spaces and the activities zones, the connection between each one of zones, the access to them, and the circulation to reach one another. The observations of the human behavior have been used to evaluate frequently usage of the different public facilities and the nature of users' movements. The face-to-face interviews identified clearly the issues that the people face; highlight the needs of the people and what's their influence on the layout design of the Corniche, how to improve it and what to implement in the future Corniche design.

The data collected from such research method contains several items such as, the behavior of the people in such public area, the way of living, the interaction between people, the quality of life in this design pattern, the issues people find within the Corniche, the possible solutions and guideline to improve the Corniche design and enhance the life quality within it. In addition to that, it allows making the people part of the decision-making in their community, and introduces a guideline that suits the people needs.

Triangulation

The following chart explains the relationship between the different data collection methods, how they are related, connected and supporting each other. Additional to that, the data collected from different methods are forming several codes, which lead to specific themes that help in defining the results of the collected data. (Groat, L. N., & Wang, D., 2013). The use of triangulation method helps in supporting the validity and reliability of the collected data and shows that the data collected is accurate.

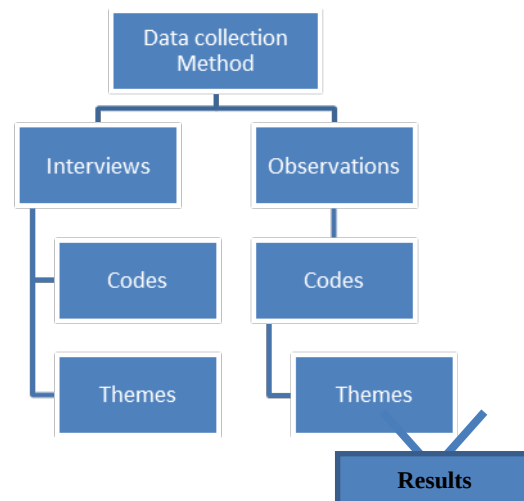


Figure 1 Triangulation

Ethnographic techniques

For this research, the selected methods used include interviews and field observations. The following explains in detail the interview and field observation design and strategies.

- Interview Design

One of the main important tools for data collection in ethnographic research is the interviews, many types of research have been relying on it heavily or solely, and in this research is relying on interviews as the primary mechanism for data collection. The ethnographic data collection that occurs by involving the interviewer within the culture, community, and context of participants. This type of conversation might not be a typical interview that occurs between the researcher and participant, rather it might go beyond this into a progress interview via daily conversation, observations, and continues interaction and meetings between the researcher and participant. (Sherman Heyl, n.d.) And this kind of interviews and conversations helps in improving the relationship between the researcher and participant which leads to more data and ideas received from the interviewer.

The interview method aims to understand the value of the Corniche for the users, how does the Corniche design supports its

function and understand the relationship between the people and the Corniche.

- **Field Observation**

The observation method helps in understanding the perspectives held by particular people. It is also used to have a full understanding of the social, physical, economical, and cultural context about the Corniche studied area. It helps in identifying the relationship between the people and the Corniche, activities and behaviors, and observes the people ongoing action in the natural settings.

Descriptive observation was conducted in the Corniche area. The observation was conducted in different areas of the Corniche to understand the various use of these places. The observation took place during the cold weather and throughout the week at different times. The purpose of selecting various days and timing for conducting the observations is to highlight the variety of activities and human behavior in this area.

The focus of the observation was on the human behavior, their activities, the relationship between the physical environment and the people, the use of different areas, the period spent in one area, the movement between section to the other, and the human interaction with all these activities.

Data collection and analysis

Narrative analysis is the method used in analyzing the collected data. This method is used when there is one or more participants are involved in explaining and sharing an event or a particular experience. The narrative analysis helps in understanding the social phenomena and human experience through the content of the analyzed stories. (Cortazzi, n.d.) There are many reasons for using narrative analysis method, which include: (Cortazzi, n.d.)

- Emphasis on the people stories and the way to explain the world
- Does not use narrative as stories that tell facts about the world
- Use narratives as social outcomes that are generated by people in specific context.
- Views narratives as educational tools which people express themselves and their experience and share it with others.
- Additionally, narratives can help in constructing personal or community identity, rationalize, organize, educate, remind, entertain, cope, or make an argument of a particular situation or event.

4. Analysis & Results

After collecting the data and conducting the interviews with several participants, analyzing the data and generating review is very critical for the completion of this study. The interviews were conducted with several people in the form of “informal conversations” and the codes and themes were generated according to the people’ responds from different research aspects, with respecting all of the participants’ experiences and personal preferable.

Generating themes and codes is the process of organizing the interviews collected data into sections and categories before having the final analysis of the information (Peräkylä, A.,2008). The data collected to be analyzed has to undergo the following stages:

- Starting with reading the transcripts several times and reviewing it.
- Second is to identify the relevant information, opinions, activities, and concepts.
- The third step is to highlight the important items to be coded and categorized.
- The fourth step is to generate themes out of these codes and

categories and connect them to the research issues.

- Finally conclude the themes and analyze the results.

Interviews

Many interviews were conducted in this study to get a variety of responses and experience from different users, in different timing, and different location of the Corniche. Some of these interviews were long and detailed, while others were short and brief. The following is brief of the main discussed points during the interviews:

Several interviewees talked about their experience at the beach and its condition of being clean and managed, and also describing the facilities and services provided such as the showers and restaurants. Many participants mentioned that they go for the Corniche for a picnic with the family as they appreciate the green areas. The location of the Corniche and the accessibility to it was one of the main areas that the participants talked about, for example having connections between the Corniche and the surrounding hotels, and the availability of public transportation reaching there. Many people said that the Corniche is good for families and friends gathering especially with the high security available. They consider it as a place for relaxing.

Some of the participants said that walking on the Corniche with having the view to the sky is their main purpose of visiting the Corniche. They said that there is a special walking area where people walk, jog and run. Also, some of the participants stated that they like to take photos in the Corniche. Other participants said that they go to the Corniche for fishing, especially during the evening and early hours of the day.

Several interviewees talked about the various services provided in the Corniche,

such as the cycling lane, walking lane, seating areas, exercising area, and bike parking. Also, they talked about the renting facilities provided for bikes and small children cars and the availability of different restaurants along the Corniche.

Field Observations

While being on the site, several things are important to consider while observing which helps in answering the research goal, these things include:

- Physical setting.
- Objects and material culture.
- Use of language.
- Behavior cycles.
- The order in which events occurred.
- Physical characteristics.
- Expressive body movements.

Being in the field for few times and observe the people behavior is essential for this study, as am looking into the people behavior and how they interact with each other and understanding the use of each design element in the cornich. The following list highlights the observations items during the time spent in the Corniche:

Table 1 Observations

OBSERVATION
Many people were visiting the cornich during the day, some of them just walk along the cornich, others were riding bicycle and running.
The cornich also was full with families, especially during the weekend, many children playing on the grass and running around their families, and renting bikes and riding it all along the cornich and returning to their families spot.
The nearest area to the sea water was place for small fishing activity especially during the night.
The green open areas were occupied with children and adults, where children used it as a playground area, and adults used it as a physical exercise

spot.

The exercising equipment's, the various lane of the Corniche were occupied. Seating in the various seating areas was very well occupied along the coniche

Many Events, flights show, science festival, mother day festival, yasalam festival were conducted along the Corniche with huge number of visitors.

Many people were standing in different locations of the Corniche to take photos from various angels; some of them consider the natural views while other consider the high rise buildings.

Many people were renting boat for a tour on the sea, renting bike, seating in the Restaurants, and shopping in the Beach shops.

Some people were doing different activities such as Group dancing and exercising, Water activities like jet sky, having friends gathering and Swimming.

Additional to the above, many Tourist busses stopped along the Corniche bus stops as an important feature of the city.

From the conducted interviews, it is clear that there is a connection between the users and the Corniche, as some refer to the Corniche visit as their daily routine and there is something wrong they feel it whenever they do not visit the Corniche. People considered that the Corniche visit as treatment way and stress reliever. The Corniche is a gateway to allow communicating and communing with nature and enjoying it. It was clear that the design of the walkways and landscape features were important for them to mention and criticize.

Corniche for some people is mainly for exercising and having different activities. As its better than indoor exercising environment like gym. They highlighted the importance of exercising in the Corniche to their health. People considered

being in the Corniche as a way to meet people and have real life relationships. Emphasizing on the amount and variety of facilities and services provided along the Corniche was also one of the attractions in their point of view for the Corniche. The way the Corniche is connected to the surrounding urban areas were impressive for the people as well.

Safety, security, maintenance, connectivity, and facilities, were some of the main consideration for many people as they repeatedly mentioned how the Corniche is considered as safe place to be in during the morning or even at night. Additional to that, the facility provided and its functionality was very important for many users and they highlighted it clearly with how good the maintenance for the services and facilities is.

The conducted interviews represent many themes mentioned by several peoples that helps in framing the study, these themes include the value of the Corniche, the Corniche design criteria, and the purpose of visiting the Corniche.

From my observation, I saw people doing all different kind of activities in the Corniche area, and all of the sections of Abu Dhabi Corniche were utilized by users. Starting with the cycling lane, where it was occupied most of the time with bikers, adults and children were using all facilities related to bike, from hiring bike and parking it at the bike parking areas. The walking lane was also occupied and used mainly by people who are running, jogging and walking, this area had benches at the sides of the lane, where people were resting from time to time from their walk or run. During the weekend and holidays, the Corniche is considered the main area for people to visit and spend their time. Whenever there was an event in the Corniche, the Corniche become very crowded with people coming by all kind of transportations, some are walking; others

using public services, and others used cars and taxi. The beach area was surprisingly used and many people were walking and swimming during that time of the year.

The data collected from the conducted interviews and field observations help in generating codes and themes that in turn will help in highlighting the concerns of the Corniche. Some of the highlighted issues

- The value of Corniche on the people
- The purpose and visiting of the Corniche
- The design criteria of Abu Dhabi Corniche based on people point of view.

This ethnography study is designed to understand the value, the importance, the quality and the meaning of the Corniche to the users. The goal of this study is to highlight the social value of the Corniche with the effect of the physical Corniche design on the people social life. Section one highlights the result and finding from the observations done in the Corniche and the conducted interviews, with identifying the Value of the Corniche for the people. Section two represents the meaning of the Corniche and the purpose of visiting the Corniche from different point of view gathered through several interviewed people. The people behavior due to Abu Dhabi Corniche design is also identified in the third section. In addition to the above, the different activities, services, and facilities provided and mentioned by the interviewee and observed through the observations are highlighted in all three sections.

Value of the Corniche

It is clear from the data collected and analysis that the Abu Dhabi cornice is not just an additional extra urban public place that people rarely visit, while the Corniche is considered as an essential place to be visited on a daily basis for many people. For many people the Corniche is

considered as one of their daily task, which makes them feel unsatisfied if they miss visiting it once. Not only it has been observed how people are connected to the Corniche as a physical public area, but also emotionally and as part of health recovery and enhancement. People believes that the Corniche is one of the unique places in Abu Dhabi where they are having many memories and experience, it's a place for themselves, for family, friends, and for the community. It is a place where they are connected to the nature from the city side and connected to people in public safe place.

Purpose of visiting the Corniche

The Corniche more than being the borderline between the land and water, its use and function vary and differ from a person to the other. People are using the Corniche for different purposes, such as being its way to escape from the stressful life and relax; it's considered a place for releasing stress and breathing fresh air. It is considered as a leisure place to enjoy time, as many events and festivals are held in the Corniche, and enjoy being connected to nature. The view of the city from the Corniche is very attractive that made it one of the tourist attraction spots. Many people enjoyed having different activities on the Corniche such as walking, running, cycling, playing sports, exercising, and fishing. The Corniche is designed with having full respect to the need for different activities, as many renting facilities for bikes and parkings, and special running lane are considered in the design. The Corniche is also used as a social gathering space for friends, family, and community, due to all of the open spaces, public plazas, restaurants, coffee shops, festivals, and events.

Design criteria

The Corniche contains many elements and design features to serve different functions and to attract visiting it. There are many attractive design features such as having

water feature along the Corniche. Many features were function-oriented such as bike parking, shading devices, exercising equipment's, and seating benches. People believe that a Corniche that is designed with separate lanes for cycling, walking and running, sitting and viewing is very beneficial to attract people with various activity interest to be in the Corniche. The accessibility to the Corniche is essential especially for such public areas, with having all different alternative options to reach the Corniche and that is by either using pedestrian tunnels, public transport or private cars. The equipment provided for exercising and bike-parking are located along the Corniche at multiple spots with full periodic services and maintenance during the year is enhancing the value of the Corniche and its usability. Open public yards and plaza is the attractive spot for public community gathering, celebrations, national events, and festivals.

In conclusion, we can say that the people daily experience in the Corniche and their interest in visiting the Corniche in daily basis is enhancing the value of Abu Dhabi Corniche for being a place for people and community. The facilities provided and services located along the Corniche such as equipment's, bike parking's, and restaurants are the supportive elements for the Corniche to achieve its target as an active public area. Children, adults, and elderly, are enjoying the Corniche due to the design consideration that suit each category from providing playing yards, open public spaces, different lanes, seating areas, relaxing spaces, restaurants, and refreshing corners.

5. Discussion & Conclusion

The Cornich (i.e. waterfront) design of Abu Dhabi represents a unique waterfront Design. The purpose of this research is not to identify or expand on the features of Abu Dhabi Corniche, nor to highlight its weaknesses, but to highlight the characteristics of Abu Dhabi Corniche that

make people consider it as one of its greatest strengths that enhance its value and attraction strength.

Waterfront and Corniche designs, and just like other urban areas, require many considerations and design implementations such as the accessibility, safety, walkability, view, etc. There is a potential for considering a special character of Abu Dhabi Corniche that serves its various ranges of visitors.

With the current character of Abu Dhabi Corniche, it is clear that the development of the Corniche area has been structured by a fundamentally several groups of significant values and represented several uses and functions of the Corniche.

Many considerations and design implementations have been presented in Abu Dhabi Corniche for enhancing social behavior, for example:

- Variety of designed places with different facilities provided
- Enhancing the connectivity to the Corniche and easy access to its areas for pedestrians
- Implementing several gathering areas in order to enhance the people connectivity
- Allocating special areas for different events and festivals to take place in the Corniche
- Respecting the nature and having clear view to the sea
- Concern with providing an enhanced image as part of the overall city plan to attract visitors and economic investment

Several design guidelines for the Corniche have been concluded and summarized as follows:

- One of the main important design elements of the waterfront is the continuity and public accessibility to the water edge. The idea of proposing pedestrian walkway along the coastline enhances the

value of the surrounding property and valued by the public users.

- Some of the design consideration for the waterfront and Corniche are the connectivity to the water edge, the visually corridors from the street down to the water, the possibilities for future expansion, flexibility of use, simple and clear infrastructure, producing quality public space.
- Additional to the physical setting for the Corniche area, the Corniche need to serve community purpose as well, including areas for festivals, marketplaces, and different public programs and facilities.
- Other than having the Corniche as a functional space, the design should have deep attention to the local sense of place and its related uses. As providing, a functional design with keeping the waterfront uses of fishing and marinas, and at the same time proposing a walkways and parks spaces for the public is one of the design technique for a successful waterfront design.

This research contributes to literature in highlighting the relationship between the public and the Corniche design and how the social life is affected by it. This research helps in the understanding of the importance and value of the Corniche for the users, and the different requirements for the Corniche design. It also presents how the people see the Corniche and what they believe it's important to have in its design. Additional to that, this study shows the connectivity between the users and the physical spaces from different directions, such as safety, walkability, views, activities, and facilities.

Suggestions for further research and study is to conduct the study during the whole year in order to get peoples feedback for the Corniche during the hot weather, to

have more observations timing and understand how is the people behavior during the summer season, and look for people's suggestions to improve the quality of Corniche during these times of the year.

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EVALUATING THE HOUSING QUALITY AND RESIDENTIAL SATISFACTION: A SCENARIO FROM MARGINALIZED URBAN PRECINCT OF DHAKA

Sadia Afrin^{1*}, Sohel Rana¹ Ebtesam Zoha²

¹Faculty of Built Environment, University of Technology Malaysia,

²Faculty of Built Environment, University of Malaya

*asadia2@live.utm.my, rsohel2@live.utm.my, monazoha@gmail.com

www.nzaar.com

Abstract

This paper provides the assessment of the housing quality in marginalized urban precinct of Dhaka, Bangladesh. Studies discovered that a fast spatial development of slums in Dhaka which has been occurring significant fluctuations that were seen in land utilization. The survey was to define which of the circumstances were ranked by the users with the overall satisfaction level about their housing quality and its effect on human well-being. The urban slums are found to give an insufficient indoor-outdoor environmental quality and it is expected to fundamentally enhance the well-being, and health hazards of the slums inhabitants. The data on household characteristics and housing quality have been provided by the 44 households from two notable slums in Dhaka. The qualitative approach lets an enhanced perception of the dwellers' experiences on housing quality. These outcomes will assist to formulate the much desirable policy for affordable housing design according to socio-cultural parameters.

Keywords: Satisfaction, Housing Quality, Well-Being, Environmental Quality, Perception

1. Introduction

It has been evaluated that more than one billion of inhabitants live in the poor housing such as sprawling and squatter settlements in developing nations [1]. The extensive deficiencies of housing and sub-standard residential and social conditions describe most urban slums in the developing countries of Africa, Asia, and Latin America. Researchers show that nearly a billion of people reside in marginalized conditions in inadequate accommodation, insecurity, and an absence of access to sanitation or water in the world [2]. While, many reviews have endorsed the reasons for the housing inadequacies to the fast population growth and urbanization in the developing nations [3].

The developing urban areas and towns in Bangladesh confront encounters that incorporate high rates of individuals living in slums, high living cost, deficiency of amenities and basic utility services (particularly sanitation, water, waste, sanitation, and energy), spontaneous urban growth, political and social clash over

resources, an abnormal state of defenselessness to catastrophic events and poor transportation frameworks. Dhaka, Bangladesh's capital is a rapidly urbanizing megacity in one of the world's populated and poorest nations, [4] where 40% of its population of more than 14 million lived in slum settlements.

The particular targets of this qualitative study were to: carry out the housing quality observing review in destitute families; and to understand about the occupants' residential satisfaction considering the basic two initial human needs. In this study, the limitations are: mostly, head of the families (including female-headed families) were chosen for the interview session, whereas other family members joined the session as well, which is an unwanted result of individual victimization of data.

2. Literature Review

The house has constantly developed globally and habitually on both socio-cultural and physical circumstances. Consequently, each development creates its

own particular forms based on social arrangements and cultural values. Taymurr (1992) and Gur (1994) described culture as a built form in the dynamic, complex, and universal phenomenon, with the variation of time and space [5, 6].

Socio-cultural Phenomenon in Housing

Rapoport (1969) explicitly emphasizes that *“house form is not simply the result of the physical forces or any single casual factor but is the consequences of a whole range of socio-cultural factors seen in broadest terms- the specific characteristics of culture- the accepted way of doing things, the socially unacceptable ways and implicit ideals needed to be considered since they affect housing and settlement form.”* [7] Fundamentally, the dwelling is a substantial mechanism instilled with social and cultural character.

Olanrewaju (2003) have demonstrated that specific intellectual variables, for example, socio-cultural, experience, and financial ability influence the human impression level of their dwelling condition [8]. Similarly, the major variables of housing, for example, residency framework, social position, and family pattern are significant features in cultural and social issues. Besides, other components, for example, social impacts, sex, age, human values influence human perception about their dwelling. Nevertheless, Rapoport (2000) and Lawrence (1987) had confirmed that dwelling patterns and cultural values among others are applicable determinants of housing quality [9, 10]. Considering the previous, Olayiwola, Adeleye, & Jiboye, (2006) confirmed that the socio-cultural characteristics are imperative parameters in the assurance of reasonable dwelling [11].

Indicators for evaluating Housing quality

Foster (2000) presumes that housing is a synthesis of attributes in any neighborhood with a variety of social, intellectual and

financial phenomena [12]. Though housing addresses people's lives and their country; an incredible significance credited to the part in human comfort level by both society and nature. This is the reason Eldredge (1967) presumes as housing expresses the facilitated amenities and improve a decent lifestyle, and neighborhood quality [13].

Moreover, housing act as a multidimensional bundle of amenities and products reaching out the house itself. It is essential to value the importance of an inhabitable (subjective) housing, so, it requires a comprehension of “value or quality” which as indicated by Onion, referred to in Afon (2000), *“is a mental or good trait of a thing which can be utilized while depicting the nature, condition or property of that specific thing.”* [14]

The acceptability of housing should consider, sort of development, space, amenities and utilities, materials, aesthetics and function among indoors and outdoors. Ebong (1983) distinguished the age of a building, basic utility services, aesthetics, access to fundamental amenities, spatial sufficiency, waste disposal, air contamination, as important quality determinants in accommodation [15]. Thus, the dwellings should include the arrangement of infrastructural facilities towards the enhancement of improved livelihood.

The Scottish Housing Standard specifies five essential standards mentioning regarding housing that must be consistence with regulations, free from deterioration, basic amenities, energy efficient and it must be sound, sheltered and secure [16]. The subjective assessment should also consider the type of construction, availability of space, spatial arrangements, amenities, materials between function and dwellings.

In the study, the qualitative assessment will be founded on the evaluation of residential satisfaction about the housing qualities in

terms of the building structure, material, utilities and services, environmental quality etc.

Correlating Maslow's Hierarchy of Needs in the Context of Housing

As indicated by Maslow (1970), fulfilling the essential needs of a man is vital for creating and realizing possibilities and limits of the individual [17]. The hypothesis concentrates on the beginning of human needs by emphasizing a global and unavoidable meaning of these inspirations. Maslow's characterization of needs comprises of five levels of subjective needs, including “*physiological needs, safety needs, needs of affiliation, needs of esteem, and the need for self-actualization.*”

Various researchers reported on houses provision for diverse levels of desires. Miller (2007) and Oliver (2006) propose that housing spaces can be ordered into three stages precisely home, house, and shelter [18, 19]. A home is considerably more than a physical structure than a house, while shelters are given to secure people. The differences are not negligible, or sentimental, but rather essential. As indicated by Oliver (2006), “House” is a signifying idea, where “small dwelling” is depicting the physical arrangement of the building, though “home” is a demonstrative idea [19]. Home is an image of the lives inside it that implies it indicates a social framework and family's relations to the dwelling space it owns.

The dwellings only can accommodate the physiological needs of the occupants. This recommends that residential satisfaction in a house, while depending on the social or economic position, is identified with the user's higher perceptual desires, for example, flexibility, sense of belonging, love and intimacy, aspirations, values and satisfaction. Thus, according to Lowe et al. (2013) it is accordingly essential that mass housing requirements can be incorporated in two vital stages of home making, to be

specific, the design phases of dwelling units, and the prospect manifestation works by the inhabitants [20].

Maslow esteems the initial step of human needs is signified by the very “*basic needs*” “*physiological needs*”, regarded as the fulfillment which gives a person's involvement and existence for a living; the requirement for water, air, food and so forth. Sex is also an imperative behavior of any individual that guarantees the survival and development.

The subsequent stage is characterized by the “safety or security needs”, which contain the necessity of having a shelter, the need of clothing, and so on. The “*needs of affiliation, need of esteem, the need of self-fulfillment*” are the relatively higher steps in the theory, which suggests the person's craving of all qualities one needs to achieve the most extreme level that can be accomplished as it is hard to characterize this point of confinement.

The theory's mechanism depends on progressively fulfilling the elementary human needs. Basically, it is esteemed that any individual begins by receiving and building specific choices and activities which would bring the satisfaction of the *physiological needs* and which address the person's survival itself.

Dhaka as a Study Area

Environmental problems are some of the most noticeable side effects of the difficulties confronting unplanned and slum settlements in Dhaka. Expansive slums, contaminated waterways, waste management are most common in urban slums, wellbeing and improvement perceptions evaluate the circumstances on the personal satisfaction [21]. Though housing quality in marginalized slums is regularly viewed as substandard, the slum inhabitants are regularly compelled to live in environmentally dangerous areas,

contaminated places near open drainage system, waste disposals, and sewers etc.

A solid reason that might be showed for this is the evidence connecting accommodation quality with inhabitants' well-being, personal satisfaction. It is additionally vital to comprehend the comfort determinants for the slum occupants. There is a need to study its significance in the assessment of qualitative housing quality and residential satisfaction in Dhaka, Bangladesh.

With a specific end goal to suit and deal with the mounting weight postured by the expanding populace, it is basic and inevitable that the limit of essential services, for example, water supply, shelter, public transport, waste and sewerage management, electricity, and so forth be extended [22]. It is exceptionally unavoidable and challenging for the government to give the basic urban services to urban poor, and profoundly dense slum advancement become inescapable. The surviving infrastructure with appropriate delivery framework in Dhaka can't manage the basic living prerequisite for the immense population, and the slums turn out to be significantly more marginalized. It is not that the government have not attempted to supply moderate housing, however in very constrained amount, keeping in order to encourage individuals to move out from slums to a better housing environment.

3. Research Methods

The method used in this study was the stratified random sampling. A sample of 44 households was investigated. The study was conducted into two lower-income slums including Korail (under City Ward-19) and Adabor (under City Ward-43). The Korail slum is the largest slum with more than 2,00,000 inhabitants and Adabor slum is another notable slum. The technique used was questionnaire survey which included the quality of life, dwellers' perception, and satisfaction on the housing condition. Another section comprised of open ended

question for the family members above 18 years old.

The data was gathered into focus groups of inhabitants in the qualitative method of study. Throughout the investigation, audio recordings and notes were involved for coding and analysis of the key dwellers, associated by profound perception, able to produce decent quality information. The qualitative findings were validated through triangulation and member checking. Open-ended questionnaire survey involves the dwellers to categorize the satisfaction level for comforting features. The respondents were need to level their perception on satisfaction grounded on 5 "numerical Likert-scale; 1 (Very dissatisfied-VD), 2 (Dissatisfied-D), 3 (Moderately satisfied-MS), 4 (Satisfied-S), and 5 (Very satisfied-VS)."

4. Analysis & Results

Selection of 44 respondents was done in stages and investigation of the data revealed that female respondents (56.82%) were more than male (43.18%) respondents. It has been found that more than half (61.4%) of the respondents having a space of 60-80sft for their living and the rest 25% and 13.6% of the total respondents living in a space having 'above 80-below 100sft' and 'above 100sft' respectively. In most cases, the room occupancy rate is extreme (5-8 person) in a single congested dwelling. Table 1 summarizes the socio-demographic characteristics of the respondents.

Table 1: Socio- Demographic Characteristics of the Respondents

Variables		N=44	%
Gender	Female	25	56.82
	Male	19	43.18
Age	18-24	8	18.2
	25-34	23	52.3
	35-44	12	27.3
	≤ 45	1	2.2
Household Size	60-80 sq.ft	27	61.4
		11	25
		6	13.6

		Above 80- below 100 sq.ft		
		≤ 100 sq.ft		
Length of Stay	2-4 years	26	59.09	
	5-7 years	14	31.82	
	≤ 8 years	4	9.09	
Rooms in household	Single room	38	86.4	
	Double room	6	13.6	
Room Occupancy	3-4 person	19	43.18	
	5-8 person	25	56.82	
Monthly Income (BDT)	4000-6000	3	6.82	
	6000-8000	9	20.45	
	8000-10000	15	34.1	
	Above 10000	17	38.63	

The usual average number of people in a dwelling is 4-5 and around half of households have more than five individuals. The immense population density and lack of open space make the settlements confined and uncomfortable. The slums are gutted in a very short time because of flammable construction materials during fire hazards. Only 15.6% of their houses is made of brick wall and tin roofing while 84.4% of houses is made of tin both wall and roofing are made of straw, bamboo, and polythene.

Thus, the safety and security are a major concern to have a livable home. Indoor spaces are used for all habitual activities such as dining, cooking, sleeping, studying etc. From the survey the respondents have reported about the sufficient air-flow and light; 53.3% of the respondents have only one window in their dwelling, and surprisingly a large amount of them (35.6%) have no window and a few of them have 2 windows which are very rare. Table 2 is presenting the scenario of basic utility services in those study areas.

Table 2: Basic Utilities as a Physical Element of Housing Quality

Basic Utilities		%
Cooking Space	Indoor Cooking	45.45
	Veranda	34.1
	Open Space	20.45
Toilet Facilities	Common/ Shared	100
Waste Disposal	Dustbins	27.27
	Side Drain	13.63
	Side lake	22.7
	On the Street	36.36
Electric Supply	Legal Connection	13.6
	Illegal Connection	86.4
Water Supply	Common Tube well	52.2
	Common Tap water	36.4
	Other Source	11.4

In the slum areas, most (45.45%) of them have cooking facility inside of their only living space and others utilize the spaces outside (mostly veranda) of their dwelling and open spaces or courtyards, while they face significant problem during the rainy season. The individual toilet facilities in near to absent, the dwellers economically utilize the shared or common toilet, while separate toilet facility is a necessity for hygienic purposes. The current condition is primitive without the proper sanitation system and usually located at the end or a corner of the settlement near to the lake.

The inadequate number of toilets mostly remain without the septic tank or sewerage connection. Inappropriate technology and deficiency of maintenance are key reasons for poor sanitation. The waste disposal is a very basic household service for a dweller and it is a normal scenario to see heaps of garbage and rubbish creating unsanitary conditions. Currently they mostly use the lakeside areas, drains, streets as a waste disposal places, whereas, very few of the dwellers use the provided dustbins. The water and air are highly contaminated due to the filthy waste, sewerage systems. In each household, they have the electric connection but most of them have illegal

connections. Similarly, the wet cores or water sources (water taps, tube wells) are mostly located adjacent of the toilet facilities near the lake.

24 attributes addressing housing quality in the questionnaire formed the basis for this research. 10 most frequently used attributes contributing to comfort from the survey are shown in the following table 3.

Table 3: Frequently used Attributes Contributing to Housing Quality

Factor	Percentage of all responses
Shelter	47%
Warmth, Temperature	42%
Waste disposal	40%
Noise, Sound	36%
Health Distress	31.5%
Polluted air	34%
Sewer	30%
Water Pollution	25%
Open drainage	19%
Peace, silence	16%

The dwellers' personal evaluation of the satisfaction level of housing quality has been evaluated on six influential factors – quality of dwelling, basic services, space, amenities, environment, and common facilities as in Figure 1. It is to highlight that, not a single dweller is fully satisfied with the quality of their living condition. Moreover, the majority of the dwellers are very dissatisfied with the physical environment in those settlements. More than 85% of the dwellers are very dissatisfied with the housing conditions. Followed by, dissatisfied dwellers above 60% with the basic services, space, amenities and common facilities.

Elements	V-D	D	M-S	S	V-S
	%	%	%	%	%
Quality of Dwelling	86.36	6.81	4.81	2	-
Basic Services	65	30.5	3	1	-
Space	63.5	13.5	18.5	4.5	-
Amenities	64.5	10	23.5	2	-
Environment	31	64.5	2	2	-
Common Facilities	63.5	18.5	18	-	-

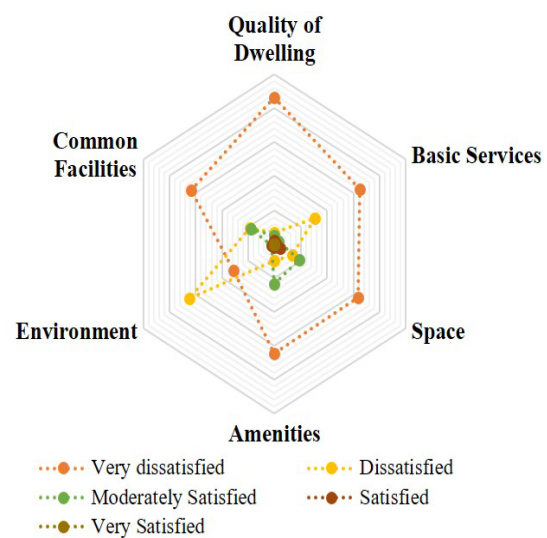


Figure 1: Occupants' Satisfaction Level on Housing Quality

5. Discussion & Conclusion

The household members often suffer from various diseases (for example, diarrhea/dysentery, malaria, jaundice, and respiratory diseases, tuberculosis, skin diseases, and other diseases). All these syndromes are a consequence of substandard environmental conditions unsanitary and unhygienic situation, lack of basic services, environmental and mental deprivation, and precarious health situation.

The slum settlements are adjacent to a large lake that is highly contaminated with sewer water, solid waste and other discarded stuff. The adjacent territories are poorly maintained with narrow lanes, poor sanitation, and highly concentrated land use. The high danger of waterlogging in the

drainage system with the deposition of solid waste makes the environment filthier.

The findings provide significant insights into conveying standard services in slums situated in urban precinct like Dhaka. The study found that the environment of household and its surrounding is directly correlated with the users' satisfaction. To satisfy the need of each person is to the housing and the interest for reasonable livable safe housing with all the provided basic needs is required to be highlighted first in Maslow's hypothesis for the cases of marginalized slums. Obviously, the rest of the needs are the uppermost level of needs. People will find happiness, affiliation, esteem, self-fulfillment eventually only when they can get the basic human needs with a sustainable house; a house of an adequate basic standard that is safe and secured with proper facilities.

The quality of marginalized neighborhood has not been standard to the well-being, social, housing needs, and cultural needs as it affects the quality of life and psychosocial aspects of the occupants. Though the statistics have been drawn from an informal settlement in Dhaka, its outcomes are anticipated to be of broader national and universal application and can endure as a foremost concern for the intervention of stakeholders. This paper will also work as a realization for an improved prospect.

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WHY DO PEOPLE TEND TO WALK IN CERTAIN PLACES? A REVIEW OF URBAN SOCIAL AND PHYSICAL ATTRIBUTES AFFECTING PEDESTRIAN'S SENSORY EXPERIENCE

Sherina Rezvani*, Amirhosein Ghaffarianhoseini & Norhaslina Hassan

University of Malaya, Kuala Lumpur, Malaysia

*sherinarezvani@gmail.com

www.nzaar.com

Abstract

Unlike walkability studies, pedestrians' sensory experience during walking received less focus. Literature suggests significant link between sensory experience and sensory pleasure that consists of sensations that are initially perceived solely by human's five senses without further rationalization. In each walking trip, pedestrians face variety of physical and social attributes exist in urban space that impacts them sensory. However, which of the attributes causing sensory experience or in what degree they impact the pedestrians is widely unknown. In this paper, by reviewing the existing studies, we identified 20 social and physical attributes with their 189 variables. Theoretical mapping and statistical analysis using the variables and senses shows that sight (91%) has the highest capacity to be influenced by the urban space followed by Touch (57.14%), Hearing (33.86%), Smell (18.51%) and Taste (11.11%). Additionally, the result of this review reveals areas of the research that could be focused on for further studies.

Keywords: Pedestrians, Walkability, Urban Space, Sensory Experience, Five Senses

1. Introduction

Unlike walkability, less attention is focused on pedestrians' sensory experience during walking. While walkability in general refers to a series of physical attributes of the urban space that make walking possible, studies show walkability alone may not always lead to pedestrians' positive experience during walking and relatively their positive perception towards the urban space [1][2][3][4].

Recent studies support strong link between human's basic five senses and the formation of experience, which is referred to as 'Sensory Experience'. Sensory experience grants the dialogue between the external environment and human internal perception. In the urban space, there are certain attributes of built environment that manage to attracting people to certain places, [5]. This could be related to the sensory experience the place creates [6] that is perceived by our five senses. Our basic five senses are responsible for human detection, decision making and reaction and what surround us [7].

With the social and physical attributes surrounding pedestrians in urban space, pedestrians face many variables that could influence one or more than one or all of their senses simultaneously [8]. What pedestrians see, hear, or smell may result in their willingness to walk certain paths or change their walking direction [9] [10]. What is said leads to two main questions, 'Which attributes of the urban space associate with pedestrians' basic senses and what is the impact of this association on the sensory experience?'

To answer these questions this paper reviewed the related literature and studies, in the fields of 'Walkability', 'Public Urban Space' and 'Human Sensory Reactions' with the purpose of firstly, categorizing Social and Physical attributes of walkability and demonstrate a theoretical association between the attributes and each sense. Secondly, exploring the evidences of 'sensory experience' in the existing studies and the relationship it has on pedestrians walking and perception towards urban space. Eventually, through this review, it is hoped to highlight the importance of

‘Pedestrian’s Sensory Experience’, its implementation on the current urban design principles and create attention to the areas in this field that did not receive enough focus and seek more attention in the future studies. It should be note that in this paper, we reviewed walkability studies that investigated walkability broader than its physical form.

2. Literature Review

A proper series of physical attributes in streets and neighborhood, increases possibility of pedestrians easy walking and physical safety as well as preventing pedestrians to change their walking direction into hazardous pathways [10] while a casual conversation between individuals, social exchanges, being involved in community activities [11] and as some studies suggested lower crime rate [12] are considered to be some of the achievements of a socially enhanced community. It is believed that walkable environments, due to the possibility of walking, pedestrians find the chance to meet each other more frequently and engage in socially interactive activities [5] with the physical environment supporting these social interactions.

Through the literature, we identified overall 20 main categories of attributes with total of 189 variables, including 166 physical variables and 22 social variables including variables including 1. Walkways (45 Variables), 2. Road (4 Variables), 3. Crossing (8 Variables) 4. Accessibility (8 Variables), 5. Connectivity (6 Variables), 6. Land Use (6 Variables), 7. Climate (8 Variables), 8. Pollution (4 Variables), 9. Pedestrian’s Presence (5 Variables), 10. Maintenance (6 Variables), 11. Buildings (12 Variables), 12. Motor Vehicle (8 Variables), 13. Density (6 Variables), 14. Visual Property (35 Variables), 15. Nature (5 Variables), 16. Inclusiveness (4 Variables), 17. Meaningful Events (5 Variables), 18. Comfort (4 Variables), 19. Safety (4 Variables), 20. Pleasurability (5

Variables).

It is believed that there is a significant link between ‘experience’ and ‘pleasure’ [13]. However, defining the pleasure is could be very varied and subjective. Aydede[14], suggests that the pleasure forms the experience is rather sensory its self, which means that the pleasure resulted from an act is merely resulted from the perception caused by basic senses and does not go further than the basic sensation that the sense is detecting. He suggests that in one theory a ‘Pleasant Sensory Experience’ is the one occurs when a sensation is responded that is liked and or desired. In short, we could say a pleasant sensory experience is ‘Joyful’ integrating with one or more than one of human senses.

In the urban space, studies show that sunny, mild and dry weather positively associate with higher number of people prioritize walking and biking over cars as transportation modes [15]. Visual property of the place perceived by sight such as shapes, patterns and edges create attraction and narrative for the place [16] while proportion of space could increase the perceived safety for the pedestrians [17].

Children reportedly prefer to spend more time walking in places with natural colorful texture accompanied with good scents, which in their words is associated with “enjoyable and fun experience”. Neighborhoods with natural scenery presence also increase cognitive developments of the child [10] unlike neighborhoods with high levels of traffic exposure [18] .

Excessive noises resulted from high volume of motor vehicles and construction cause noise sensitivity, which is associated with anxiety and stress leading to serious mental and physical issues for children, adults and seniors [19].

Although, the direct association between

sensory reaction of taste and walking is yet to be explored, studies show that streets with the presence of food establishments along with other types of retail shops associate with more pedestrian visits, however studies show that residents living in neighborhoods with higher density of fast-food facilities have more chances of increasing their BMI and mean waist circumference [20].

To elaborate more on which of the variables exist in urban space influences sensory experience, we draw a theoretical mapping between the senses and 189 identified and the result shows significant association between all senses and the variables with 'Sight' impacted the most and 'Taste' with lowest percentage of influence. In the result section, there will be more detailed description.

3. Research Method

The research method used in this study included 3 stages. 1st Using comprehensive review of most recent papers published recently including original case studies as well as peer reviewed studies and urban design principles guidelines to collect the secondary data and design an assessment model inclusive of attributes and their variables, 2nd designing theoretical mapping to create a link between the senses and the secondary data, which later on utilized in the analysis stage. 3rd Analysis of 49 original case studies using the assessment model and theoretical mapping result (1st and 2nd stages results) to statistically demonstrate the associations between the variables and senses as well as the percentage of the research done on the variables in these 49 studies.

The studies used in the 1st and 2nd stages included more recent researches in the field of walkability, livability, public space, sensory experience and sensory reactions while the 3rd stage included studies more focused on walkability, walking experience and built environment.

4. Analysis & Results

Comparison Mapping result shows that theoretically, there is association between five senses and Social and Physical attributes. But, by more in depth exploration into the relationship between the identified variables and senses, it is seen that not all the variables are related to the senses. It should be point out that the identified relationships are purely based on theoretical mapping and self-exploration and to confirm any of them further research is required.

However, to move forward with the direction of the current study we limited ourselves with what the theoretical mapping enlightened us with. It is also noteworthy to mention that although quantitatively, senses like Smell and Taste do not have significant percentage of association with identified variables, we could not undermine their importance since other studies support the fact that sensory complexity is one of the important factors motivating citizens for recreational walking [21]

- **Sight:** Has the highest statistical percentage of (91%) associated with all the 20 attributes and 172 out of 189 identified variables among all the other senses associated 100% with 'Walkway', 'Pedestrian Presence', 'Maintenance and Cleaning', 'Buildings' and 'Visual Property', 'inclusiveness', 'Meaningful Events', 'Safety' and 'Pleasurability'. This result is based on the fact that at least 172 variables are visible or could become invisible (e.g. due to the bad weather or lack of lighting).
- **Hearing:** Has (33.86%) association with 64 identified variables. There is 100% association with 'Pedestrian Presence', 'Density', and 'Safety'. There are no associations identified between 'Pollution' and 'Visual Property' with hearing. This result is purely based on whether the identified variable produces frequencies

detectable by human ears.

- **Touch:** Has (57.14%) association with 102 of the identified variables. There is 100% association with 'Accessibility'. There is no association identified between touch and 'Density' and 'Visual Property'. The result is purely based on what influences human nervous and limbic system as well as skin detection.
- **Smell:** Has (18.51%) association with 35 identified variables with 100% association with 'Pollution'. There is no association identified between smell and 'Road', 'Crossing', 'Connectivity', 'Building' and 'Visual Property'. This result is purely based on human olfactory system and whatever human inhales. In fairness, senses of Smell and Taste collaborate closely together.
- **Taste:** With only 11.11% has the lowest association with 21 identified variables. With 100% association with 'Pollution'. There is no association identified between Taste and 'Road', 'Crossing', 'Connectivity', 'Climate', 'Pedestrian Presence', 'Buildings', 'Motor Vehicles', 'Density', 'Visual Property', 'Nature', 'Inclusiveness' and 'Safety'.

Based on the analysis we also identified variables that are covered in less than 10% of the studies and including Type of walkway (shared or else), Tactile pavement, Telephone/post boxes, Vendors, Distance to crosswalks, Buildings Under construction, Articulation of the building, Visibility of Patterns, Proportion of space, Human scale elements, Transparent building's façade, Visibility of diverse activities, Visibility of ground (e.g. paved or else), Visibility of distressed pavement, Concentration, Perceived openness, Perceived nuisance noise with **(8.16%)**, Sidewalk on both sides, Adjacent walls, Corner, Water-body, Toilet, Visual Ads (e.g. stands), Guardrails, Mid-cross blocking, Cul-de-sac, No. of non-designated buildings, Smell, Pedestrians

Waiting (line), Public Facilities (e.g. trash bins), Smell, Building Age, Building Lighting, Visibility of adjacent space/street, Visibility of Animals, Visibility of Vandalism, Stray Animals, Public space Opening hours with **(6.12%)**, Public Art, Bollard, Fire Hydrants, Billboards, Disabled facility, Crossing Distance, Barriers limiting access (e.g. drainage, boulevards, etc.), Distance to the border vacuums, Wind, Missing Facilities, Building Façade, Visual advertisements perception, Lack of vision due to bad weather, Controlled entrance of the public space with **(4.08%)**, Corner island, Blind corners, Curve, Columns, Advance stop bar, LED Screens, Poles/Bare poles, Vending Machines, Snow, Fog, Building continuity, Narrative (of the place), Visibility of personalized design, Visibility of Public Art, Visibility of slope, Street Density, Sound (nature), Natural Scents, Buildings personalization with **(2.04%)** and Humidity, Dryness, Smoke, Haze, Visibility of Texture, Reflection, Visibility of Sky, Visibility of the path, Perceived businesses' usefulness with **(0%)**.

The literature as well as the current principles of the urban design emphasizes on the importance these variables have on walkability as well as the shaping of Sensory Experience [22] [23]. Thus, including them in the future studies seems as a suitable approach to enhance pedestrians' sensory experience.

5. Conclusion

Ppedestrians' sensory experience during walking and how pedestrians perceived their surroundings certainly plays an important role in their motivations to walk. Literature suggested strong link between shaping of sensory experience how humans' sensory likes and desires are responded. The theoretical mapping demonstrates significant link between social and physical attributes and five senses. This may suggests urban designers and policy makers to relook into the streets

and reevaluate the attributes surrounding pedestrians to investigate the degree of the impact they have on us in sensory level perhaps too much visual information or too many facilities on the sidewalks are not beneficial for pedestrians' sensory experience and instead of facilitating walking damages the sensory pleasure a pedestrian seeks during a walk.

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COMPARATIVE REVIEW ON PROPRIETY OF ESTIMATING RATE FOR DEFECT REPAIRING DEPOSIT THROUGH APARTMENT BUILDING SCALE

Park, Junmo., Seo, Deokseok*

Kyungsan Engineering Co., Ltd., Halla University

adviser.cm@gmail.com, *seodk@halla.ac.kr

www.nzaar.com

Abstract

The defect repairing deposit is an important issue of the defect lawsuit in the apartment building, but it is a problem because there is no basic system in the establishment and operation of the legal system. We have proposed an estimating rate of defect repairing deposit through case analysis of defect lawsuit. However, the previous study had a limitation that the number of cases was relatively small and the characteristics of each case were not fully taken into consideration. In this study, therefore, we estimated defect repairing deposit rates according to the number of households and the total gross floor area, which are important factors of defect lawsuits. Through the variance analysis, it was confirmed that there is a difference between before and after 500 in the number of households and about 50,000 m^2 in the total gross floor area. The defects lawsuit collected based on this was divided into Group I and Group IV. As a result, it was confirmed that the larger the scale of group is, the lower the defect repairing deposit rate tends to be. Also, in case of the same scale, the rate of defect repairing deposit tends to increase in the additional case than the previous study.

Keywords:

1. Introduction

Modern society is increasingly interested in the efficient use and management of existing buildings rather than the demand for new buildings as the industry and economy are advanced and the culture come to full maturity [1].

This phenomenon is also applied to the residential space, and on the one side the construction of various houses is being done, at the same time, on the other side efforts to maintain existing houses are being made. [2].

In Korea, as a universalized form of housing, apartment building, especially apartments, is the main form of housing. These apartments are very popular in Korea because they are more advantageous than existing houses in terms of convenience of residence, maintenance cost, and safety. Therefore, many Koreans live in apartments or want to live in apartments [3].

However, Korean apartments are expensive among housing, and the disputes

surrounding them are accelerating due to the upgraded image by the subject of the business and the improvement of the divided owner's eye level.[4]

If the safety, function, and aesthetics required as housing are not properly demonstrated or significantly degraded, it becomes a dispute. This is called "defect" and the subject of defect varies widely throughout housing.

The lawsuit over defects occurring in apartments is becoming a social problem in Korea. In the case of defect lawsuits, the dispute between the parties about defects is fierce, and the purpose of the ultimate defect lawsuit is to estimate a reasonable defect repairing cost [3].

On the other hand, the judgment amount that can be called the conclusion of the defect lawsuit is defect repairing cost in terms of defect lawsuits. In defect lawsuits, the appraiser examines whether the defect repair is necessary or not, and what extent is appropriate. On the basis of this, the court judges the judgment amount to be added or

subtracted at the appropriate level. However, there are various influential factors in estimating the judgment amount of defect lawsuit, but the level of application for each factor varies depending on appraiser and court, and objective criteria to assist them are insufficient [3].

The defect repairing deposit among the most important legal issues in the defect lawsuit is one of the several things that are legally stipulated. The defect repairing deposit is originally prepared for the case where the subject of business or the contractor who built the apartment building cannot carry out the defect repair. The contractors participating in the apartment construction are obliged to deposit defect repairing cost with related financial institutions or obtain a guarantee [2].

However, the defect repairing deposit system in the current legal system is being exploited as an important measure of litigation by brokers who lead defect lawsuits. Defect lawsuit brokers propose defect repairing deposit as standard for damages promised to occupant while planning defect lawsuit. Therefore, many occupants have misunderstood that they can receive amount equivalent to defect repairing deposit as damages through defect lawsuit [2, 3].

In addition, the provisions of the Housing Act and the Apartment Building Management Act, which are representative laws for defect repairing deposits, are weak in various aspects. Each regulation stipulates superficial guarantee, and the basis system is insufficient. In particular, despite the nearly 40 years since its enactment, it still has not presented the argument regarding arbitrarily specified articles during the period of industrialization [2, 3].

The core agenda for defect repairing deposits can be divided into three categories: First, the estimating criteria of

the defect repairing deposit, second is the estimating rate, and the last is refund ratio when the warranty corresponding to each period is terminated when the warranty period expires, which is regarded as a main point [5].

Among these core issues, the estimating rate of defect repairing deposits is the most important issue. In the previous study, the case study on defect repairing deposit was conducted and new estimating rate of defect repairing deposit was proposed based on this analysis. However, there is a problem that the number of cases is small and the characteristics of each case are not considered sufficiently. It is also one of the things to consider as the limitation of the criteria based on the average.

In this study, we intend to find improvement measures that can be used as a basis for considering the impact on the estimating rate of defect repairing deposits. To do this, we intend to use the number of households and the total gross floor area that are known to be effective among the characteristics of each case.

2. Literature Review

2.1 Defect Repairing Deposit

2.1.1 Defect Repairing Deposit

The defect repairing deposit among the most important legal issues in the defect lawsuit is one of the several things that are legally stipulated. The defect repairing deposit is originally prepared for the case where the subject of business or the contractor who built the apartment building cannot carry out the defect repair. The contractors participating in the apartment construction are obliged to deposit defect repairing cost with related financial institutions or obtain a guarantee [2].

2.1.2 History of Defect Repairing Deposit System

The defect repairing deposit system is related to the Housing Construction Promotion Act (1972), which was enacted

to promote housing construction in industrialized society. In addition, the defect repairing deposit was first institutionalized as Decree on the Management of Apartment Houses(1979) was enacted. Estimation criteria for defect repairing deposits can be found in the Regulations on the Management of Apartment Buildings. According to the Regulations, the defect repairing deposit is to pay a cash or guarantee that is more than two-hundredth of the total project cost described in the business plan, and the keeping period is set to two years.

The revision of Decree on the Management of Apartment Houses(1981) regulated the subject of business's term of warranty liability, and defect repairing deposits and implementation procedures. As a result, the defect repairing deposit obliges the financial institution to deposit a cash or guarantee equivalent to three-hundredth of the total construction cost of the apartment building, excluding land and land prices.

Since then, the laws and ordinances has been revised and the related regulations have been changed to the Housing Act (2003) and the Apartment Building Management Act (2016). However, the estimating criteria and the rate of defect repairing deposit remain unchanged.

2.2 Problems of Defect Repairing Deposit

2.2.1 Review of related system history

The regulations on defect repairing deposits that were set arbitrarily during the industrialization era have no basis for establishing standards. Korean society in the 1970s and 1980s lacked many social bases including physical infrastructure as well as cultural aspects, and it was turbulent period of change. In addition to defect repairing deposits, many social systems are insufficient.

However, since the 1990s, the social climate has begun to change as the economy and politics become stable. Unlike before, discussions on the social agenda have

begun to be systematically made. Even the small provisions of the legal system are found, analyzed, and adjusted to the reality through numerous dialogues and discussions [6].

On the other hand, there is a lack of such efforts for the provisions on defect repairing deposits, and there is no basis for establishing the system yet. No one knows why criteria for calculating the total amount of defect repairing deposits is the total cost of the construction, and why the ratio is 3% [6].

In previous research, defect repairing cost, which is most closely related to establish the basis for defect repairing deposit, was examined. The defect repairing deposit is for the case where the subject of business responsible for defect repair is not able to repair the defect. In case the subject of business becomes bankrupt or in the condition impossible to carry out defect repair, it is stipulated by the law that the occupants withdraw defect repairing deposit and make the defect repair. The defect repairing deposit is limited in use, but it is set to be used for defect repair. Therefore, estimating defect repairing deposit needs to be linked with defect repairing cost [6].

Nonetheless, current laws and ordinances are based on total construction costs that are not directly related to defect repairing costs. It is worth considering that in 1979 or 1981 when these standards were enacted, there were not many apartment buildings and there was little actual results data on defect repairing costs.

However, since the 1990s, when the construction of apartment buildings became commonplace and accumulated a lot of data, in particular, when the housing law was enacted in 2003, reasonable and objective standards should have been prepared. However, even in the Apartment Building Management Law, which recently

enacted separate laws on apartment buildings, there has been no such effort [6].

2.2.2 Misuse in defect lawsuits

Another reason why defect repairing deposits are important is that they are being misused as an important measure of litigation by brokers who are responsible for defect lawsuits.

Defect lawsuit brokers propose defect repairing deposit as standard for damages promised to occupant while planning defect lawsuit. Therefore, many occupants have misunderstood that they can receive amount equivalent to defect repairing deposit as damages through defect lawsuit [7].

2.2.3 Criteria for estimating defect repairing deposit

The estimating standard for the defect repairing deposit is the total construction cost. However, this is suitable as an estimating standard for the performance bond according to the construction stage, but it is unreasonable as an estimating standard of defect repairing deposit. The defect repairing deposit is for the case that the subject of business or contractor who is liable to repair the fault will not be able to repair the defect. Therefore, it is more reasonable to estimate the actual repair cost to be paid for defect repair. Also, in the case of defect lawsuits, the damages paid as a result of the trial are the defect repairing costs legally stipulated.

2.2.4 Defect Repairing Deposit Estimating Rate

Reviewing the related system history, there is no ground that the estimating rate of the defect repairing deposit is set at 3% of the total construction cost. In recent years, the purpose and reason of system are explained when establishing or changing a system. However, the provisions for defect repairing deposits were established and operated about 40 years ago. At that time, the social systems as a whole were established and operated without clear

ground system. Therefore, it is difficult to evaluate rationality based on current standards.

2.2.4.1 Review of suitability through case analysis and proposal of rate

Therefore, in order to compensate for this, we examined the extent of the appropriate level through the case analysis of defect lawsuit. The previous study on the estimation rate of defect repairing deposit shows that the average rate of defect repairing deposit through analysis of 48 cases was 1.11%. This was less than half compared with 3% of the total construction cost stipulated in the relevant laws and regulations. Through this, we have proposed 1.5% as estimating rate of defect repairing deposit. [6].

2.2.4.2 Expert Survey on the Proposal

In order to examine the appropriateness of the above-mentioned defect repairing deposit estimating rate, the questionnaire was also conducted on related experts [2].

As a result of the survey on lawyers, architects and professional appraisers related to defect lawsuits, they answered the estimating rate of defect repairing deposits was inadequate (69.1%). On the other hand, the newly proposed estimating rate was appropriate (72.7%).

2.2.4.3 Comparison Verification of Proposal Rate Additional Case

On the other hand, a study was conducted to supplement the limitation that the number of case studies for existing performance studies is small and analyzed only on the basis of average [7].

In this study, the rate of defect repairing deposit of defect lawsuits was estimated for 239 cases, and the distribution state by each interval was examined by setting the interval by each rate. As a result, the estimating rate of defect repairing cost is 1.14%, which is not much different from the previous one.

2.2.5 Annual Refund Ratio of Defect Repairing Deposit

2.2.5.1 Review of the annual refund ratio

The defect repairing deposit is required to refund the deposit at the end of each warranty period in accordance with relevant laws such as the Housing Act (Table 1).

However, like the other agendas related to defect repairing deposits, there is no basis for the establishment of regulations on annual refund ratio.

Table 1. Annual Refund Ratio of Defect Repairing Deposit

Year	Refund Ratio
1	10%
2	25%
3	20%
4	15%
5	15%
10	15%
Sum	100%

2.2.5.2 Suitability Review through case analysis and Proposed Rate [5]

Therefore, previous studies analyzed the defect repairing costs of defect lawsuits and summarized the results by construction type and year. As a result, it was found that defect repairing cost actually needed more than the prescribed rate in case of 1 ~ 2 years and 5 ~ 10 years. On the other hand, in the case of 3 ~ 4 years, the defect repairing cost actually required was very small.

Based on this analysis, we proposed to modify the annual refund ratio of the defect repairing deposit as follows (Table 2).

Table 2. Suggestion on Annual Refund Ratio of Defect Repairing Deposit

Year	Refund Ratio
1	15%
2	35%
3~4	10%
5~10	40%
Sum	100%

2.3 Raised Problems

2.3.1 Limitations of the previous study

The previous study examined the interrelationships among factors such as number of households, total gross floor area, deposit, appraisal, and judgment amount of defects lawsuit cases [3].

However, there was no research on how these factors affect the setting of the estimating rate of defect repairing deposits to an appropriate level.

In addition, we proposed a estimating model of defect repairing deposit through defect lawsuit case analysis [3]. However, the characteristics such as number of households and total gross floor area of each case were not considered sufficiently. Therefore, it is imperative to prepare measures to overcome the limitations of previous researches, such as the fact that the regression model presented has a large variation in accuracy for each case.

In sum, previous studies conducted a case study on defect repairing deposit to derive the factors affecting defect repairing deposit and to estimate the defect repairing cost and newly proposed the estimating rate of the defect repairing deposit.

However, there are many problems to be solved in the future such as the relatively small number of cases studied, insufficient consideration about characteristics of each case, the limitations of an average-based criterion, etc.

2.3.2 Necessity of Research

In this study, we intend to find an improvement measure that can be a more accurate and realistic criterion for estimating rate of defect repairing deposit. To do this, we will use the number of households and the total gross floor area that are known to be effective among the characteristics of each case.

In this study, we collected more cases by supplementing the previous study and divided into groups according to the number of households and the total gross floor area. We also will propose estimating rate of defect repairing deposit according to statistical analysis results analyzed by each group. Also, we will propose 95% of confidence interval of each mean value considering the limit on the utilization of the mean value.

3. Research Methods

3.1 Case Data

In this study, we intended to compare the data collected from the previous study with those collected further. The cases of previous study are 48 apartment complexes and the cases of additional data are 240

3.2 Analysis Method

We examined what effect the number of households and the total gross floor area have on the rate of defect repairing deposit. For this purpose, variance analysis and correlation analysis were performed.

After that, we obtained the representative value of the rate of defect repairing deposit and calculated 95% of the confidence level of it. In this study, the average was set as the representative value.

3.3 Analysis Sequence

The detailed procedure of the study is as follows. First, analyze the correlation between the number of households, the total gross floor area and the rate of defect repairing deposit for each case of the previous study. Second, if this analysis is significant, perform regression analysis. On the other hand, if there is no direct correlation, divide each case into a number of households and a total gross floor area by scale and review the difference between groups. One-way ANOVA or independent sample T-tests are performed according to the number of groups. Third, when the difference between case groups is

confirmed, obtain representative value of defect repairing deposit rate for each separated group. Fourth, analyze the additionally collected data in the same way. Fifth, compare the case group of the previous study with the additional collected case group.

4. Analysis & Results

4.1 Review of Number of Households and Total Gross Floor Area

The results of previous study confirmed that there was a correlation between the number of households, the total gross floor area, the defect repairing deposit, and judgment amount (the defect repair cost).

On the other hand, the correlation analysis of the number of households and defect repairing deposit did not derive significant results. The same was true for the total gross floor area.

Therefore, this study divided the groups by the number of households and total gross floor area, and compared their variances.

4.1.1 Number of households

The defect repairing deposit rate according to the number of households is shown in the following figure (Figure 1). In order to determine the number of effective households, we divided the groups into the following order and analyzed.

First, we divided the scale of the number of households into 500 households, 500 ~ 1,000 households, 1,000 ~ 1,500 households, and 1,500 ~ 2,000 households, and as a result of group differences, there was no difference between groups by one-way ANOVA. Next, we divided the number of households into less than 1,000 households and more than 1,000 households. There was no difference in the results of examining the difference between these groups by the independent sample t-test. However, there was the difference

when dividing by 500 households, (Table 3).

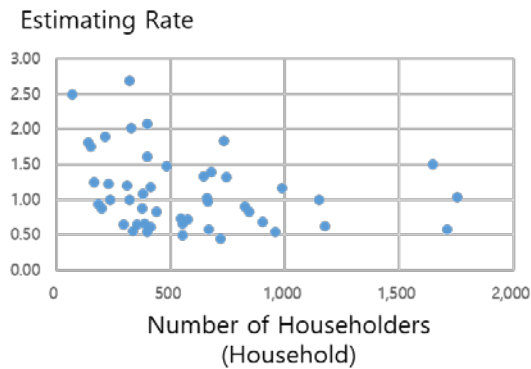


Figure 1. Estimating Rate for Defect Repairing Deposit by Number of Households

Table 3. Classification of Group by Number of Households

Case	Classification of Group	Variance	Validity
1	less than 500 500~1,000 1,000~1,500 1,500~2,000	One-way ANOVA	No
2	less than 1,000 more than 1,000	t-test	No
3	less than 500 more than 500	t-test	Yes

4.1.2 Total gross floor area scale

The total gross floor area was also analyzed after the number of households. The rate of defect repairing deposit according to the total gross floor area is shown in the following figure (Figure 2). In order to determine the effective total gross floor area scale, the following groups were divided into the following order.

First, the total gross floor area was divided into 50,000 to 100,000 m², 100,000 to 50,000 m², and 150,000 to 200,000 m². And group differences were examined. As a result, there was no difference between groups. Second, the total gross floor area was divided into 100,000 m² and over 100,000 m², but there was no difference. Finally, when divided by 50,000m², there

was a difference in the rate of defect repairing deposit (Table 4).

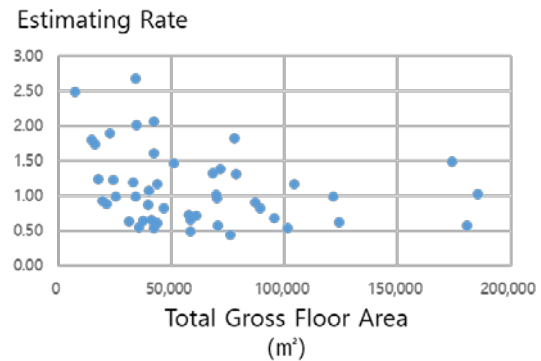


Figure 2. Estimating Rate for Defect Repairing Deposit by Total Gross Floor Area

Table 4. Classification of Group by Total Gross Floor Area

Case	Classification of Group	Variance	Validity
1	less than 50,000 m ² 50,000~100,000 m ² 100,000~150,000 m ² 150,000~200,000 m ²	One-way ANOVA	No
2	less than 100,000 m ² more than 100,000 m ²	t-test	No
3	less than 50,000 m ² more than 50,000 m ²	t-test	Yes

4.1.3 Analysis Group Settings

To put the above together, in order to analyze the rates of defect repairing deposits for defect lawsuits, classification standards by size of the number of households and the total gross floor area are 500 households and 50,000 m². In sum, it can be divided into the following four groups (Figure 3).

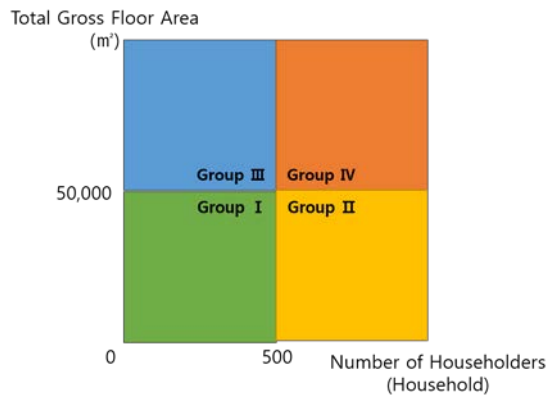


Figure 3. Classification of Case Group

4.1.4 Groups of previous study

The results of classifying the previous study by the above group are shown in the following figure (Figure 4). In the case of group I and group IV, minimum data for analysis were obtained, but group II and group III are not easy to analyze because there are few cases.

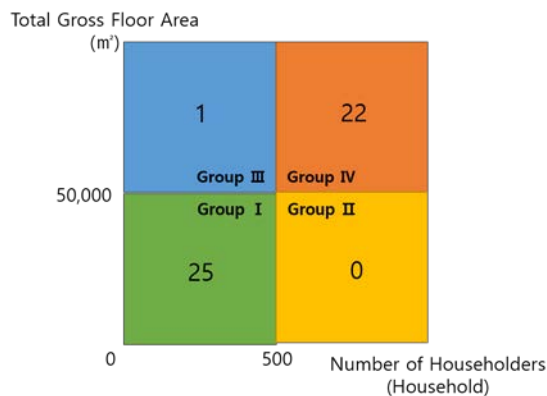


Figure 4. Case Group of Literature Study

4.1.5 Groups of Additional Cases

On the other hand, additional cases were classified as follows (Figure 5). Among the 240 cases, Group I consisted of 53 cases, Group II was 2 cases, Group III was 38 cases, and Group IV was 147 cases. As the previous study, the number of data for analysis is too small for Group II. On the other hand, in the case of Group III, 38 cases can be analyzed for additional cases, but the number of previous study is so small, so it is difficult to compare.

This study premises the comparison between the previous study and the additional case. Therefore, in the subsequent analysis, it proceeds only for group I and group IV.

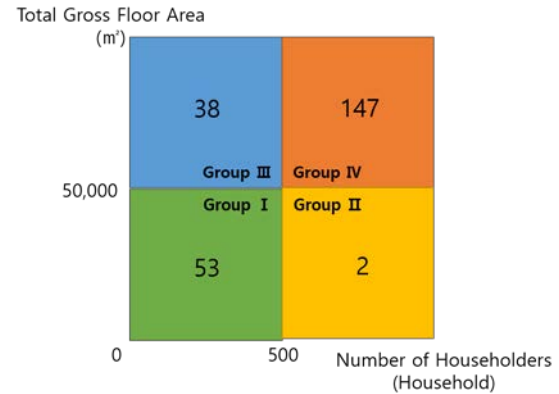


Figure 5. Case Group of Additional Data

4.2 Comparison by Group

4.2.1 Group I

Estimating rate of defect repairing deposit of previous study in group I is 1.26% on average. The 95% of confidence interval for the mean is 1.006 to 1.506.

On the other hand, the estimating rate of the defect repairing deposit for the additional case is 1.46% on average. The 95% of confidence interval for the mean shows 1.175 to 1.735.

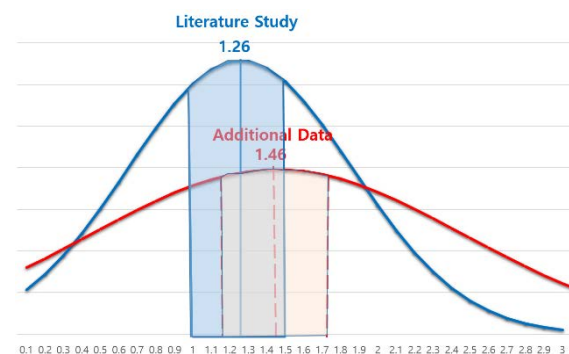


Figure 6. Comparison of Group I

4.2.2 Group IV

The estimating rate of the defect repairing deposit in the previous study in Group IV is 0.92% on average. The 95% of confidence interval for the mean is 0.763 to 1.085.

On the other hand, the estimated rate of defect repairing deposits for additional cases is 0.97% on average. The 95% of confidence interval for the mean shows 0.862 to 1.073.

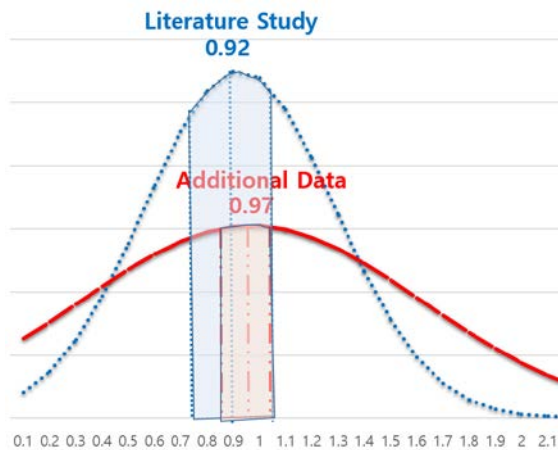


Figure 6. Comparison of Group IV

4.3 Results

According to the above-mentioned analysis results, in case of Group I with a number of households less than 500 and a total gross floor area less than 50,000 m², the average rate of defect repairing deposit of previous study was 1.26% while the additional case was 1.46%, which was 0.2% higher.

On the other hand, in the case of group IV with a total number of households of 500 or more and a total gross floor area of 50,000 m² or more, the previous study was 0.92% and the additional case was 0.97%, which was only 0.05% higher.

In sum, the rate of defect repairing deposit of the additional cases was higher than that of the previous study. In addition, the relatively small group I showed higher defect repairing deposit rates than the larger group IV. However, this means that the ratio is high and does not mean that real defect repairing cost is higher.

5. Discussion & Conclusion

As a result of analyzing the effect of number of households and total gross floor area on the estimating rate of defect repairing

deposit, it is found that there is a difference of tendency if divided into groups of appropriate scale. 500 households of the number of households, and 50,000 m² of the total gross floor area were the standards. When divided into four groups By these standards, the groups that can be compared to collected case data are group I and group IV.

As a result of the case study, in the previous study, group I was 1.26% and group IV was 0.92%. In additional cases, group I was 1.46% and group IV was 0.97%. In both groups, group IV was lower than group I. As a result, it can be confirmed that the larger the group, the lower the defect repairing deposit rate tends to be. In addition, this trend was more conspicuous in the additional case than in the previous study.

On the other hand, for Group I, the previous study was 1.26% and the additional case was 1.46%, and the defect repairing deposit rate for the additional case was higher. In the case of group IV, the previous study was 0.92% and the additional case was 0.97%. In both sides, additional cases were higher than previous studies. In other words, in the case of the same scale, the rate of defect repairing deposit tends to increase in the additional case than in the previous study. However, due to the difference in trends, Group I increased by 15.9% and Group IV increased only by 5.4%.

In this study, we proposed to estimate the defect repairing deposit by the appropriate scale according to the number of households and the total gross floor area. In the future, through data collection and analysis of other factors, we would like to contribute to establishing estimating system of more accurate and realistic defect repairing deposit.

6. Acknowledgment

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CONCEPTUAL FRAMEWORK FOR A DECISION-MAKING MODEL BASED ON THE ANALYTIC HIERARCHY PROCESS (AHP) TO SELECT THE BEST PUBLIC PRIVATE PARTNERSHIP (PPP) MODEL FOR AIRPORTS

Ali Omar Mohammed^{1*} & Timuçin Harputlugil²

¹Interior Design Department, Cankaya University, Ankara

²Architecture Dept., Cankaya University, Ankara

*c1488602@student.cankaya.edu.tr, tharputlugil@cankaya.edu.tr

www.nzaar.com

Abstract

The adoption of public-private partnerships (PPPs) as a strategy for infrastructure projects, such as airports, highways, bridges, water supplies, and telecommunication, has been implemented in developed and developing countries with a number of obstacles. Based on this stance, critical success factors (CSFs) of public-private partnership projects and the selection of appropriate PPP models are critical issues that need to be analyzed. A multidisciplinary review of the literature on the critical success factors of public-private partnerships projects reveals the lack of a comprehensive decision-making model for selecting an appropriate PPP model.

This paper presents a conceptual framework for a decision-making model to select the best PPP model considering CSFs for developing countries. The model is expected to be used for infrastructure projects, mostly for airports. The decision-making model is structured on the Analytic Hierarchy Process and sensitivity analysis. The decision-making model is expected to be adopted as a tool and contribute to decision makers for selecting the best fit PPP model for airports in order to enhance projects successfully.

Keywords: Public-Private Partnership (PPP), Critical Success Factors (CSF), Analytical Hierarchy Process (AHP), Sensitivity Analysis, Decision Making Model, Airport

1. Introduction

Measuring the success criteria of public-private partnership (PPP) procurement is a complex issue and depends highly on which stakeholders and experts have been asked. PPP refers to a specific strategic approach in which the projects are executed over the duration of contractual relationships between public and private entities to provide services and/or assets [1]. PPPs have become a popular way for governments to engage private actors in the delivery of government infrastructure and services with the aim of increasing quality and providing better implementations [2]. However, it is no surprise that researchers would continue to study this area of the PPP market [3], which will improve our understanding of the pros and cons of PPP. [4]. Critical Success Factors in PPP projects are the most important area of study related to the success of PPP procurement. According to the literature review on CSFs in PPPs, the attention given to further review and analysis is needed in this area of

study and area of success criteria of PPPs. However, the criteria for the success of public-private partnerships projects are a very important subject which has received little attention in the literature [5].

The conceptual framework and methods outlined in this paper have been developed as a part of a Ph.D. research project with a special focus on the success criteria of PPP projects for transportation sector “airports projects” in developing countries. A literature review for Critical Success Factors of Public-Private Partnership Projects covering the international point of view and comprehensive comparisons between different PPP models in transportations sectors have been done. The Analytical Hierarchy (AHP) Process method will be used to prioritize the success criteria (SC) from the perspective of Turkish experts, academics and decision makers. Based on the priorities gained, another AHP session will be structured to compromise the SC with the alternatives so

as to select the best fit. The outcomes of the literature review and AHP based surveys are expected to produce valuable ideas throughout the development of the interactive decision-making model in the final stage. This paper reviews PPP and its critical success factors followed by a brief description of the Multi-Criteria Decision-Making method and the methods based on the literature review covering AHP. The paper aims to reveal a conceptual framework for a novel approach to select the best fit PPP model based on AHP. In this paper, a proposed conceptual framework is presented and explained in detail.

2. Literature Review:

Although PPP is an important strategy in delivering public facilities and service in many developed and developing countries, the term PPP is still not clearly defined [5]. However, according to Canadian Council for PPP in 2007, PPP is defined as “a cooperative venture between the public and private sectors, built on the expertise of each partner that best meets clearly defined public needs through the appropriate allocation of resources, risks, and rewards” [6]. As shown by Zhang, et al. [7], in their critical review of PPP research, the popular research topics include PPP models and their applications as risk management, financing, and economic issues, legal and procurement issues, government regulations and guarantees. PPPs can perform in different models such as concessions, build-own-operate (BOO) build-operate-transfer (BOT), build-lease-transfer (BLT) and transfer of operation rights (TOOR) [8]. In the U.S. since 1991, the major types of PPP projects used are design-build (70%), concession (11%), design-build-finance-operate (5%) and design-build-finance (5%) [9]. Moreover, in Turkey, the popular PPP model which has been used is built-operate-transfer (BOT) [8]. Design Built Finance Operate (DBFO), Built Transfer Operate (BTO), Operate and Maintain (O&M), Design Construct Manage and Finance (DCMF) are

other PPP models which have been used widely in many developed countries [3]. In addition, these countries have performed this method for delivering infrastructure projects in many sectors: transportation, telecommunications, power, water, sanitation, health, education, and correctional facilities among others. Some developing countries have only implemented PPP as a delivery method for construction transportation, telecommunications and power infrastructure [10]. Many PPP models have been implemented in infrastructure development in both developed and developing countries, with diverse results [11]. However, it is very important that the role and performance of the public and private sectors be clearly identified and studied in order to achieve successful projects. [12]. Different reasons for failure of, and obstacles to, PPP projects have been studied and investigated by researchers during the previous year [12-14].

2.1 *PPP in the transportation sector*

Public-private partnerships (PPPs) are an effective way to build and implement new infrastructure and to solve critical transportation problems in many sectors such as airports, ports, railways and bridges. In addition to these, PPP is used for renovating, operating, maintaining and managing existing transport infrastructure facilities [15]. Therefore, the application of competitive tender procedures to award PPP contracts becomes even more important [8]. Many developed and developing countries are contending with two different policies, the first of which is that countries are faced with the necessity to improve competitiveness by investing in transport infrastructure and the second of which is that various member states are compelled to contain their public budgets [17]. Airports, as special and important infrastructure, constitute some of the most capital-demanding infrastructure and the level of risk to which these investments are subject is very significant, hardly

decreasing the ability of private investors and/or governments to undertake such bids [18]. On the other hand, there is not one single model for a PPP that can be used for any airport project. In a number of cases, the participation of the private sector needs to be limited due to regulatory or operational limitations. Moreover, financial and market limitations do not allow for private investment profitability. Nevertheless, there are also cases where general risks in a country, such as political instability and security risks, especially in the developing world, are perceived to be too high for major foreign private investment, and the domestic private sector does not have the necessary financial base for such business. Hence, the important question for any government considering an airport PPP is which PPP structure model is possible in the given situations, and which is able to achieve the best results for governments. Selecting the appropriate PPP structure model will always depend on a number of factors, including project objectives, financing requirements, market realities, the ability of the government to manage and supervise, the political and regulatory landscape and the risk factors. [16]

2.2 CSFs for PPP in the literature review

Critical success factors could be defined as the 'few key areas of activity where favorable results are absolutely necessary for a manager to reach his/her goals' [3, 16]. Numerous studies have been conducted to identify critical factors for PPP implementation, and a number of researchers have adopted the concept of CSFs to improve the understanding and the perfect way of implementing PPP policy to develop infrastructure in developed and developing countries [3, 17]. The concept of CSFs has been studied in different areas of PPP sectors, including the water sector [18, 19], telecommunications, housing [14], and the energy and transportation sector. [20] Moreover, researchers have investigated factors influencing the success of PPP in specific processes, such as the

tendering process [17], the feasibility phase [21], and the briefing stage [22]. Recently, attention has been given to studying CSFs for PPP projects in developing countries by many researchers in many countries such as the UAE, Nigeria, Ghana and China [18, 23-26].

Although there are many studies in the area of CSFs for PPP projects in the literature review in different sectors especially in the year 2016 [17, 18, 20, 23-27], it is clear that summaries, reviews and detailed analyses of these studies to identify the most important success factors for PPP implementation is critical. To deliver a PPP project in a better manner in developing and developed countries, a systematical review of the literature from 2000 to 2016 on CSFs for PPP was done in this paper to improve this objective. A list of the most important findings of PPP CSF studies in the last sixteen years and the details of the findings are shown below:

1. Risk allocation and sharing;
2. Strong private consortium;
3. Available financial market;
4. Commitment made by partners;
5. Transparent procurement;
6. Political support; and
7. Favorable legal framework.

2.3 Analytical Hierarchy Process Method (AHP)

The AHP method was developed by Thomas Saaty in the 1970s. AHP is based on decomposing a complex MCDM problem into a system of hierarchies and then evaluating the components by a pairwise comparison. The pairwise comparison matrix is constructed using the relative importance of the alternatives in terms of each criterion [28]. The requirement for pairwise comparison in AHP is regarded as an advantage as it requires decision makers to think more deeply about the weights of different factors and to analyze all situations for deeper levels. Another advantage of AHP is its

ability to measure quality and quantity indicators by using mental preferences, expertise, and objective information [29]. According to Saaty, AHP is based on a two-stage process: first, “decomposing the complexity” and then “synthesizing the relations”

In the first step, AHP breaks down a complex decision making problem into a hierarchical structure (as shown in Figure 1), composed of decision-making components (criteria and alternatives) with at least three levels: (1) overall objective at the highest level; (2) multiple criteria which define alternatives at the intermediate level; and (3) alternatives at the lowest level. The second step involves comparisons of alternatives and criteria. Once a problem is analyzed and the hierarchical levels are formed, preferences are determined at each level based on the relative importance of each criterion. At each level, the pairwise comparison is made among the criteria to identify the impact of each criterion compared to certain criteria at the upper levels. Pairwise comparisons are carried out using a 9-point standard scale [29].

AHP is a reliable method for calculating the weight of each criterion since it is based on decision makers’ points of view rather than decision matrices. AHP also allows performing sensitivity analyses over criteria and sub-criteria. A unique feature of AHP is the possibility of calculating the compatibility/incompatibility of decisions made by the decision makers [29].

The advantages of using AHP include achieving a higher quality product and a shorter product development process. AHP helps capture both subjective and objective evaluation measures, providing a useful mechanism for checking the consistency of the evaluation measures and alternatives suggested by the team, thus reducing bias in decision-making. AHP allows organizations to minimize the common pitfalls of the decision-making process, such as lack of focus, planning, participation or ownership, which ultimately are costly distractions that can prevent teams from making correct choices [30]. The AHP structure comprises four levels, as shown in Figure (1): the goal, decision makers, criteria and the alternatives.

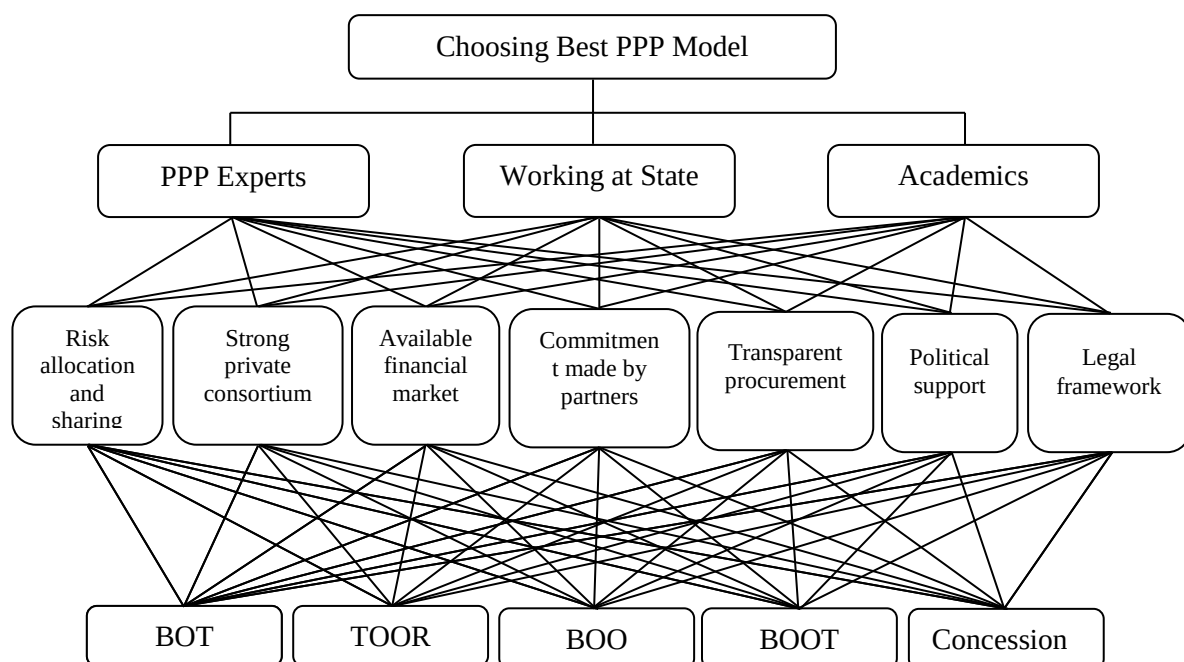


Figure 1. AHP Structure

3. Research Methods

The aims of this paper are to structure a conceptual framework so as to specify the effective success criteria that affect the selection of a best fit PPP model for airports project in developing countries. Using an inductive approach based on explorative analysis is the strategy of this research.

The research design is illustrated in Figure (2). The data which have been collected from the literature review are deconstructed, categorized and linked in order to use them as input data to the

Analytical Hierarchy Process method. The AHP method is used as the Multi-Criteria Decision Making (MCDM) method to evaluate the concepts (CSFs and PPP models) that have been selected from the literature review for a pairwise comparison. The decision-making model will be developed based on the sensitivity analysis to the result data from the AHP method. The criteria and the alternative from the final step will be sensitively analyzed to obtain the best fit result. Validation of the model will occur by applying it to a case study in future.

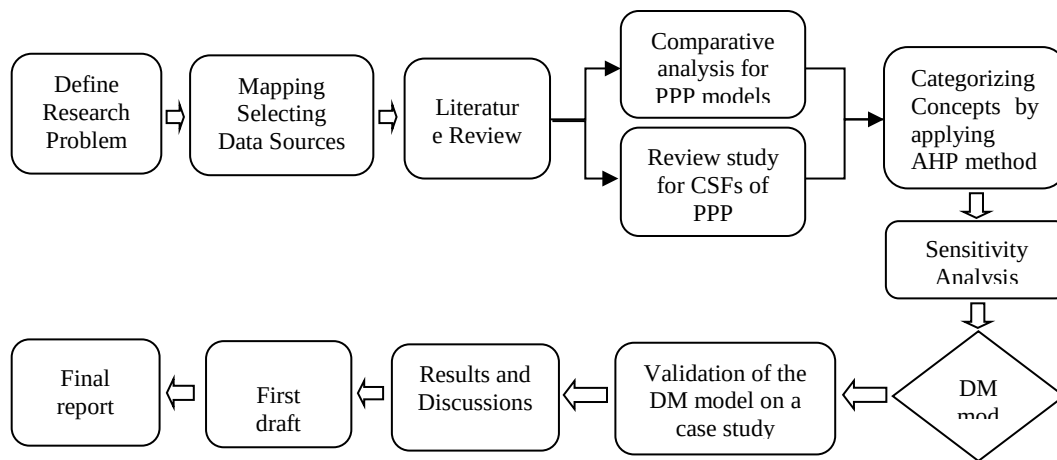


Figure 2. Research Design

4. Conceptual Framework for selecting a PPP Model.

The conceptual framework is defined, according to Jabareen [31], as “a network, or a plane of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena and are products of qualitative processes of theorization.” The proposed conceptual framework provides a step-by-step pattern to identify the research goal. The framework offers a process starting with identifying the research concepts that are collected from the literature review. The literature is reviewed to determine the most important critical success factors for public-private partnership projects through the articles published and indexed in search

engines such as Scopus and Web of Sciences. The next steps in the framework aim to explain how these concepts will be selected as well as the priorities by using pairwise comparisons with a suitable MCDM method (AHP). This Decision-Making Model will be used as a tool to select the best fit PPP model based on the success criteria for airports public-private partnership projects in developing countries. Finally, a real case study will be used to evaluate the model. The conceptual framework process contains five main steps: i) Identification, ii) Concept selection, iii) Evaluation and Implementation, v) Model development, and vi) Result improvement as shown in Figure (3).

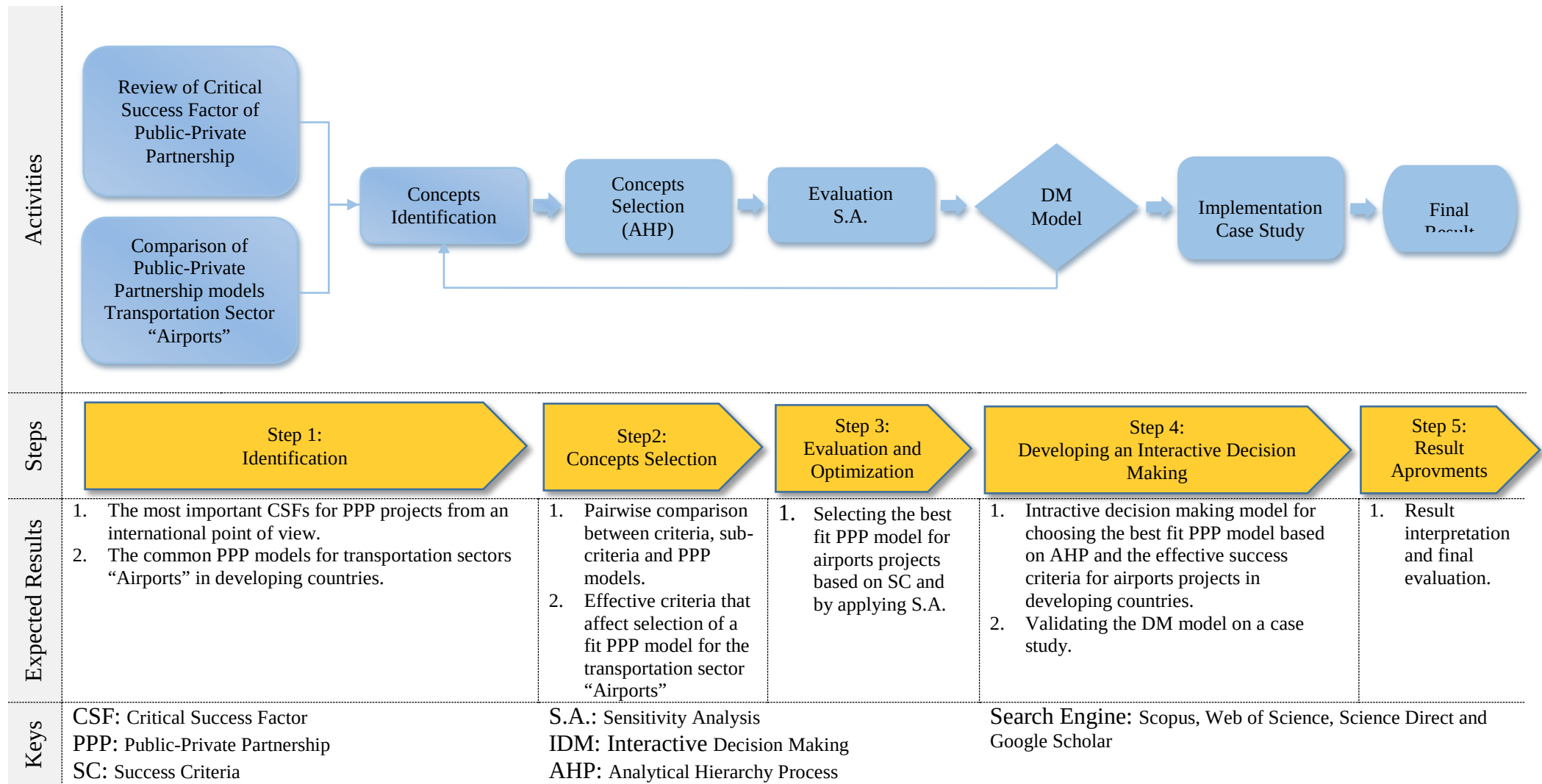


Figure 3. Conceptual Framework to select a PPP model

5. Discussion & Conclusion

Public-Private Partnership projects are increasingly being used in the rapid development of both developed and developing infrastructure projects. The aim of this paper is to reveal a conceptual framework for a novel approach to selecting the best fit PPP model based on AHP. In the paper, a proposed conceptual framework is presented and explained in detail. The finding from the literature review has revealed that there are seven important critical success factors for PPP projects including risk allocations and sharing, a strong private consortium, an available financial market, commitments made by partners, transparent procurement, political support and favorable legal frameworks. These CSFs will be pairwise compared with the selected PPP models, which are BOT; TOOR; BOO; BOOT and the Concession by the AHP method. The results will be used as input data to the interactive decision-making model. The framework presents a method that enables the decision makers to select the best fit PPP model for airport projects. The framework should be tested in a case study. Furthermore, the decision-making model revealed based on the research is expected to be adapted as a tool and expected to contribute to the decision makers for selecting the best fit PPP model for airports in order to enhance the projects successfully.

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CONSIDERING THE EFFECTS OF LOCAL UPLIFT AND SOIL ELASTIC PERFECTLY PLASTIC BEHAVIOR ON SOIL-STRUCTURE INTERACTION PROBLEM UNDER SEISMIC LOADING

Nadia El Abbas^{1*}, Abdellatif Khamlichi² & Mohammed Bezzazi¹

¹Department of Physics, Faculty of Sciences and Technics, Tangier, Morocco

² Department STIC, ENSA Tetouan, Tetouan, Morocco

*nadia.elabbas@gmail.com

www.nzaar.com

Abstract

Seismic response of an interacting soil-structure system has been studied by taking into account elastic perfectly plastic soil behavior and local uplift of the foundation. The structure was modeled by an equivalent flexible beam mounted on a rigid foundation that interacts with basement soil. This last was modeled by means of discrete Saint Venant's units mounted in parallel and distributed over the entire width of the foundation. Each unit consists of an elastic element which is connected in series with a plastic element having constant flowing stress. The rotation was considered to remain small. The equations governing the problem were derived by taking into account the equilibrium of the coupled soil-structure system where the mat of the structure was idealized as a single-degree-of-freedom. The obtained non-linear system of ordinary differential equations was integrated by using the Matlab command ode15s. A parametric analysis was then performed in order to evaluate the maximum response of the system under seismic loading as function of the selected soil model and key dimensionless parameters that include the slenderness ratio and the ratio of mat elastic resonance frequency to the vertical resonance frequency of foundation. The obtained results have shown that taking into account local uplift of the foundation under seismic loading yields smaller rotational angles than those obtained for a purely elastic analysis. Tip horizontal displacement can however be increased or decreased by considering the soil plasticity.

Keywords: Elastic-perfectly Plastic, Local Uplift, Soil-Structure Interaction

1. Introduction

In this work, seismic response of an interacting soil-structure system is studied by taking into account elastic perfectly plastic soil behavior and local uplift of the foundation. The equations governing the problem are derived by taking into account the equilibrium of the coupled soil-structure system. Small rotations are assumed and the mat of the structure is idealized as a single-degree-of-freedom (SDOF) oscillator while the foundation is taken to be rigid. The obtained discrete system has three degrees-of-freedom which are related to mat tip lateral displacement, base vertical displacement and base rotation. The associated non-linear system of ordinary differential equations is integrated by using the Matlab command ode15s. A parametric analysis is then performed in order to evaluate the maximum response of the system under seismic loading as function of the chosen soil model and key

dimensionless parameters. These include the slenderness ratio and the ratio of mat elastic resonance frequency to the vertical resonance frequency of foundation.

2. Literature Review

In the field of earthquake engineering, soil-structure interaction (SSI) is an important phenomenon that has to be taken into account in order to improve description of the coupled structure foundation system behavior. Many authors have studied this problem and various approaches based on analytical models, rigid bodies or flexible systems were introduced to deal with the different aspects resulting from this particular interaction [1-3].

The Winkler foundation based models consider that the soil can be represented by distributed elastic springs [4-10]. These models which are simple and computationally efficient were proved to be

effective for the simulation of soil-structure interaction for common civil engineering structures that are undergoing relatively small displacements. Some nonlinear effects arise when the structure has the possibility to experience a rocking rigid block motion which can yield then to foundation base uplifting.

Numerous analytical studies of the seismic response of an elastic-plastic oscillator have assessed the beneficial effect of SSI on the system response. These include studies dealing with rigid foundation base [11-13] and flexibly-supported systems [14-16]. Plastic behavior of the soil was integrated in [16] where the authors have investigated the seismic response of a single degree-of-freedom system of bridge piers. The interaction between bridge piers and supporting soil was simulated by an improved elastic-plastic Winkler model in which the uplifting effect of foundations was considered. They have concluded that permitting uplifting and plasticity of foundations in design can reduce the seismic load acting on the pier body and play thus an advantageous role in the seismic capability of bridge piers.

Allotey et al. [18] examined the strengths and limitations of the FEMA 356 nonlinear Winkler modeling approach, when used in predicting the cyclic response of various recent soil-footing-structure interaction experiments. The results of the study show that the model is capable of satisfactorily predicting all the different cyclic response quantities apart from permanent horizontal displacements.

Zheng et al. [19] studied a two-degrees-of-freedom model of reinforced concrete continuous bridge with foundation-pier dynamic interaction. They have considered nonlinearities of both reinforced concrete pier and soil foundation in order to evaluate seismic response of this system. The authors have based their modeling on the revised Winkler foundation model with

both plasticity and local uplift effects. They have used the modified Takeda hysteretic model to represent soil behavior and considered four ground motions to assess the seismic performance of the bridge-foundation system.

3. Research Methods

3.1 Description of the model

The system considered is shown in Fig.1. The structure is assumed to behave as a beam like mat which can be characterized by its first mode of vibration. This yields to a SDOF oscillator which is characterized by its natural frequency $\omega = \sqrt{k/m}$ and damping ratio $\xi = c/(2m\omega)$ where k is the lateral stiffness, m the mass and c the lateral damping. The oscillator is placed at height h from the base.

The mat is supposed to be mounted on a rigid foundation basis that is assumed to react as a rigid rectangular plate of negligible thickness. The foundation mass denoted m_0 is taken to be uniformly distributed; the width of the base is $2b$ and the total moment of inertia about the center of the foundation is denoted by I_0 . In the following M_r designates the total moment acting on the base mat, u the elastic horizontal displacement of the mat tip relative to the base and $\ddot{u}_{gx}$ the seismic acceleration. The following notations are also used: $\omega_v = \sqrt{k_w/m_0}$ vertical vibration frequency of foundation; $\alpha = h/b$ slenderness ratio; $\beta = \omega_v/\omega$ frequency ratio; $\gamma = m/m_0$ foundation mass to superstructure mass ratio.

The soil-structure interaction takes place at the interface separating the rigid footing and the foundation soil. The coupling of the system is modeled by Saint-Venant's units that are mounted in parallel. Each unit consists of an elastic spring connected in series with a plastic element which is activated if the strain from elastic spring

reaches the yield stress σ_y . This last corresponds to the plasticity plateau as shown on Fig. 2 and where k_w is the soil modulus of elasticity per unit length. The units are distributed over the entire width of the foundation, see Fig .1. Horizontal slippage between the mat and supporting elements is assumed to be negligible.

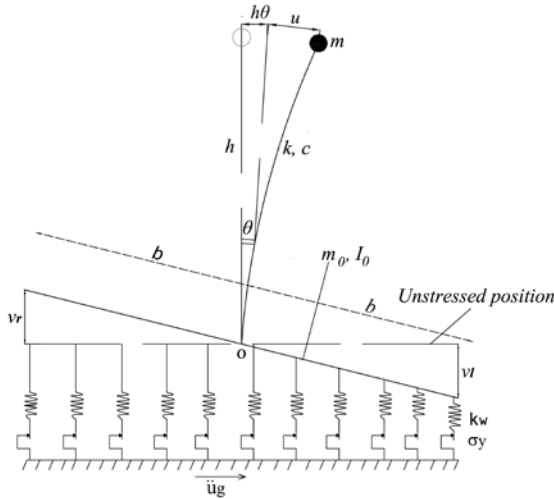


Figure 1. Flexible structure resting on elastic perfectly plastic foundation.

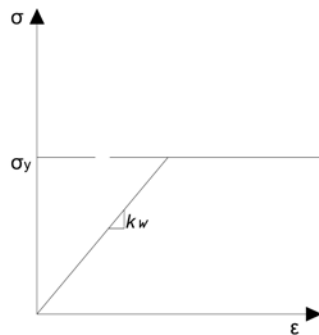


Figure 2. Elastic perfectly plastic behavior of spring and plastic element mounted in series.

In the elastic range of deformation, the stress-strain relationship is given by: $\sigma = k_w(v \pm x\theta)$ where v is the vertical displacement of the base mat centre of gravity, θ is the angle of rotation of the mat base and x is the abscissa along the foundation with origin taken at its centre. When the stress reaches the threshold σ_y for some plastic frontier point x_{pi} , where

$i=l$ or $i=r$ that designates left or right edge, then $\sigma = \sigma_y$. Also local uplifting occurs if $\sigma = 0$ for some critical position point x_{ci} .

Fig.3 presents the overall scheme adopted for performing the elastic perfectly plastic analysis and dealing with the plasticity and uplifting nonlinearities. The steps in the scheme are as follows:

Step 1: under a selected ground motion and for actual positions of base that are associated to uplift or plastic frontier conditions, compute the answer of the coupled system for the given increment and obtain: (i) rotation of the base, (ii) vertical displacement, (iii) horizontal displacement. Step 2: Compare the actual obtained value of θ with zero.

Step 3: Determine the actual value of critical positions x_{ci} which corresponds to $\sigma_y = 0$.

Step 4: Determine the actual value of plastic positions x_{pi} which corresponds to $\sigma_y = k_w(v \pm x_{pi}\theta)$.

Step 5: Compare x_{pi} with algebraic value of half width of foundation mat.

Step 6: Compare x_{pi} with x_{ci} .

3.1 Equations of motion

The equations of motion can be derived by taking into account the equilibrium of the coupled soil-structure system. The following equilibrium equations can be written:

- Equilibrium of forces acting in the horizontal direction: $\sum F_x = 0$
- Equilibrium of forces in the vertical direction: $\sum F_y = 0$
- Equilibrium of moments about the center of the foundation of the mat: $\sum F_z = 0$

Because the rotations are assumed to be small, the following approximations hold $\cos(\theta) \approx 1$ and $\sin(\theta) \approx \theta$ (1)

Considering the equilibrium of forces in the lateral direction, the simplified equation of motion in terms of the mat tip lateral displacement writes

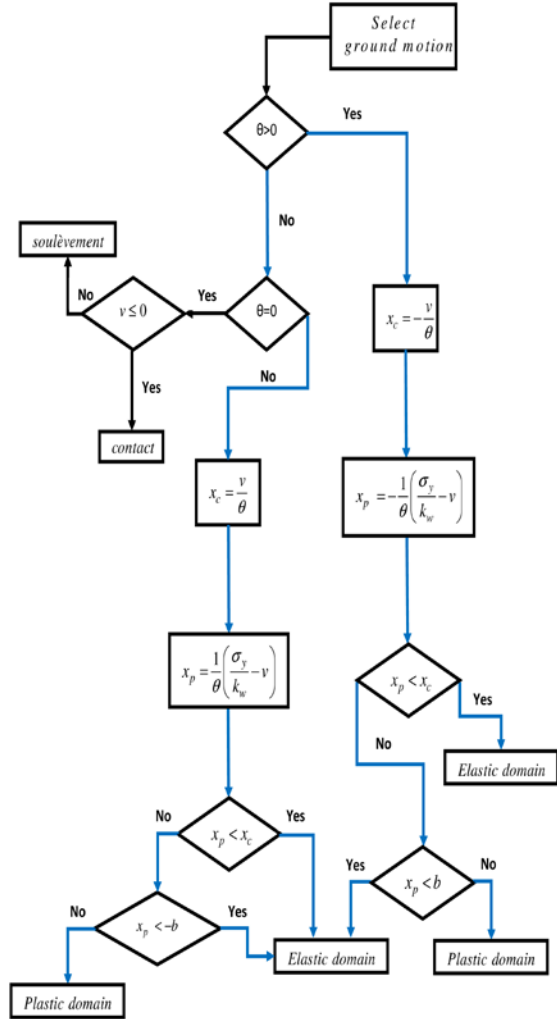


Figure 3. Schematic outline of the elastic perfectly plastic analysis procedure

$$m\ddot{u} + mh\ddot{\theta} + c\dot{u} + ku = -m\ddot{u}_{gx}(t) \quad (2)$$

The equilibrium of forces in the vertical direction can be written as follows:

$$(m + m_0)\ddot{v} + F_v = -(m + m_0)g \quad (3)$$

with

$$F_v = \int_{-b}^{x_{pl}} k_w v_{(\ell,r)} dx + \int_{x_{pr}}^{x_{pr}} k_w v_{(\ell,r)} dx \quad (4)$$

$$+ \int_{x_{pr}}^b k_w v_{(\ell,r)} dx$$

The vertical displacement at the edges of the foundation mat, Fig. 1, measured from

the initial unstressed positions are:

$$v_i = v \pm x \theta, \quad i = l, r \quad (5)$$

In equation (4), F_v is the total vertical force acting on the base mat. This force is obtained as

$$F_v = \int_{-b}^{x_{pl}} k_w (v \pm x \theta) dx + \int_{x_{pl}}^{x_{pr}} k_w (v \pm x \theta) dx \quad (6)$$

$$+ \int_{x_{pr}}^b k_w (v \pm x \theta) dx$$

Because the foundation cannot extend above its initial unstressed position, an edge of the foundation mat would uplift at the time instant for which the following condition is fulfilled [19]

$$v_i(t) > 0, \quad i = l, r \quad (7)$$

Integrating equation (6) by taking into account the uplifting condition given by equation (7), one arrives after simplifications at the following expression

$$F_v = k_w v (x_{pl} + 2b + x_{pr} - x_{pl} - x_{pr}) \quad (8)$$

$$+ \varepsilon_2 k_w \theta \left(-\frac{1}{2} \varepsilon_1^2 b^2 + b^2 \right)$$

$$+ \varepsilon_2 k_w \theta \left(\frac{1}{2} x_{pl}^2 + x_{pr}^2 - \frac{1}{2} \varepsilon_1^2 x_{pl}^2 - \frac{1}{2} \varepsilon_1^2 x_{pr}^2 \right)$$

with

$$\varepsilon_1 = \begin{cases} 1 & \text{contact at both edges} \\ \frac{\varepsilon_2 v}{b \theta} & \text{one edge is uplifted} \end{cases} \quad (9)$$

$$\varepsilon_2 = \begin{cases} -1 & \text{left edge uplifted} \\ 0 & \text{contact at both edges} \\ 1 & \text{right edge uplifted} \end{cases} \quad (10)$$

Substituting equation (8) into equation (3), one obtains the following equation:

$$\ddot{v} = -\frac{\varepsilon_2 k_w \theta}{m+m_0} \left(\frac{1}{2} x_{pl}^2 + x_{pr}^2 - \frac{1}{2} \varepsilon_1^2 x_{pl}^2 - \frac{1}{2} \varepsilon_1^2 x_{pr}^2 \right) - \frac{\varepsilon_2 k_w \theta}{m+m_0} \left(-\frac{1}{2} \varepsilon_1^2 b^2 + b^2 \right) - \frac{k_w v}{m+m_0} (x_{pl} + 2b + x_{pr} - x_{pl} - x_{pr}) - g \quad (11)$$

Taking the resultant moment about the centre of the foundation at the base of the mat, the following equation is readily obtained:

$$I_0 \ddot{\theta} + hm(h\ddot{\theta} + \ddot{u} + \ddot{u}_{gx}) + M_r = 0 \quad (12)$$

with $I_0 = m_0 b^2 / 3$ and where M_r is the resistant moment which represents the global action of spring and plastic slider system acting on the foundation base. It is derived by considering the forces applied on the free body diagram of the base mat as

$$M_r = k_w \int_{-b}^{x_{pl}} [\pm vx \pm x^2 \theta] dx + k_w \int_{x_{pl}}^{x_{pr}} [\pm vx \pm x^2 \theta] dx + k_w \int_{x_{pr}}^b [\pm vx \pm x^2 \theta] dx \quad (13)$$

Integrating equation (13) and taking into account equation (7), one obtains

$$M_r = \varepsilon_2 k_w \left(\frac{1}{2} vx_{pl}^2 + \frac{1}{3} \theta x_{pl}^3 - \frac{1}{2} \varepsilon_1^2 vb^2 + \frac{1}{3} \theta b^3 + \frac{1}{2} vx_{pr}^2 + \frac{1}{3} \theta x_{pr}^2 - \frac{1}{2} \varepsilon_1^2 vx_{pl}^2 - \frac{1}{3} \varepsilon_1^2 \theta x_{pl}^3 + \frac{1}{2} vb^2 + \frac{1}{3} \theta b^3 - \frac{1}{2} \varepsilon_1^2 vx_{pr}^2 - \frac{1}{3} \varepsilon_1^2 \theta x_{pr}^2 \right) \quad (14)$$

Substituting equation (14) into equation (12) yields the following equation

$$\ddot{\theta} = \frac{3\alpha^2}{\gamma h} (c\dot{u} + ku) - \frac{3\varepsilon_2 \alpha^2 k_w}{m\gamma h^2} \frac{1}{2} vx_{pl}^2 + \frac{1}{3} \theta x_{pl}^3 - \frac{1}{2} \varepsilon_1^2 vb^2 + \frac{1}{3} \theta b^3 + \frac{1}{2} vx_{pr}^2 + \frac{1}{3} \theta x_{pr}^2 - \frac{1}{2} \varepsilon_1^2 vx_{pl}^2 - \frac{1}{3} \varepsilon_1^2 \theta x_{pl}^3 + \frac{1}{2} vb^2 + \frac{1}{3} \theta b^3 - \frac{1}{2} \varepsilon_1^2 vx_{pr}^2 - \frac{1}{3} \varepsilon_1^2 \theta x_{pr}^2 \quad (15)$$

Finally, the equations of motion of the system are formed by equations (2), (11) and (15). This is a highly nonlinear system of second order ordinary differential equations. Its integration can be achieved iteratively by using the Matlab command ode15s. This enables then to calculate the response of the structure and to perform parametric studies.

4. Analysis & Results

4.1 Response to seismic excitation

In the following, the systems responses for both elastic and perfectly plastic soil models are calculated. The system response is considered under the 1940 El Centro earthquake record input and with fixing the following dimensionless parameters during the simulations:

$\alpha=8, \beta=2, \gamma=0.1, \zeta=0.05, \zeta_v=0.03$. The other parameters were fixed at the following values: $h=12m, m=105.07 \times 10^3 kg, c=21.85 \times 10^3 kg.s^{-1}, \omega=2.08Hz, \sigma_y=1.5 \times 10^{-4} MPa$ and $k_w=18.4 \times 10^6 N/m$.

Fig. 4 gives a comparison of the seismic response of the system in terms of the lateral displacement of the structure and the foundation rotation, for both elastic and perfectly plastic analyses.

The perfectly plastic behavior was found to moderate the system response: it decreases the tip displacement in comparison with the elastic analysis. The same observation can be done with regards to rotation. One can notice also from Fig. 4b that rocking has occurred for the soil elastic model while this is absent in the case of elastic-perfectly plastic soil.

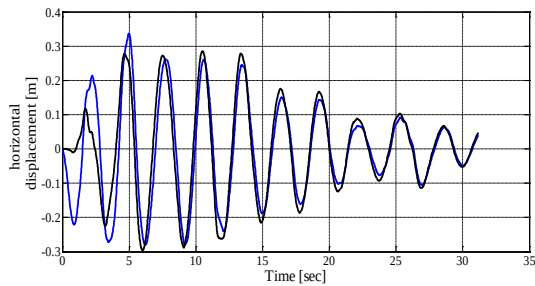


Figure 4a. Horizontal displacement of the structure: blue color is for elastic analysis black corresponds to the perfectly plastic analysis ($\alpha=8, \beta=2, \gamma=0.1, \zeta=0.05, \zeta_v=0.03$)

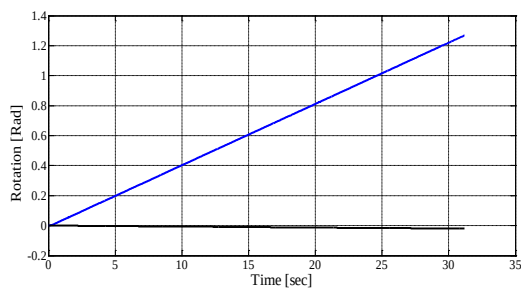


Figure 4b. Horizontal displacement of the structure: blue color is for elastic analysis black corresponds to elastic perfectly plastic analysis ($\alpha=8, \beta=2, \gamma=0.1, \zeta=0.05, \zeta_v=0.03$)

4.2 Parametric investigation of maximum response

A parametric study was conducted in order to analyze the effect of the chosen soil model and as function of the key parameters α, β, γ . The maximum values of the tip mat displacement and base rotation are considered when elastic and elastic perfectly plastic soil interacting models are considered along with a base-mat foundation which is allowed to undergo local uplifting. The response of the system under the 1940 El Centro earthquake record input was calculated for both of these soil models.

Two parametric studies were performed:

- The first one concerned variation of the maximum values of the mat tip displacement and base rotation as function

of the slenderness ratio with $\beta=2$. Fig. 5 gives the obtained results for $\alpha \in [5, 8]$.

- In the second study, the maximum response is evaluated as function of the frequency ratio with $\alpha=8$. Fig. 6 gives the obtained results for $\beta \in [2, 8]$.

As shown in Fig.5, the maximum values of the tip displacement and base rotation vary largely with α . The perfectly plastic analysis moderates the magnitudes of rotation. However this behavior does not moderate all the time the magnitudes for the tip displacement. The magnitude can be increased or decreased depending on the domain containing the slenderness ratio.

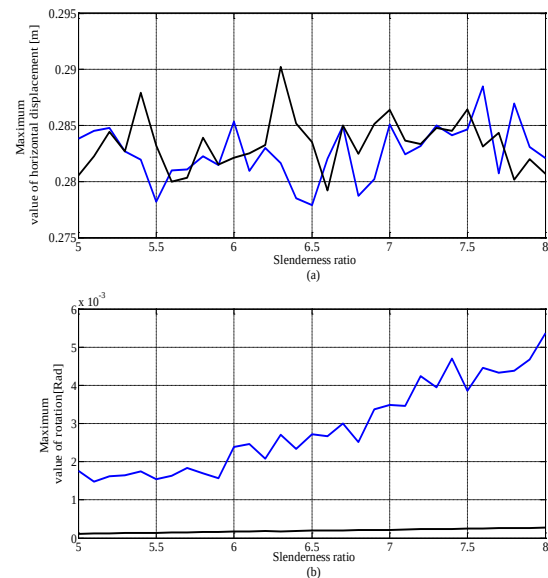
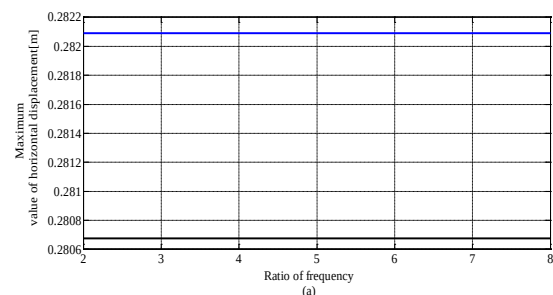


Figure 5. Maximum values of the tip lateral displacement and base rotation as function of the slenderness ratio α : (a) Tip displacement; (b) base rotation; blue color is for elastic analysis and black corresponds to elastic perfectly plastic analysis



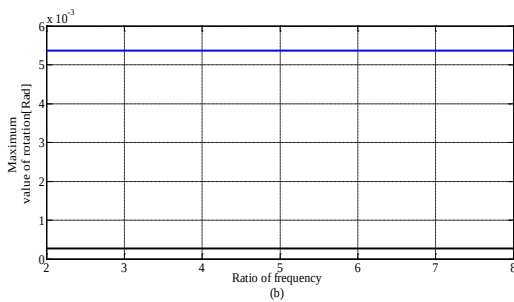


Figure 6. Maximum values of the tip lateral displacement and base rotation as function of the frequency ratio β : (a) Tip displacement; (b) base rotation; blue color is for elastic analysis and black corresponds to the elastic perfectly plastic soil

5. Discussion & Conclusion

In this work, a parametric analysis was performed in order to evaluate the maximum response of the soil-structure system under the 1940 El Centro earthquake record input by taking into account local uplift of the foundation and soil plastic behavior. This was conducted in terms of key dimensionless parameters that include the slenderness ratio and the ratio of mat elastic resonance frequency to the vertical resonance frequency of foundation. The obtained results have shown that the structure response is largely affected by these factors in the investigated ranges of parameters. Taking into account local uplift of the foundation under seismic loading and the plastic regime of strains was found to be beneficial for the structure because it yields smaller rotational angles. The tip horizontal displacement can be increased or decreased by considering plasticity of soil depending on the considered range of parameters.

6. References

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AN INVESTIGATION INTO THE POSSIBLE REASONS FOR SLOW UPTAKE OF MARINE ENERGY PROJECT DEVELOPMENT AND UTILIZATION IN NEW ZEALAND

Akhil Sawant*

Auckland University of Technology (AUT)

*akhilsawant11@gmail.com

www.nzaar.com

Abstract

In this paper, we aim to investigate the possible reasons for slow uptake of marine renewable project developments and utilization in island country like New-Zealand. New-Zealand sources its electricity for primary consumption majorly from renewable sources of energy. Out of the 81% of renewable energy production, 57% is contributed from hydropower generation plants. In the past years, hydropower plants have reached saturation point and the government must invest into other forms of energy to achieve its target of sourcing 90% energy from renewable sources. One such source identified was marine energy, but out of the 6 projects finalized, none ever progressed. After intense literature review and interviews, it was clear that before investing into such projects, having countries own research Centre is very important. It would not only provide skilled manpower but also locally develop market to assist faster project developments. Communication is another parameter identified under social impact as a barrier towards marine energy developments in New-Zealand.

Keywords: Marine Energy, Renewable source of energy, Barriers

1. Introduction

By utilizing non-renewable source of energy like natural gas, coal, oil etc. for production of electricity, we are rapidly disturbing Earth's carbon budget balance which is contributing to temperature rising faster than what organisms can adapt¹ (National Geographic, 2016). This is one of the main reasons why we should be looking into production of power through renewable sources of energy. New Zealand is one of the fore runners in materializing this theory with 80.8% of its power generation is from renewable sources of energy² (Ministry of Business Innovation and Employment, 2015).

The government has set itself with a target of getting that contribution to 90% by 2025³ (National Policy Statement, 2011).

Sources for power generation in New Zealand are as follows⁴ (Ministry of Business Innovation and Employment, 2015):

Source of energy	% contribution	Over all contribution
Hydropower	57%	81%
Geothermal	17%	
Wind	5%	
Solar	0.1%	
Bioenergy	2%	
Gas	14.9%	19%
Coal	4%	

Table 1: Source of Power Generation in New-Zealand

¹ <http://nationalgeographic.org/encyclopedia/non-renewable-energy/>

² <http://www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/statistics/electricity>

³ <https://www.mfe.govt.nz/sites/default/files/nps-reg-2011.pdf>

⁴ <http://www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/statistics/electricity>

This data shows us that hydropower generation is a major source of power generation in New Zealand contributing 57% of the total power production. But, does it have the capacity to help achieve New Zealand's target of 90% contribution by renewable sources of energy by 2025? As per our study and previous electricity generation records, hydroelectricity which is the major source of renewable energy has almost reached its saturation point with its generation showing approximately constant figures for the past 10 years as shown in Figure 2. Few developments in Solar, Geothermal and Wind energy which show positive growth rate which has resulted in our renewable source to rise to 81% today as shown in Table 2. But, Solar, wind and Geothermal energy have their share of limitations when it comes to project capacity which may not help government achieve its goal of 90% electricity generation from renewable sources by 2025.

One resource which remains untapped by New-Zealand government is Marine energy. Marine energy is nothing but converting the kinetic energy of tides or waves in the ocean into electrical energy with the help of different devices which may be on the surface or under water. Marine energy as per study of Aotearoa Wave and Tidal Energy Association (AWATEA), has a potential of more than 8000 MW of power generation capacity in New Zealand⁵ (Underhill, 2016). If we calculate with 25% efficiency of the turbines, it accounts to approximately 17,500GWh of power generation. As per our power requirements, this will account to

41% of total energy required by New Zealand.

In 2007, New Zealand government formed Marine Energy Deployment Fund (MEDF) which is administered by Energy Efficiency and Conservation Authority (EECA) to fund \$8 million over a period of 4 years for development of marine energy resources in New Zealand. In all, 6 projects were funded under this scheme namely:

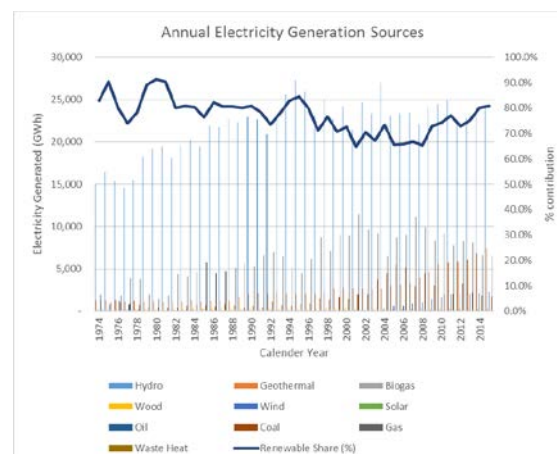


Figure 1: Annual Electricity Generation Contribution by Source in New-Zealand

Table 2: Percentage Growth rate of Power Generation form different sources

<i>Power Generation Source</i>	<i>Power Generated in 2010 (GWh)</i>	<i>Power Generated in 2015 (GWh)</i>	<i>Percentage Growth</i>
Hydroelectricity	24,493	24,283	(1%)
Geothermal	5,546	7,411	34%
Solar	4	33	725%
Wind	1,621	2,333	44%

⁵ <http://www.awatea.org.nz/wp-content/uploads/2016/06/10.-AWATEA-2016-Mike-Underhill-EECA.pdf>

Crest Energy – Kaipara Harbour; Chatham Island Marine Electricity (CHIME); Tangaroa Energy Rakaia Amps – Stewart Island Wave Energy Technology New Zealand (WET-NZ) – Moa Point, Wellington – two projects; Community Leisure Management – Parnell Baths, Auckland⁶ (Underhill, 2016). None of the projects were ever completed and the funding has also stopped.

These facts and figures are strange, given the huge potential of marine energy in New Zealand, why would government stop or

2. Literature Review:

The first serious discussion and analyses of renewable power source in New-Zealand emerged during 2007 when former Prime Minister announced a national target of 90% renewable electricity by 2020. However, by 2014, there was no significant improvement in the renewable source contribution and was rightly pointed by Michael R.W. Walmsley that hydropower generation has reached its saturation point and any more investment in hydropower plant projects would only increase in Energy Return on Energy Investment (EROI) ratio which is not favorable. According to the author, there is a need to invest in other renewable sources of energy like wind and geo-thermal plants to achieve our targets⁷ (Michael R.W. Walmsley, 2014). But, if we see the contribution of Wind and Geothermal power source in Figure 1, it is not significant and with this rate, we would never be able to achieve our 2020 target. Michael R.W. Walmsley may have underestimated the potential of Marine energy power generation by not mentioning its possible contribution towards our goal. M. Fadaeenejad identifies that wave energy has higher power density, high utilization factor and lower environmental impact as

slow down projects related to development of marine energy. If we are able to find out the exact reasons for slow uptake of marine energy in New Zealand through this paper, we could help project managers to focus on those aspects and speed up the process which would benefit not only New Zealand but also the entire world. Also, the fact that New Zealand is geographically separated from all the other nations, it has to reduce its dependency for power generation on source fuels like crude oil and coal.

compared to other renewable sources of energy. The author highlighted technologies like “Wave Dragon” and “Pelamis” would be best suited for island countries like New-Zealand⁸ (M. Fadaeenejad, 2013). Given the high potential of marine renewable energy, a study was conducted to identify the tidal energy potential of the Manukau Harbour in New Zealand by Terry Moore. Author found that Manukau Harbour has enough tidal energy to make a small distributed generation project of about 1MW⁹ (Moore, 2014). This proves the potential of New-Zealand seas. However, Alistair G.L. Borthwick’s study agrees to the enormous potential of marine renewable energy, but, identifies three challenges like bringing energy to shore, storing it and exporting it cost effectively. Apart from these reasons, the author rightly stresses the major reason for uncertainty in the marine technology is that there is no ocean data gathering campaigns which may provide vital information of seabed roughness, wave surface elevation, tidal currents, eddies and turbulences which according to us is extremely crucial for success of any engineering design or technology

⁶ <http://www.awatea.org.nz/wp-content/uploads/2016/06/10.-AWATEA-2016-Mike-Underhill-EECA.pdf>

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.apenergy.2014.04.048>

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.rser.2013.08.077>

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.seta.2014.07.001>

deployment process.¹⁰ (Alistair G.L. Borthwick, 2016).

Apart from technical challenges, Marine renewable energy has its share of social and ecological challenges. There is a consensus among social scientist like Paul A.J. Bonar that most people support renewable energy projects, but when it comes to deployment, it faces denials from the locals. This behavior is termed as NIMBYism i.e. Not In My Back Yard which is true¹¹ (Bonar, 2015). Similar, results were discovered by Jiska De Groot when the author conducted survey and interviews with island community people in UK. The result portrays that 82.1% of the respondents were highly in favor of using renewable energy to generate electricity, but, when it came to deployment of marine energy project in their vicinity, the acceptance dropped down to 40%¹² (Groot, 2016). However, Bouke Wiersma's findings completely contradict with NIMBYism. Author argues that visual impact plays a very different role in offshore renewable energy developments. According to authors, offshore wind farms which are visible from the shore often run into opposition while others that are onshore do not as they are considered fitting in well visually and as place enhancing¹³ (Wiersman, 2014). According to our analysis, I would disagree with Mr. Bouke Wiersma's findings that visual impacts play a different role. The theory of NIMBYism holds true even in New Zealand community where concept of wind turbines was initially accepted for deployment but later faced stern opposition from locals after finalizing the project location. This could also hold true with Marine energy project deployments.

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/J.ENG.2016.01.011>

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.rser.2015.03.068>

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.ijome.2016.01.007>

With social impacts, identification of ecological impacts of marine energy developments is vital. Paul A.J. Bonar noted that, apart from visual impacts, some projects are denied on the basis of environmental and materialistic grounds, Example, impacts on marine life and fishery business. It is rightly quoted by the author that due to limited knowledge on the ecological impacts of marine energy projects, it is difficult to estimate the level of damage possible to the environment. He argues that it is also possible to have a positive impact on the ecology like artificial reef and biofouling¹⁴ (Bonar, 2015).

Several studies investigating the impact of noise created by marine energy converters have been carried out in recent past. According to Joanne K. Garret research on sound levels in Falmouth Bay which is affected by local shipping as well as natural sources like weather conditions and marine organisms, it was observed that during installation process, the local sound levels considerably increased with a median difference of 8.5dB¹⁵ (Garret, 2014). However, in one of the research done by Paul A. Lepper, which measured the noise radiation from wave and tidal energy converter devices was found relatively lower when compared with some construction activities such as marine pilling and seismic air gun surveys. This data is used by author to prove that there is minimal impact on aquatic life. But, environmentalist doubt the quality of data collected due to unique challenges like environment self-noise, high level of background noise and wide variety of devices¹⁶ (Paul A. Lepper, 2015).

¹³ DOI: 10.1002/wcc.282

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.rser.2015.03.068>

¹⁵ DOI: 10.1007/978-1-4939-2981-8_39

¹⁶ DOI: 10.1007/978-1-4939-2981-8_74

Recent evidence suggests that there is no major impact on marine life when it comes to deployment of marine energy converters. Andrea Copping set up cameras at SeaGen tidal project in Strangford Lough, North Ireland and posited that noise produced by energy converters had no effect on marine life. Similar outcomes were reported for different sites like Mississippi river and Cobcooks Bay. However, author agreed to observe behavioral changes in the aquatic life like not approaching the turbine when its speed increases¹⁷ (Copping, 2014). In addition to the work of Andrea Copping, Haley A. Viehman collected data for 22 hours which included two tidal cycles by setting up a camera in commercial scale turbine in Cobcooks bay. It was observed that the probability of fish entering the rotating turbine decreased by over 35%. Smaller fishes had greater probability of entering the rotating turbine as compared to larger fishes. The authors findings suggested that fishes' behavior in response to tidal turbine appeared similar to response to obstacles such as trawls¹⁸ (Viehman, 2014).

These results were contradicted by the experiment of Matthew K. Pine. The author conducted experiment of noise impact on metamorphosis of crabs. The findings suggest that the time to metamorphosis (TTM) when exposed to natural noise is 21-31% lower as compared to no noise; 38-47% lower as compared to tidal turbine noise and 46-60% lower compared to sea-based wind turbine noise treatment. This proves the effect of anthropogenic noise effect on metamorphosis of crab and hence changing the benthic ecosystem in areas where turbines are installed¹⁹ (Pine, 2015). However, this was laboratory based experiment and its practicality is yet to be tested at actual sites. According to us, we should compare the TTM of crabs with

natural sea bed noise and not with no noise. Since it is not expected that there will be no natural noise. We are very sure that this would then have very minimal impact on the benthic ecosystem in areas where turbines are installed.

John Van Der Melen carried out a model study to evaluate the potential environmental impact of tidal energy extraction in the Pentland Firth at large special scales (>100kms) using 3-D hydrodynamics biochemistry model. A realistic 800 MW scenario and a high impact scenario with massive expansion of tidal energy extraction to 8 GW scenarios were considered. The realistic 800 MW scenario suggested minor effects on the tides, and undetectable effects on the biogeochemistry. The massive expansion 8 GW scenarios suggested effects would be observed over hundreds of kilometers away with changes of up to 10% in tidal and ecosystem variables, in particular in a broad area in the vicinity of the Wash. There, waters became less turbid, and primary production increased with associated increases in faunal ecosystem variables. Moreover, a one-off increase in carbon storage in the sea bed was detected. This study suggests positive environmental effect²⁰ (Melen, 2016).

Considering certain impacts, it was suggested to push the wave farms further away from the shore with expected result of minimizing the impact. But, this assumption was contradicted by study done by G. Iglesias. According to authors findings, locating the farm further away from coast will not result in reduction of absolute impact but would rather change its impact area. Hence confirming that farm-

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.ocecoaman.2014.04.002>

¹⁸ 10.1007/s12237-014-9767-8

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http://link.springer.com.ezproxy.aut.ac.nz/chapter/10.1007/978-1-4939-2981-8_104

²⁰ doi:10.5194/bg-13-2593-2016

to-coast distance is not panacea that will solve all the impacts²¹ (Iglesias, 2014).

David Benson conducted a study to assist resolving issues with environmental impact assessment (EIA) of marine renewable energy installations. Author observed and rightly noted that the major problem with EIA are predicting a significant impact, monitoring detects significant impact and cumulative impacts. The author suggested that expert judgement be incorporated in certain instances which would help in paradigm shift towards strategic assessment and systematic planning if the potential conflict between marine renewable energy installations and marine biodiversity are to be maintained²² (Benson, 2014). Studies relating to resolving environmental impact are scanty and that there are more fewer studies focusing on environmental risk evaluation. Andrea Copping worked towards development of environmental risk evaluation system by following simple framework which divided the potential risk into three categories namely, Episodic like vessel impact, Intermittent like Blade strike and Chronic like Chemical reactions. These risks were then rated on likelihood and impact based on few case studies on actual sites and evaluated. According to authors findings, the risk of vessel impact which could cause oil or other harmful liquids to spill is very minimal. The analysis examined the shipping record for the area to establish the frequency with which these incidents can happen. Though the probability was very low, such incidences can be mitigated by providing enhanced training to tug and barge operators, adequate nautical chart marking and notice to mariner's announcements. An analysis was undertaken to estimate the likely addition of toxicity from anti-biofouling

coatings used on ocean energy devices for scenarios of tidal energy development in Puget Sound and wave energy development on the Oregon Coast. Using background levels of toxicity for the two water bodies, the analysis concluded that the risk of additional toxicity would be small in Puget Sound and negligible contributions to water and sediment of the Oregon Coast. In the risk of encounter between tidal turbine blades and southern resident killer whales, there is no specific case recorded as it is suspected that due to the noise made by the machine, the whales avoid coming in contact with the turbines. But there is a contradicting theory stating that the noise may also attract the whales. So, a study was done simulating the impact of turbine blades on whales. They concluded that it won't have serious injuries other than bruises on external skin. The designed framework provides preliminary assessments for these risks and acts as a framework granting future data on direct interactions of ocean devices with environment²³ (Copping, 2015).

Experts consider economic viability of the marine renewable energy project as one of the major barrier for its commercial deployment. Few studies suggest that with development and deployment of marine renewable energy projects, it would help countries economy to be more independent on fluctuating fossil fuel prices. G.J. Allan rightly states that it would create employment opportunity in the country like Scotland and would have non-negative impacts on development of other sectors and hence boosting economy²⁴ (G.J. Allan, 2013). On the contrary, when it comes investment and project cost, marine renewable energy production looks far-fetched. S. Astariz in his study identified four major cost in budgeting for wave

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.renene.2014.03.059>

²² <http://dx.doi.org/10.3389/fmars.2014.00075>

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<http://link.springer.com.ezproxy.aut.ac.nz/article/10.1007/s12237-014-9816-3>

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dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.marpol.2013.05.003

energy plant namely, (i) Pre-operating cost, (ii) Construction Cost, (iii) OPEX and (iv) De-commissioning cost. After considering all the particulars, onshore/nearshore wave energy plant costed between 90-140 €/MWh and offshore wave energy plant costed between 180-420 €/MWh. Considering the highest cost of non-renewable source of energy being 60 €/MWh, wave energy converters is an expensive affair. The author concludes by stating that it could only be affordable if it would be subsidized by the local government²⁵ (S. Astariz, 2015). In addition to the findings, D.S. Jenne calculated Levelized cost of energy (LCOE) analysis of marine energy converters reference models published by USA as a step to share knowledge. The LCOE considering 10MW commercial project for different reference models are RM1 - \$0.42/kWh; RM2 - \$0.31/kWh; RM3 - \$0.98/kWh; RM4 - \$0.48/kWh; RM5 - \$0.98/kWh and RM6 - \$1.47/kWh. As per authors findings, Tidal energy converters cost less as compared to wave energy converters since they are more mature. The author also highlights that further possible reduction in LCOE could be achieved by improving OPEX and CAPEX strategies²⁶ (Jenne, 2014). The above findings are consistent with study done by Vincent S. Neary which concluded with similar findings²⁷ (Vincent S. Neary, 2015).

Several studies investigating co-location have been carried out on merging wave energy converters with wind energy converters. C. Perez Collazo has rightly identified the advantages of having a combined harnessing approach. Author

observes the advantages of co-location as follows: 1) Enhanced energy Yield, 2) Better predictability, 3) Smoother power output, 4) Common grid infrastructure, 5) Shared logistics, 6) Common structure or foundation system and 7) Shared operation and maintenance cost²⁸ (Collazo, 2014). Similarly, Francesco Tavera Pinto stated that It is of paramount importance to bring the LCOE of MRE production further down to a level where it can compete with traditional energy sources on an equal footing. As per authors recommendation, hybrid energy converters that allow harvesting two or more renewable sources at the same time under the same structure would allow important synergies and savings. This clearly implies that the author is in favour of co-existence of MRE with offshore wind energy farms²⁹ (Pinto, 2015). S. Astariz findings on the same subject of co-location suggest that energy cost is reduced by 50% as compared to stand alone wave farm when integrated with offshore wind farm³⁰ (Astariz, 2015).

There is a misconception of people living on islands that deployment of marine renewable energy project would disturb their fishing grounds affecting their livelihood. Katherine L. Yates conducted a simulation study to assess trade-offs and co-existence opportunities. Her findings suggested that if renewable energy targets were increased beyond 81%, it would impact both fishing as well as marine protected areas. But, in case of co-existence, increase in targets did not affect either activities. Infact, results showed 11% reduction in cost for pot fishing business³¹ (Yates, 2015). The above simulation was

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.rser.2015.01.061>

²⁶ <http://www.nrel.gov/docs/fy15osti/64013.pdf>

²⁷ <https://vtechworks.lib.vt.edu/handle/10919/49211>

²⁸ <http://www.sciencedirect.com.ezproxy.aut.ac.nz/science/article/pii/S1364032114008053>

²⁹

<http://scitation.aip.org.ezproxy.aut.ac.nz/content/aip/journal/jrse/7/6/10.1063/1.4939086>

³⁰

<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.renene.2015.05.028>

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.jenvman.2015.01.045>

supported in real life by Kieran Reilly. The author conducted a survey and found that 40% of fishermen agreed that marine renewable energy needs to be developed, 45% disagreed and 15% stayed neutral. The most positive finding of the survey was that 70% of the fishermen community believed that fishing and marine renewable energy projects could co-exist. However, the main perceived impact by the fishermen is the loss of access to traditional fishing ground. In such cases, the author suggests that data be collected on frequent fishing grounds and not select that site for development of the project. Some of the other concerns of fishermen are impact on some fish species during construction phase of the project resulting in reduced catches³² (Kieran Reilly, 2015). The concerns raised by fishermen community are valid and could only be resolved if they are a part of the process. Paul A.J. Bonar rightly suggested in his findings that stakeholders must be included in the decision-making process. This may prove costly but in longer run, but local knowledge helps developers to identify concerns and potential conflicts early in planning stage when it is easier to implement changes or consider alternatives (Bonar, 2015).

Governance plays a vital role in attracting investors to invest in marine energy projects. R. Bucher studied on creation of investor confidence and came up with some relevant findings. According to the authors research, strategic drivers for reaching maturity and creating investor confidence are i) System engineering: since most of the delays and additional cost to the project are due to uncertainty of device performance. ii) Standardization: There is no standardization of technology which is making it difficult to have base and develop

more on. iii) Knowledge sharing: Every individual project is working as a separate entity and there is no sharing which is also a barrier when moving towards maturity of the technology. iv) Maximizing collaboration: which is similar to knowledge sharing where in developers need to share and collaborate with others findings and build on it. v) Off shore development experience and vi) Risk management: minimizing risk by collaborating with stakeholders and sharing risk³³ (R. Bucher, 2015).

It is also seen that many countries have similar governance policies in place for offshore renewable energy projects like ones for inland wind farm projects. Glen Wrights research in terms of rights of ownership suggests that there is need for a more nuanced discourse on trends for private rights in oceans. Such evolution is necessary if marine governance policies are to effectively support new industries progress the blue economy and ensure health of oceans³⁴ (Wright, 2014). In addition to Glen Wrights findings, Yen-Chang compared experience on marine governance of UK and Canada and suggested development of an integrated management organ. He also asserted previous researches of public participation for environmentally friendly development of a marine renewable energy industry. The author also concluded that apart from stringent environmental assessment process, transparency of these projects approval processes should also be increased³⁵ (Yen-Chang, 2016).

Glen Wright is of the opinion that development of negative environmental impact and scientific knowledge is slower in pace as compared to the technology and

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.marpo.2015.04.001>

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.renene.2015.11.033>

³⁴

<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.marpo.2014.10.021>

³⁵ doi: 10.1093/jwelb/jwu039

the industry due to limited practical experience and notoriously difficult marine environment to study. Author says that cost is a major concern for the investors in Environment Impact Assessment (EIA) process. According to the author, EIA process should do more to incorporate all available knowledge and permit deployment of devices that can permit new knowledge³⁶ (Glen Wright, Strengthening the role of science in marine governance through environmental impact assessment: A case study of the marine renewable energy industry. , 2014). In addition to this research, Glen Wright conducted a research on industry perspective on the Scottish marine governance framework which stated that there is a need to assist the developers in production of data, and to demand only the data which is necessary and potentially useful. One way author suggests is to focus on impacts rather than stressors. Author says that as policymakers, they should bear in mind that certainty and stability are crucial for supporting investments which would in-turn support project development³⁷ (Glen Wright, 2014). Glen Wright in one of his research established a legal research agenda for ocean energy development. Author identified elements required for legal research agenda as follows: 1) International laws: There are no international laws in space for use of ocean beyond international boundaries. However, all the ocean energy projects are within 12miles of the coast which requires only regional laws. But factoring it for future projects is very important. 2)Environmental impact and liabilities: There are chances that government may relax rules in pursuit of carbon mitigation goals and therefore causing harm to ecosystem. According to author, lack of baseline data and notoriously difficult to study marine environment

presents a major challenge for developing framework for EIA and approving any project. 3)Rights and ownership: Internationally, no one owns the oceans. But with growing requirement of sea space, there is a need to lay down laws for sea space internationally. 4) Consenting Processes: It should address scale of development and level of risk posed in particular by imposing more permissive procedures for small scale and time limited developments in areas of low environmental sensitivity. 5) Managing ocean space and resources: prioritising and keeping coexistence strategy in mind would help sustainable and continuous growth opportunity for marine energy developments³⁸ (Glen Wright, 2015).

Approach towards development of marine renewable energy is critical for its successful implementation. Mark Healy studied the impact of MARINET initiative which included 12 European on the development of marine renewable energy. MARINET is nothing but knowledge and research sharing database on marine renewable energy developments. MARINET initiative has streamlined testing process of new technology which has resulted in numerous projects being implemented around Europe. According to author, the only reason why European nations are ahead in development of marine renewable energy projects is because of MARINET³⁹ (Henry, 2015).

Considering all the literature, it is clear that marine renewable energy has tremendous potential and extremely useful for island countries like New-Zealand. It was clear that New-Zealand government initiated the process by identifying sites and provided funds for the deployment of projects. What

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.ocecoaman.2014.07.004>

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.marpo.2015.12.014>

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.marpo.2015.09.030>

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<http://dx.doi.org.ezproxy.aut.ac.nz/10.1016/j.ijome.2015.06.002>

could have been the reason for not even a single project commencing.

3. Research Methodology:

Our research methodology will be based on literature reviews of 45 articles published across the globe regarding marine energy projects deployment and various barriers towards its successful implementation. We have cover articles related to the field of social research, environmental impacts, economic scenarios/case study, research based on co-location strategies of wind and wave farm, co-existence with fishing, renewable project and marine protected areas, Governance strategies/changes required and recommended approach for project deployment.

We will also be getting inputs from local fishing community and officials from Aotearoa Wave and Tidal Energy Association (AWATEA) to validate our research findings.

4. Discussion & Conclusion

In literatures referred for this paper, it was evident that many authors have their conclusions that marine renewable energy is not a mature technology and still needs improvement. But, if every nation would think like this, there would be no development at all. We believe that all technologies are always in the phase of improvement and same is the case with Marine renewable energy. European nations are so successful with marine renewable energy, the only reason being their collaboration. They have a European Marine Energy Centre (EMEC) which is a hugely successful in attracting wave and tidal energy devices for testing. They also have established MARINET which shares all the knowledge and latest development in the field. This encourages new ideas and concepts which in turn boosts development of marine renewable energy in Europe.

New Zealand should also first focus on having their own research Centre which would encourage development and enable

testing. This would not only help in faster development but also include benefits like small scale testing and demonstration, employment opportunity, vertical linkage and agglomerate economies. This would also encourage investors.

Addressing social impact is also a major part of marine renewable energy development in New Zealand. With previous project sites not getting consent of resource from government due to objection from the locals caused the project to delay which resulted in investors to back out from the project. It is found that most of the objections are due to lack of communication between the locals and the project developers which results in myths and hence giving rise to unwanted obstructions. Transparency should be maintained at every stage which would enable smooth functioning of the project. With previous research proving that fishing and MRE projects can co-exist, there should be no cause of worry for locals as there will be minimum impact to existing businesses like fishing. The theory of NIMBYism should also be put to rest, as marine energy projects are mostly underwater and hence causing minimal visual impact. But, all this is only possible if there is clear link of communication between all stakeholders. The social impact parameter was validated when we interviewed the local fishing community people regarding development of marine renewable energy developments in their fishing grounds. Most of the respondents initially were against any kind of man made developments in their fishing grounds. They were not sure about its impact of their business and hence rejected the thought of project development. As we discussed about the fact that such project would have no impact what so ever on their activities and in reality, would act as an artificial bed that would attract life, made them come on board with the idea of such project developments.

Economic viability of marine renewable energy is also one of the critical barrier for its deployment in New Zealand. The cost of power produced from Tidal energy converters is over \$500 NZ for 1MW power whereas the wholesale electric price is around \$100 NZ. This difference is estimated to reduce in next few decades. This means that government support in the form of subsidy is utmost important for the success of such project. It was also seen that most of the project cost escalated here in New Zealand due to lack of support infrastructure like availability of spare parts and skilled manpower. These things could be taken care of once we have a research facility here like one in Europe which will encourage infrastructural developments and create a conducive environment for the projects to develop by ultimately bringing the costs down.

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COMPARATIVE STUDY OF GREEN BUILDING RATING SYSTEMS: IN TERMS OF ENERGY

Théo Escaillas*

Auckland University of Technology (AUT), Institut Catholique d'Arts et Métiers (ICAM)

[*theo.escaillas@2017.icam.fr](mailto:theo.escaillas@2017.icam.fr)

www.nzaar.com

Abstract

The construction industry is responsible for consuming most of our resources. Many studies have been carried out in order to adopt a sustainable approach in this sector and many tools have been developed in order to assess and certify "sustainable building" most known as Green Buildings. Moreover, according to other previous researches, the energy consumption and waste is mainly caused by the construction industry, hence, this paper aims to focus on the energy category in these assessment tools (Green Building Rating Systems – GBRS), more specifically in BREEAM, LEED and Green Star NZ in order to 1) examine and compare the importance and priority given to the energy category among these three schemes; 2) analyze the main requirements; 3) find out the most sufficient rating systems in terms of energy. The result of this study shows that the energy category is the most important of all the others and, despite many differences in their approach to energy conservation, BREEAM, LEED and Green Star NZ all focus in reducing energy and global emissions.

Keywords: Construction Industry, Green Building Rating Systems, BREEAM, LEED, Green Star NZ

1. Introduction

L'industrie de la construction est responsable d'une majeure partie des dégradations environnementales mondiales (1) et particulièrement due aux besoins et consommations énergétiques qui représentent près de 50% de la consommation mondiale (2,3).

Après la première crise pétrolière du début des années 1970 et avec une demande constamment croissante, d'un taux annuel de +3,2% (4), l'efficacité énergétique devint rapidement une priorité (5) dans l'ensemble des secteurs, et plus spécifiquement celui de la construction. Il a été évalué que la consommation énergétique causée par l'acte de construire est relativement faible par rapport à celle liée à la vie du bâtiment (6), par conséquent, la majeure partie de l'énergie consommée est la conséquence directe de l'utilisation même de ce-dernier, où le design initial a un impact colossal.

Cela étant, et connaissant les limites de notre planète à répondre à l'ensemble de nos besoins et à absorber l'impact de nos

activités, il est devenu essentiel d'améliorer, repenser nos habitudes de concevoir et construire afin de limiter au maximum les effets destructeurs sur notre environnement (7). Le concept du Green Building, ou éco-conception, est né de ce constat et est rapidement devenu le porte bannière du développement durable (8).

Ce concept recevant de plus en plus d'intérêt de la part des architectes et ingénieurs, les gouvernements commencèrent à élaborer des labels, certifications afin de promouvoir, certifier et encourager ces types de bâtiments et projets (9).

Depuis 1990, une centaine d'outils de ce type ont été créés (10) pour différents pays présentant néanmoins beaucoup de similitudes, en particulier concernant le thème de l'énergie, l'une des catégories proéminentes (11). En dépit du nombre de certifications sans cesse croissant (12, 13), BREEAM, développé en 1990 par le « Building Research Establishment » (BRE, Royaume-Unis), et LEED, lancé peu après par le « US Green Building Council » (14), restent deux références majeures. En

effet, BREEAM est l'outil ayant évalué et certifié le plus de pays (15) alors que LEED est certainement le plus reconnu, et sont les plus représentatifs des certifications des bâtiments éco-conçus (16). En Nouvelle-Zélande, Green Star NZ fut développé en adaptant la version australienne dans le but de « répondre aux besoins de bâtiments de pays chauds où les besoins en refroidissement et protections solaires sont d'une importance majeure » (17, 18).

Les études réalisées par le passé ont listé et comparé BREEAM et LEED dans leurs globalités dans l'objectif de découvrir certains points de convergence. Ainsi les articles publiés ont pour la plupart donné une vue globale sur ces derniers mais en se focalisant peu sur la catégorie de l'énergie (19). Dans cette étude, nous allons donc nous attarder sur cette catégorie de l'énergie présente tant chez BREEAM, LEED que Green Star NZ - BREEAM et LEED étant les deux certifications les plus utilisées mondialement il est alors intéressant de savoir s'ils requièrent essentiellement les mêmes exigences - soulignant donc l'importance accordée à l'énergie et les besoins intégrés - et de connaître la place de Green Star NZ, outil principalement utilisé en Nouvelle-Zélande, par rapport à BREEAM et LEED.

2. Research Methods

Cet article est une recherche comparative entre trois différentes certifications de « bâtiments verts » : BREEAM, LEED et Green Star NZ.

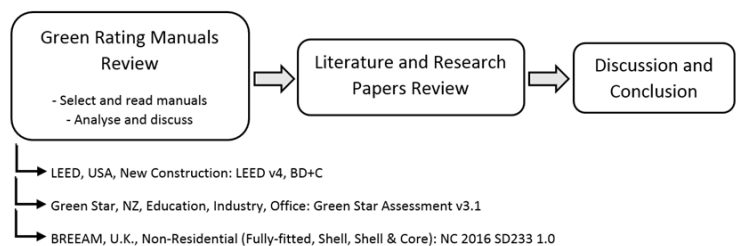
Bien que ces certifications aient le même objectif final, qui est de faire réduire les besoins énergétiques et émissions de CO₂, ces-dernières présentent des caractéristiques et des méthodes d'évaluation propres, comme le type du bâtiment étudié, son étape du cycle de vie etc...

Ainsi, dans le but d'effectuer notre étude comparative, nous nous sommes seulement

intéressés aux bâtiments Non-Résidentiels dans le cas de la nouvelle construction.

Les informations recueillies et exploitées dans cette étude sont issues de documents et manuels officiels les plus récents mis à disposition sur les librairies officielles des certifications étudiées.

La Figure 1. ci-dessous permet de visualiser la démarche effectuée pour l'écriture de cette étude ainsi qu'un détail des références des manuels utilisés.



3. Analysis & Results

3.1. Presentation of the Green Building Rating Systems studied

3.1.1. BREEAM

BREEAM (Building Research Establishment's Environmental Assessment Method), lancé en 1990, fut le tout premier outil de certification dédié à la construction durable. D'abord développé par et pour le Royaume-Unis, BREEAM s'est ensuite développé à l'international en s'adaptant localement.

L'objectif premier de BREEAM est de permettre de reconnaître les bâtiments éco-conçus en certifiant de façon crédible ces-derniers. Ainsi, cet outil est une forme de label, marque, gage d'une démarche environnementale appliquée de la conception, construction et utilisation du bâtiment.

Afin de répondre au mieux aux problématiques données ainsi qu'à l'ensemble des bâtiments, BREEAM a développé plusieurs variantes : BREEAM Infrastructure – BREEAM Communities – BREEAM New Construction – Home

Quality Mark – BREEAM In-Use – BREEAM Refurbishment ; qui conservent néanmoins un système de fonctionnement commun. En effet, BREEAM est un outil d'évaluation et de notation de performance de bâtiments devant répondre à un ensemble de critères regroupés par catégorie. Un nombre de crédits précis est dédié par catégorie et donc par critère, permettant, après application des coefficients de pondération, de connaître le score final en pourcentage. La table ci-dessous donne la distribution des labels en fonction du score obtenu pour BREEAM New Construction, outil auquel nous allons particulièrement nous intéresser :

Classement BREEAM	% score
EXCEPTIONNEL	≥85
EXCELLENT	≥70
TRÈS BIEN	≥55
BIEN	≥45
PASSE	≥30
NON CLASSE	<30

Cette étude va donc se focaliser sur BREEAM New Construction, qui présente 10 catégories : Management, Health and Wellbeing, Energy, Transport, Water, Materials, Waste, Land use and ecology, Pollution et Innovation, et plus particulièrement sur la catégorie de l'Energie.

3.1.2. LEED

LEED (Leadership in Energy and Environmental Design) dont la première version date de 1998, est une certification développée par l'US Green Building Council en réponse à l'outil de même type lancé par le Royaume-Unis, BREEAM.

Tout comme BREEAM, LEED fut élaborée afin de s'adresser à tous types de bâtiment partout dans le monde et à tous les stades de vie : Building Design and Construction, Interior Design and Construction, Building Operations and Maintenance, Neighborhood Development et Homes.

Cette étude se focalise exclusivement sur Building Design and Construction dont le

système de fonctionnement et d'évaluation est semblable à BREEAM mais avec des catégories différentes : Location and Transportation, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation et Regional Priority. Le tableau ci-dessous donne la correspondance score/classement propre à LEED.

Classement LEED	score
Platinum	52-69
Or	39-51
Argent	33-38
Certifié	26-32

3.1.3. Green Star NZ

Green Star NZ est la plus récente des trois certifications étudiées dans ce papier. Cette adaptation de la version australienne présente le même processus de notation que BREEAM et LEED. Le bâtiment évalué doit répondre aux différents critères des catégories requises par Green Star NZ v3 (Management, Indoor Environment Quality, Energy, Transport, Water, Materials, Land Use & Ecology, Emissions et Innovation), dont le nombre de points obtenu sera ensuite impacté d'un coefficient de pondération correspondant et sommé pour obtenir une note globale. De cette dernière, le classement du bâtiment équivalent sera déduit :

	Classement Green Star NZ	score
CLASSE	Leader mondial	75+
	Excellentes pratiques	60-74
	Très bonnes pratiques	45-59
NON CLASSE	Bonnes pratiques	30-44
	Pratiques moyennes	20-29
	Pratiques minimum	10-19

3.2. The importance of the Energy category in the Green Rating Systems

L'énergie, sa production, son utilisation ainsi que sa conservation sont des sujets extrêmement présents dans le développement durable et plus particulièrement dans la construction durable. Dans la plupart des outils, le nombre de crédit associé à une catégorie ainsi que son coefficient reflètent l'importance de cette dernière.

A travers cette section, nous allons donc examiner les différents nombres de crédit et coefficients que les différentes certifications étudiées associent à l'énergie dans le but de déterminer laquelle considère le thème de l'énergie comme le plus important.

Dans un premier temps, il est important de notifier que la distribution des crédits, ainsi que celle des coefficients, dépendent entièrement du type de bâtiment étudié – raison pour laquelle nous avons décidé de ne s'attarder qu'aux projets non-résidentiels de nouvelles constructions.

Green Star NZ ainsi que BREEAM font les distinctions entre bâtiments en fonction de leurs utilisations finales. En effet, nous pensons expliquer cela par la demande d'énergie qui est différente en fonction de l'utilisation finale du bâtiment - un entrepôt n'aura par exemple pas le même besoin en énergie qu'une école. C'est sans doute pourquoi Green Star NZ présente aussi trois subdivisions : Education, Office et Industry, et BREEAM : Fully fitted, Shell et Shell & Core.

En s'intéressant aux distributions des crédits, nous avons identifié qu'en moyenne, 22% des crédits totaux sont attribués à l'énergie. BREEAM et LEED considèrent même cette catégorie comme la plus importante (en terme de nombre de crédit attribué) encourageant par

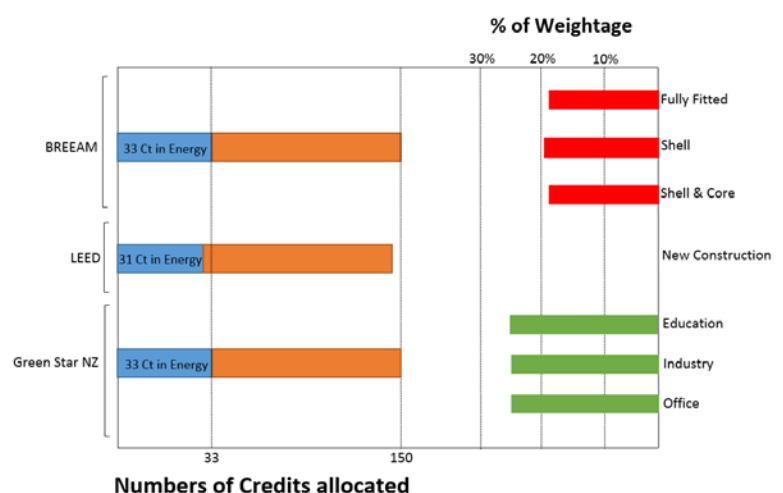
conséquent l'innovation et la recherche de nouvelles solutions destinées à réduire la consommation énergétique et l'émission de CO₂. Green Star NZ, pour sa part, attribue une part plus importante de crédits à la catégorie dédiée aux Matériaux, sans doute afin de réduire l'impact environnemental du secteur du bâtiment - étant responsable d'une importante part des dégradations environnementales.

D'autre part, les coefficients pondérés aux différentes catégories sont un moyen plus significatif de traduire la priorité accordée. Contrairement aux distributions de crédits, on observe une disparité au niveau des coefficients entre certifications.

Green Star NZ est l'outil avec le plus haut coefficient, 25%, BREEAM accorde en moyenne un coefficient de pondération de 19% alors que LEED présente néanmoins la particularité de ne pas accorder de coefficient de pondération.

Mis à part ces différences, l'étude des distributions de crédits et des coefficients de pondération nous permet d'affirmer que l'ensemble des certifications étudiées donnent la priorité à l'Energie.

La Figure 2. ci-dessous résume et permet de visualiser les informations traitées.



3.3. Analysis of Requirements and Credits awarded for Energy

BREEAM, Green Star NZ ainsi que LEED considèrent donc l'énergie comme la catégorie la plus importante en lui accordant le plus grand nombre de Crédit et un coefficient important.

Néanmoins, cela ne signifie pas que ces derniers requièrent les mêmes critères d'évaluation. Dans cette section, nous allons donc nous attarder aux différents critères requis par les certifications étudiées dans le but de découvrir s'il existe des points de convergence ou non.

Pour se faire, dans un premier temps nous allons lister les différents critères présents pour ensuite identifier ceux qui sont communs puis, dans un second temps, comparer les distributions des crédits par critères. Enfin nous étudierons les méthodes utilisées pour accorder ces crédits.

La Table 1. regroupe l'ensemble des critères des différentes certifications ainsi que les descriptions correspondantes. La Table 2. permet de visualiser la distribution des crédits par critères mais aussi d'identifier les critères présents à la fois dans BREEAM, LEED et Green Star NZ.

Assez logiquement, le critère «Reduce energy consumption and CO2 emissions » est commun à toutes les certifications étudiées qui attribuent de plus la majeure partie des crédits à ce-dernier. Effectivement, BREEAM et LEED accordent 18 Crédits, soit un équivalent de 55% du total des crédits dédiés à l'énergie, Green Star NZ accorde de son côté 20 crédits pour ce même critère, soit 65%.

Ce premier critère commun à tous regroupe le plus grand nombre de crédit dédié à l'énergie. De cette observation nous pouvons donc en déduire que tous de BREEAM, LEED et Green Star NZ considèrent ce critère de réduction

d'énergie et émissions de CO₂ comme le critère le plus important.

Dans une autre mesure, le critère « Energy Monitoring », est tout aussi important, malgré un nombre de crédit dédié moins important, car est présent dans les trois certifications. Il est vrai qu'un management énergétique performant est le meilleur outil pour réduire sa consommation énergétique et donc son impact environnemental.

Enfin, le critère « Cooling System » est le troisième et dernier critère commun et couvre les besoins et systèmes en chauffage, ventilation et climatisation.

De plus, cette table nous permet d'identifier les spécificités et priorités propres à chacun. D'après les informations recueillies chez LEED, et notamment grâce au critère « Renewable Energy Production », nous pouvons affirmer que ce-dernier se focalise peu sur un « éco-design », permettant d'économiser de l'énergie en limitant sa consommation, mais plus sur l'origine de la production de l'énergie consommée. Effectivement, contrairement à BREEAM et Green Star NZ, LEED considère plus important d'utiliser une énergie issue de production verte ou d'énergie renouvelables ou encore autoconsommation.

En addition et une fois encore, contrairement à BREEAM et Green Star, LEED accorde un critère complet au Commissioning - dont le but est vérifier et étalonner l'ensemble des postes consommateurs d'énergie pour qu'ils soient en accord avec les valeurs initialement prévues. BREEAM mentionne ce commissioning comme une étape importante du process dans ces différents critères mais LEED accorde une toute autre importance en y dédiant 6 Crédits.

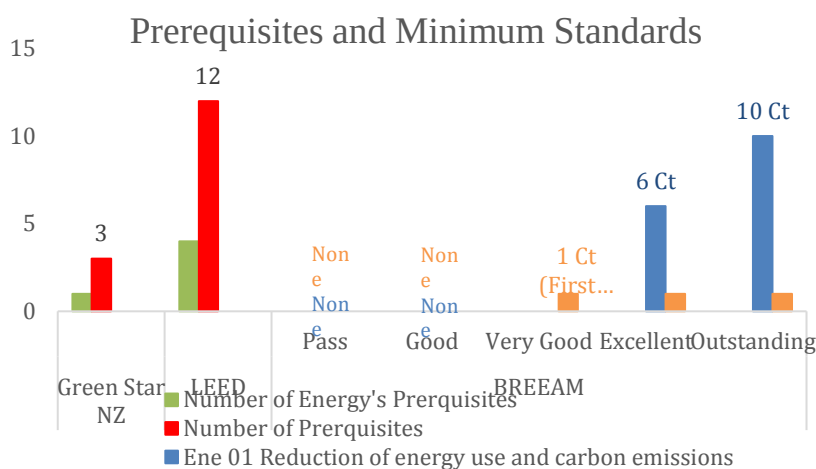
Green Star NZ, de son côté accorde plus d'importance à « l'énergie monitoring » ainsi qu'au « gas monitoring », qui peut s'expliquer par la même raison évoquée

précédemment - un bon management énergétique est une solution performante permettant d'éviter une sur-consommation énergétique.

En énumérant et révisant les différents critères nous avons aussi découvert la présence de prérequis - critères indispensables pour pouvoir être examiné - et par conséquent nous nous y sommes intéressés car nous pensons qu'ils reflètent, eux aussi, l'importance d'une catégorie.

Concernant LEED, 12 prérequis sont nécessaires pour pouvoir être évalué dont 4 uniquement appliqués à l'Energie, alors que Green Star NZ n'en demande seulement 3 dont 1 pour l'Energie. BREEAM s'articule différemment en travaillant avec les Minimum Standards qui dépendent du classement du bâtiment évalué. Les Minimum Standards attribués à l'énergie concernent les critères Ene 01 "Reduction of energy use and carbon emissions" et Ene 02a "Energy Monitoring" signifiant donc que BREEAM accorde beaucoup plus d'importance à ces deux derniers, confirmant ainsi notre affirmation faite précédemment.

La figure 3. ci-dessous résume les informations recueillies concernant les prérequis des différentes certifications étudiées.



Les critères et le nombre de crédit qui leurs sont dédiés sont propres à l'ensemble des certifications étudiées. Néanmoins, nous avons pu remarquer que ces dernières partagent quelques objectifs communs tels que la réduction globale d'énergie consommée et la réduction d'émission de CO₂. Nous pouvons alors nous interroger sur leurs méthodes et leurs process de mesures permettant d'évaluer ces deux critères.

En effet, bien que BREEAM, LEED et Green Star NZ ont pour objectifs communs de réduire l'énergie consommée et les émissions de CO₂, quelles méthodologies et par quels moyens évaluent-ils les améliorations apportées ?

Nous avons distingué 3 méthodes différentes pour mesurer et évaluer les réductions prédites, résumées dans la Table 3.

Green Star NZ and LEED basent leurs méthodes de notation sur un pourcentage d'amélioration de consommation énergétique prédit : pour pouvoir être évalué par ces deux certifications, une simulation de bâtiment doit être réalisée pour déterminer une prédiction de la consommation énergétique de ce-dernier. Le résultat obtenu est ensuite comparé à la consommation énergétique d'un bâtiment standard de même type, permettant d'en déduire un pourcentage d'amélioration qui sera traduit en nombre de crédits en suivant la table de conversion.

No	Critères	Description
1	Reduce energy consumption and CO ₂ emissions	Encourage and recognise solutions and improvement in the energy performance and consumption of buildings and carbon dioxide emissions.
2	Internal Lighting	Encourage and recognise solutions to improve energy efficiency of internal lightings.
3	External Lighting	Encourage and recognise solutions to improve energy efficiency of external lightings.
4	Energy Monitoring	To encourage and recognise the installation of energy sub-metering to facilitate on going management.
5	Gas Monitoring	To encourage and recognise energy saving achieved by reducing outdoor air rates under partial occupancy through carbon dioxide monitoring and control and/or carbon monoxide.
6	Lighting Control	To encourage and recognise lighting design that gives greater potential for energy saving through increased control and flexibility.
7	Indoor Transport	To encourage and recognise alternative solutions to lifts and improve energy efficiency of transport systems.
8	Cooling systems	To recognise and encourage the installation of energy efficient refrigeration systems and HVAC
9	Energy Efficient laboratory systems	To recognise and encourage laboratory areas that are designed to be energy efficient and minimise the CO ₂ emissions associated with their operational energy consumption.
10	Energy Equipment/Better Equipment	To recognise and encourage procurement of energy efficient equipment to ensure optimum performance and energy savings in operation.
11	Peak Energy Demand reduction	To encourage the reduction of peak demand load on electricity supply infrastructure.
12	Demand Response / Efficient systems (smart grid)	To increase participation in demand response technologies and programs that make energy generation and distribution systems more efficient, increase grid reliability and reduce greenhouse gas emissions.
13	Renewable Energy Prod/ Production energy	To reduce the environmental and economic harms associated with fossil fuel energy by increasing self-supply of renewable energy.
14	Green Power & Carbon Offset / Use of green energy	To encourage the reduction of greenhouse gas emissions through the use of grid-source, renewable energy technologies and carbon mitigation projects.
15	Enhanced Commissioning	To further support the design, construction, and eventual operation of a project that meets the owner's project requirements for energy, water, indoor environmental quality, and durability.

Critères (Energie)	BREEAM	Green Star						LEED		
		Education		Industry		Office				
Reduce energy consumption and CO ₂ emissions	Ene 01 +Ene 04	15 +3	ENE-1 +ENE-2 ENE-4	20	ENE-1 +ENE-2	20	ENE-1 +ENE-2	20	EA 02	18
Internal Lighting				3						
External Lighting	Ene 03	1			ENE-E	1				
Energy Monitoring	Ene 02a	2	ENE-6	2	ENE-6	2	ENE-6	2	EA 03	1
Gas Monitoring			ENE-3	1	ENE-3 +ENE-D	1 +1	ENE-3	1		
Lighting Control			ENE-5	3	ENE-5	4	ENE-5	3		
Indoor Transport	Ene 06	3					ENE-F	1		
Cooling systems	Ene 05	2					ENE-G	1	EA 06	1
Energy Efficient laboratory systems	Ene 07	5								
Energy Equipment/Better Equipment	Ene 08	2								
Peak Energy Demand reduction			ENE-7	2	ENE-7	2	ENE-7	2		
Demand Response / Efficient systems (smart grid)									EA 04	2
Renewable Energy Prod/ Production energy									EA 05	3
Green Power & Carbon Offset / Use of green energy									EA 07	2
Enhanced Commissioning									EA 01	6
Total Crédits dédiés à l'énergie	33		31		31		30		33	

BREEAM	GREEN STAR NZ			LEED
	Office	Industry	Education	
Réduction consommation énergétique	% d'amélioration de réduction des consommations énergétiques			% d'amélioration de réduction
Réduction émissions de CO ₂	Consommation et émission prédites via calcul du EPR _{NC} (Energy Performance Ratio)	Emissions prédites	% d'amélioration de réduction	-

Green Star NZ, quant à lui, encourage les réductions de consommation énergétique et de CO₂ mais en adoptant deux méthodes de mesure dépendantes du type du bâtiment. Les bâtiments destinés à l'Education et Industrie suivent la même méthode évoquée précédemment, mais elle diffère en ce qui concerne la subdivision "Office". Le score calculé dépend directement des émissions GHG prédites permettant ainsi d'obtenir des améliorations plus significatives car doivent répondre à un objectif plus précis et exigeant.

BREEAM propose une méthode encore différente de celles énumérées car la notation et l'évaluation de réduction de consommation énergétique et d'émission de gaz se fait via "The Energy Performance Ratio for New construction" (EPR_{NC}), système qui lui est propre.

Comme vous pouvez le visualiser sur la Figure 4, ce système exprime la totalité des améliorations du projet comprenant la consommation énergétique et l'émission en CO₂ en y appliquant même les coefficients de pondération correspondants. L'EPR_{NC} alors calculé sera ensuite traduit en un nombre de crédit correspondant.

Malgré beaucoup de points communs, il est difficile de comparer chacun de ces systèmes de notation car les méthodes et les logiciels de calculs leurs sont propres. En effet, plusieurs études réalisées ont montré que l'utilisation de différents logiciels a un impact direct sur le calcul de prédiction de consommation énergétique et d'émission de CO₂ et ainsi sur le score atteint.



4. Discussion & Conclusion

Les travaux menés par le passé ont étudié et comparé dans la globalité les certifications les plus reconnues et utilisées jusque là : BREEAM et LEED.

L'étude que nous venons de réaliser avait pour objectif premier de se focaliser plus spécifiquement sur la catégorie de l'Energie, catégorie omniprésente dans tous les outils d'évaluation et certifications de bâtiments présents sur le marché.

De plus, dans la volonté de comparer les deux leaders, que sont BREEAM et LEED, à l'outil développé récemment et utilisé par la Nouvelle-Zélande, nous avons choisi d'incorporer Green Star NZ à cette étude.

Dans un premier temps, nous avons voulu connaître l'importance et priorité accordées par les différentes certifications à l'Energie ce que nous avons pu déterminer grâce à l'étude du nombre de crédit et du coefficient de pondération.

En effet, nous avons émis l'hypothèse qu'un nombre plus important de crédit et un fort coefficient de pondération accordés à une catégorie par rapport à une autre traduit sa priorité par rapport à cette dernière. En se basant sur le nombre de crédit dédié à l'énergie, nous avons pu déterminer que BREEAM et LEED considèrent cette catégorie comme la plus importante - en accordant donc un nombre plus important

de crédits à l'énergie par rapport aux autres. Chez Green Star NZ, la catégorie de l'Energie est devancée par celle des Matériaux, toujours selon le nombre de crédits.

Cependant, en se basant sur le coefficient de pondération, nous n'observons plus de différence, avec une priorité donnée à l'énergie par l'ensemble des certifications. Ces deux observations nous ont alors permis de conclure qu'à la fois BREEAM, LEED et Green Star NZ s'accordent pour donner priorité à l'Energie. En d'autres mots, ces trois outils privilégient récompensent plus fortement un travail effectué sur les besoins énergétiques d'un bâtiment.

Dans un second temps, nous nous sommes intéressés aux contenus des différentes catégories énergétiques en étudiant les différents critères requis. Malgré beaucoup de points de divergence, nous avons réussi à mettre en exergue trois critères communs aux trois certifications : Réduction de consommation énergétique, réduction des émissions de CO₂ et contrôle de la consommation énergétique. Ces trois critères en plus d'être communs à tous, ont aussi pour particularité d'avoir un nombre de crédit équivalent.

L'étude plus en détails des différentes catégories dédiées à l'énergie nous a aussi permis de découvrir l'existence des prérequis qui sont un autre moyen de traduire l'importance d'une catégorie par rapport à une autre. Là encore, LEED et Green Star NZ donnent priorité à l'énergie en y requérant un tiers des prérequis tout comme BREEAM avec ses Minimum Standards.

Enfin, l'étude des différentes méthodes d'évaluation et de notation des critères communs nous a permis de mieux comprendre les fonctionnements des certifications qui présentent un processus plus ou moins semblable.

Néanmoins, nous avons pu voir qu'une comparaison des systèmes de notation est périlleuse du fait que les certifications requièrent des méthodes de calculs et logiciels propres et qui influencent les résultats obtenus.

BREEAM, LEED et Green Star NZ, bien que présentant des objectifs communs (réduction des consommations énergétiques et des émissions de CO₂) et donnant priorité à la catégorie dédiée à l'énergie, sont difficilement comparables à cause notamment du nombre de critères différents, qui montre bien leurs différences « plans d'attaque » mais aussi de part les différentes méthodes de calculs et logiciels qui influent directement sur les résultats.

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