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CRITICAL REGIONALISM; ARCHITECTURAL IDENTITY IN MALAYSIA

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Abstract

Critical Regionalism in architecture had its origins the early 1980s and became the focus of several symposia in newly independent countries determined to throw off the mantle of colonial rule and establish their unique architectural 'identity'. In 1989 the author of this paper devised a Taxonomy of Regionalism, which identified a spectrum of approaches from the Conservative Vernacular to Abstract Regionalism. In this paper the author revisits the taxonomy and asserts that Critical Regionalism is still in the mainstream of architectural discourse,

Keywords: *Critical regionalism, architectural identity, post-colonial, conservative vernacular, abstract regionalism.*

Introduction

Malaya (now Malaysia) achieved independence on the 31st August 1957. It was part of a process of decolonisation that began shortly after WWII. Indonesia seized independence from the Netherlands in 1945, India, Pakistan and Bangladesh gained self-rule in August 1947, and Sri Lanka and Myanmar in 1948. In Africa a 'wind of change' swept over the continent, as Nigeria became independent in 1960, South Africa and Tanzania in 1961, Uganda in 1962, Kenya in 1963, Zambia in 1964, Zimbabwe in 1965, The Gambia in 1965, Botswana in 1966, and Swaziland in 1968.

In the aftermath of decolonisation there was a growing discourse in the newly independent nations on architectural 'Identity'. The dilemma was succinctly expressed by the French philosopher Paul Ricour writing in 1965, 'In order to get on the road to modernisation, is it necessary to jettison the old cultural past? ... On the one hand the nation has to root itself in the soil of its past, forge a national spirit and unfurl this spiritual and cultural revindication of the colonists personality.

But in order to take part in modern civilisation it is necessary at the same time to take part in scientific, technical and political rationality; something which often requires the pure and simple abandonment of a whole cultural past. There is the paradox: how to become modern and return to your sources.'¹

Research Question

To what extent is Critical Regionalism manifest in contemporary Malaysian architecture?

Literature Review

In the first part of this paper the author traces the development of critical theory related to Regionalism and Identity. The consequence of rapid modernization following independence was the widespread adoption in many emerging economies of the ubiquitous International Style of architecture. The disquiet this caused in the newly independent countries prompted the discussion of Identity and Critical Regionalism, which consequently became the focus of much postcolonial architectural discourse in the 1970s and 1980s.

The term Critical Regionalism was first coined in 1981 by Alexander Tzonis and Liane LeFaivre,² who employed the expression 'Critical Regionalism', to describe "the reaction to globalisation in architecture ... and pointed to an approach ... that while inviting a ... world founded on shared values and cutting edge technology would celebrate local cultural inventions ... (and) respect physical ecosystem resources, and enable diversity."

Kenneth Frampton responded to this in 1983 in 'Towards a Critical Regionalism: Six Points for Architecture of Resistance'.³ Frampton asserted that, "The fundamental strategy of Critical Regionalism is to mediate the impact of universal civilization with elements derived indirectly from the peculiarities of a particular place... It may find its governing inspiration in such things as the range and quality of the local light, or in tectonic derived from a peculiar structural mode, or in the topography of a given site".

Frampton concluded that, "Twenty years ago (in the early 1960s) the dialectical interplay between civilization and culture still afforded the possibility of maintaining some general control over the shape and significance of the urban fabric. The two last decades (the 1970s and 1980s), however, have radically transformed the metropolitan centres of the developed world. What were still essentially 19th-century city fabrics in the early 1960's have since become progressively overlaid by two symbiotic instruments – the rise of Megapolitan development and the serpentine freeway. The typical downtown,' he noted. "which, up to twenty years ago, still presented a mixture of residential stock with tertiary and secondary industry has now become little more than a *burolandschaft* city-scape: the victory of universal civilization over locally inflected culture."⁴ Frampton

makes the same argument in his 1985 publication, *Modern Architecture – A Critical History*.⁵ His observations could equally be applied to the rapid changes of the urban landscape of Kuala Lumpur in the period 1987 to 2017.

From the early 1980s architects in Southeast Asia were increasingly engaged in the post-colonial discourse and in 1983 a conference was organised in Kuala Lumpur by the Aga Khan Award for Architecture (AKAA), Pertubuhan Akitek Malaysia and Universiti Teknologi Malaysia on the subject of *Architecture and Identity*.⁶ A number of prominent academics and practitioners participated including Lim Chong Keat, Chen Voon Fee, Hijjas bin Kasturi, Ken Yeang, Parid Wardi Sudin and Ruslan Khalid.

The following year almost an entire issue of the *UIA Journal – International Architect* - was devoted to an extended article entitled *Vernacular, Pastiche, Modern? The Search for a Malaysian Architecture*.⁷ Ken Yeang, then the President of PAM, contributed an essay entitled, 'Notes for a Critical Vernacular in Malaysian Architecture'. The issue included contributions from Hijjas bin Kasturi, Kumpulan Akitek, MAA, Lai Kok Kun, David Teh of Pakitan Reka, Jimmy CS Lim, BEP and Laurence Loh.

Discussion of Identity led, naturally, to consideration of regional expressions of modern architecture and two years later a second AKAA conference was held in Dhaka, Bangladesh on the subject of *Regionalism in Architecture*.⁸ The participants included William Curtis, Charles Correa, Balkrishna V Doshi and Kenneth Frampton. The author of this paper was invited by the AKAA to edit the proceedings of the Dhaka conference and the earlier conference in KL. A seminal paper by Dr. Suha Ozkan, Secretary-General of the AKAA entitled 'Regionalism within Modernism' scanned

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graph TD
    A[SEX IS NATURAL] --> B[Sexually Deviant  
(Prevalent)]
    A --> C[Sexually Transgressive  
(Modern Response)]
    B --> D[Consistent Orientation  
(Typical of Target)]
    B --> E[New Orientation  
(changeable)]
    B --> F[Contradictory]
    F --> G[Promiscuous]
    F --> H[Repressed]
    C --> I[Reproductive Repugnance]
    C --> J[Aesthetic Repugnance]
    I --> K[Pathetic]
    I --> L[Eccentric]
    I --> M[Stigmatized]
    J --> N[Sexually Repulsive]
    J --> O[Cultural Deviance]
    J --> P[Stigmatized]
    N -.-> Q[Hybrid Modern Repugnance]
    O -.-> Q
  
```

SEX IS NATURAL

Sexually Deviant (Prevalent)

Consistent Orientation (Typical of Target)

New Orientation (changeable)

Contradictory

Promiscuous

Repressed

Sexually Transgressive (Modern Response)

Reproductive Repugnance

Aesthetic Repugnance

Pathetic

Eccentric

Stigmatized

Sexually Repulsive

Cultural Deviance

Stigmatized

Hybrid Modern Repugnance

An evaluation matrix was created to determine how the various approaches to regionalism could be incorporated in a Taxonomy of Regionalism. It was necessary to consider the Form; the Mode of Production; the Client / end user; the Construction Technology and finally the Materials.

[illegible]

Following the AKAAs initiatives in 1985 and 1987, the question of how to reinterpret the rich cultural heritage of Asia into contemporary architecture exercised the minds of a number of academics and practitioners in the 1990s and in 1997 Singapore architects William Lim Siew Wai and Tan Hock Beng published *Contemporary Vernacular: Evoking Tradition in Asian Architecture*.¹² The book sought to reveal, ‘an important architectural direction in many Asian countries where architects are attempting to reinterpret their rich cultural heritage in terms of contemporary idioms. This is achieved in different ways: by reinvigorating tradition, reinventing tradition, extending tradition and reinterpreting tradition’. The four strands identified by Lim and Tan were illustrated by the work of Charles Correa, Geoffrey Bawa, Hijjas Kasturi, Bunnag Architects and others.

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reiterate themes by Yeang and Tay familiar to academics and practitioners in Singapore and Malaysia, but the publication expounded their views to a wider global audience. Most recently Lefaivre and Tzonis returned to the subject in a 2012 publication *The Architecture of Regionalism in the Age of Globalisation*:¹⁴

Contemporary expressions of Critical Regionalism

In the second part of this paper the author places the work of contemporary architects (and non-architects) working in Malaysia within the taxonomy.



Dwelling in Kampong Ulu Geroh
(Photograph by author)

The dwellings of the Orang Asli – the original inhabitants of the Malay Peninsular - illustrate the Conservative Vernacular in the taxonomy. The dwellings were built (and still are, where inappropriate solutions are not imposed by well-meaning authorities or NGO's) using a traditional vernacular form/typology. They are constructed using indigenous craftsman, for the indigenous population, employing low-energy technology and locally sourced materials. The example shown is of a dwelling of the Semai people at Kampong Ulu Geroh in Perak. Built without a professional architect or

contractor it is expressive of vernacular regionalism.

The traditional Malay dwelling (there are many variants) is similarly indicative of the Conservative Vernacular strand of the taxonomy. Each of the variants follows a distinct typology known by the master craftsman, the house is built for a member of the indigenous population, constructed in readily available materials and employing relatively simple technology.



Traditional Malay houses

The Salinger House designed by Ar. Jimmy C S Lim and completed in 1993 illustrates the Neo-Vernacular strand of regionalism in architecture. The dwelling, originally located at Bangi, is a radical reinterpretation of a traditional form that introduced a stone core to the house. The house was designed for Dr. Haji Rudin, a Muslim scholar and Puan Munira Salinger. It was built using local materials by craftsmen from the Bachok District in Kelantan on Malaysia's east coast. The house deservedly won an Aga Khan Award for Architecture in 1998.



The Salinger House at Bangi (Photograph by author).

The Conservation strand in Regionalism is represented by Cheong Fatt Tze Mansion in Penang (1994 to 2001). This is the restoration of a former residence to serve a contemporary function as a boutique hotel. The mode of production utilised an architect – Ar. Laurence Loh (who now owns the house) and a contractor employing many local craftsman as well as craftsmen from China to restore the original fabric. Materials were acquired locally and construction method is low technology other than air con introduced in bedrooms.



Cheong Fatt Tze Mansion (Photograph by author)

Moving next to Historically Transformative Regionalism (Modern Regionalism). The Reinterpretive strand of Modern Regionalism is illustrated by the Datai at Langkawi (1993) designed by

Singapore – based Australian architect Kerry Hill with Akitek Jururancang Malaysia as local architect of record. Here the architect has reinterpreted the vernacular. The modern form of the hotel reinterprets traditional forms using indigenous craftsmen employed by a main contractor. The building has a contemporary function as a high-end resort hotel for local and foreign guests. The construction technology is a hybrid of low and high technology (aircon etc.) and the materials are both local and international e.g. bathroom fittings. The Datai also won an Aga Khan Award for Architecture, in 2001.



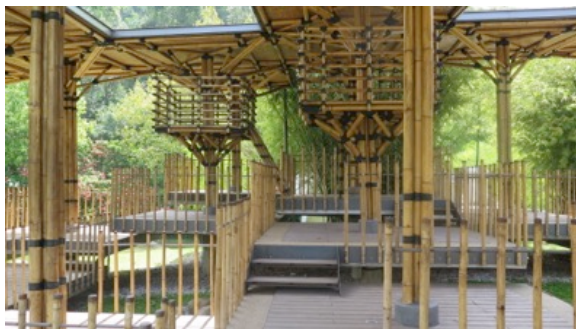
The Datai at Langkawi (Photograph by author).

Another example of Reinterpretive Regionalism is the Telegraph Pole House, also in Langkawi, designed by Ang Boon Chung and Ang Wen Hsia of WHBC Architects for an expatriate British client. The mode of production is a contractor using local labour, employing low energy solutions and locally sourced materials.



The Telegraph Pole House, Langkawi
(Photograph by author)

The Bamboo Playhouse in Kuala Lumpur's Botanic gardens designed by Ar. Eleena Jamil illustrates Reinterpretive Regionalism, using local craftsmen and traditional materials it is designed for community use. The Wakaf – a building typology that is found in the traditional Kampongs – a community-meeting place, inspires its form.



The Bamboo Playhouse (Photograph by author)

An early example of Abstract Modern Regionalism incorporating Cultural Patterns was the Dayabumi Complex (1984) designed by BEP Architects and Akitek MAA.



The Dayabumi Building (Photograph by author)

The project borrowed Islamic patterns usually associated with a Mashrabiya and these are incorporated into a strikingly beautiful

modern tower block. Built by a contractor and employing modern materials the form has moved a long way from the traditional vernacular. The building serves a contemporary function and is a successful modern building (though seemingly undervalued as an icon) that incorporates cultural references.

An example of Abstract Regionalism that is Climatically Responsive is Menara Mesiniaga designed by Ar. Dato' Dr. Ken Yeang. It was completed in 1992. Another Aga Khan Award winner (1995) it is responsive to the specific climate of Kuala Lumpur and was recognised globally at the time of its completion as a major breakthrough in the design of a high-rise building in the tropics. It fits into the Taxonomy in the category Abstract Regionalism and the sub category Climatically Responsive Regionalism. Designed for a commercial client – IBM – it was built by a major contractor and employs modern materials.



Menara Mesiniaga (Photograph by author)

Ken Yeang's own residence - the Roof Roof House - completed in 1985, similarly fits into the category of Modern Regionalism and specifically Climatically Responsive Regionalism. The house has a modern form and utilises modern materials. It was built by a contractor incorporating a variety of technical solutions yet learning from the vernacular in terms of orientation in relation to the sun path and passive cooling by prevailing winds. Two years later Ken Yeang wrote an instructive book entitled Tropical Urban Regionalism.¹⁵



The Roof Roof House (Photograph courtesy of Albert Lim KS)

Much of the work of Hijjas Kasturi the winner of the Malaysian Institute of Architects (PAM) Gold Medal in 2001, falls into the category of Modern Regionalism and specifically the strand labeled Iconographic Regionalism. The

Menara Telecom tower is said to be based on a palm tree seedling while the Malayan Bank HQ is derived from a Malay kris. The Tabun Haji building (1984) has clear Islamic influences.



Three towers by Hijjas Kasturi (Photographs by author)

Kevin Mark Low's design for PJ Trade Centre (2009) is a wonderful building for the tropics. A challenge to the ubiquitous tower block imported from temperate climates it has a permeable façade and a seminal design for a public plaza in the tropics. The design is said to be inspired by weaving of "songket", "batik" and "tenun". The building sits in the category Climatically Responsive Modern Regionalism



PJ Trade Centre (Photograph by author).

The Chempenai House - a 2013 residential project by Ang Boon Chung and Ang Wen Hsia of WHBC Architects also illustrates Modern Regionalism that derives its form from the response to the tropical climate. The bold use of the *soleil bris* places the house firmly in a hot climate. The house incorporates shading and natural ventilation of the in-between spaces, in effect learning from the vernacular.



The Chempenai House (Photograph by author).

The Visitor Centre at the Boh Cameron Tea Estate responds to the cool climate in the Cameron Highlands. The design by Huat Lim and Susanne Zeidler of ZLG relates well to the topography and public spaces are all naturally ventilated. It too fits into the category Modern Regionalism, responding to climate.



Boh Cameron Visitor Centre (Photograph by author)

The Kompleks Islam Putrajaya by Hud Abu Bakar of RSP Architects (2017) is another example of Abstract Regionalism drawing upon disparate iconographic elements in Islamic architecture.



Kompleks Islam Putrajaya (Source RSP website)

The Factory in the Forest in Penang, designed by John Bulcock of Design Unit is an instructive example of Modern Regionalism that responds to the tropical climate. Completed in 2017 the architect has extended the ecology of the site into the building. The building, designed for a

multi-national company with headquarters in California. produces medical products in a high-technology environment.

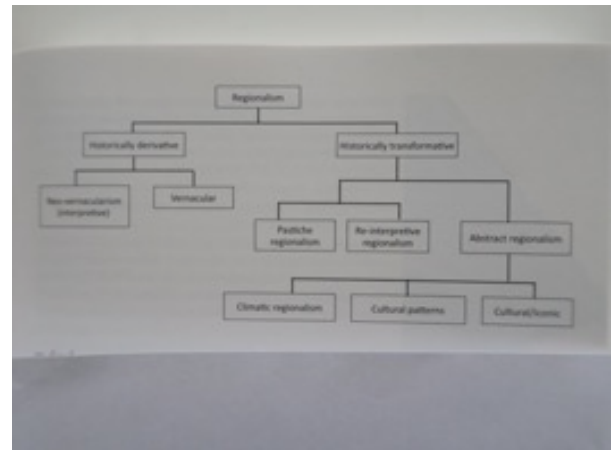


The Factory in the Forest (Photograph by author)

Future research

In the late 20th century the subject of Regionalism and Identity in Malaysian architecture moved from centre-stage as post modernism, deconstruction and tropical modernism prevailed. In the early 21st century sustainability, green architecture and concern about diminishing global resources has dominated academic discourse and practice. But in 2017 a new book *The Resilience of Tradition: Malay Allusions in Contemporary Architecture* appears to confirm a continuing interest in Critical Regionalism.¹⁶ Interestingly the new book cites the taxonomy from this author's 1989 Masters dissertation – Regionalism as

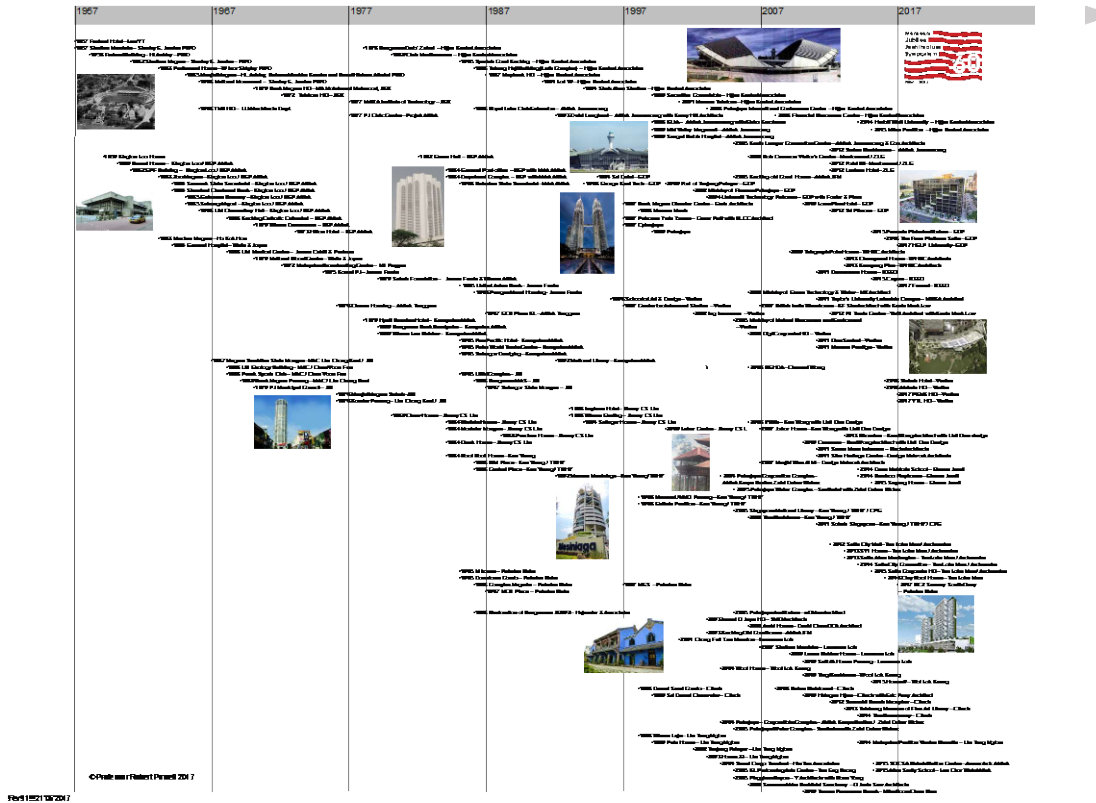
Cultural Regeneration¹⁷ - albeit in a slightly modified form.



A Taxonomy of Regionalism (Source: *The Resilience of Tradition: Malay Allusions in Contemporary Architecture*).

In 2017, the author compiled a historical timeline of architecture for the Merdeka Jubilee Architecture Symposium, held to celebrate 60 years of architecture in Malaysia since independence¹⁸. The timeline highlights the distinct phases Malaysia has gone through in each of the six decades. The key debate on Identity and Regionalism in architecture occurred in the third and fourth decades. But the timeline confirms that a number of architects in Malaysia continue to engage with issues generated directly or indirectly by the discourse on Critical Regionalism including GDP, Serina Hijjas of Hijjas Architects, Unit One, Design Network, DCA, C'Arch, Q Jade Saw and Tetowowe. The work of these architects and others is fruitful ground for research.

SIX DECADES OF MALAYSIAN ARCHITECTURE 1957-2017 - NOTABLE BUILDINGS



The Merdeka Timeline (Source the author)

Even as emphasis shifts to ‘Hybridisation’ and ‘Multiple Modernities’ it is evident that Critical Regionalism is still in the mainstream of architectural discourse, Ken

Yeang, paraphrasing Kenneth Frampton, notes that, “Critical Regionalism is about Geography and Ecology”. In short, it is about knowing who you are and where you are.¹⁹

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THE CONSEQUENCES OF A POTENTIAL UNPREDICTABLE GLOBAL COOLING ON GREEN BUILDING STRATEGIES IN THE TROPICAL BELT 2016 AND 2017

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Whereas the theory of global warming -far beyond being a mere theory- has a long-standing track record, the intellectual wave of the global cooling paradigm is new, although it is stated by their community that a cyclic phenomenon of solar spots decreasing the temperature on planet Earth is reviving every 392 years. In the presentation, both global theories are confronted with real local South-East Asian temperature logs since 1975. Global cooling adepts claim that 2017 is the turning point for the new climate worldwide cycle to become colder for about 30 years. Hence, micro analysis of the weather relevant for green building

experiments under a microscope can demonstrate whether global warming or / and global cooling is happening “glocally”. 1-3 °C higher or lower temperature has tremendous consequences for tropical countries around the Equator where thermal comfort is always close to the borderline of an upper space limit of 28.6°C. It is shown by own data in a night-time cross ventilation longitudinal study in Kuala Lumpur how the recent climate change appears, and how the carbon footprint caused by a hybrid cooling system develops by slightly lower or higher temperatures over the years.

RECONNECTING WITH NATURE

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Human beings are hard-wired to be in contact with nature, yet, we spend 90% of our lives indoors. This keynote address raises the question of whether our built environment is sufficiently *biophilic*, i.e. catering adequately to fulfill the basic human need of being in contact with the natural environment. The presentation includes several local examples of *biophilic* design solutions and their positive effect on human health and well-being. On the legislative side, some countries have for decades had mandatory requirements for *biophilic* design. Moreover, several of the green building certification schemes have recently begun to include *biophilic* design. In our increasingly urbanized World, there is a growing and conscious effort of “reconnecting with Nature”. An effort, where the built environment must play a paramount role.

ESTABLISHING THE CARBON BASELINE FOR UNIVERSITY OF MALAYA CAMPUS FOR SUSTAINABILITY REPORTING AND MONITORING

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Abstract

Sustainability in higher education is trendy nowadays as universities around the world strive to lessen the impact of expanding university activities and operations on the environment. Reporting, assessment and ranking play their part in sustainable campus initiatives in the long term as they measure and record progress for future references, decision making, and investment. Quantitative assessment of activities based on improvements from a baseline condition is particularly needed to aid universities in formulating strategies for carbon reduction measures. University of Malaya (UM), Malaysia's eminent university which is located in the capital city of Kuala Lumpur embarked on a project to establish a carbon emission baseline for its campus in 2012 and 2013. This voluntary reporting programme for carbon information was also in line with the government's commitment to mitigate Green House Gas (GHG) emissions. The application of Low Carbon City Framework and Assessment System (LCCF) methodology in this context was deemed suitable given the university's location, size, heterogeneity of activities and governance which very much resemble a small city. The framework provides carbon equivalent as a result of human activities in a bounded area. University of Malaya opted for the city based approach where assessments were made for four elements within the system which were urban environment, urban infrastructure, urban transport and buildings. This paper inventories the activities in UM Campus in the base year and the potential impact where the assessment is applied. The main objective is to establish the carbon footprint baseline which can be referenced as a comparative, and the abatement target to be achieved (which can be referenced to measure goals). It was estimated that the carbon baseline for UM campus was 10,069.95 metric tons of CO₂ equivalents in 2013. This amount was actually higher than the business as usual (BAU) scenario projected from 2012 figures. The larger proportion of this emission was attributed to traffic and energy and hence their significant contribution in carbon reduction when mitigated.

Keyword: Sustainable Campus, Carbon Assessment, Carbon Reporting, Sustainability Reporting, University Malaya, Malaysia.

THE RELATIONSHIP BETWEEN GREEN ARCHITECTURE AND VERNACULAR ARCHITECTURE

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Abstract

In order to, usage of sustainable concepts and sustainable development in architecture, Green architecture is shaped in line with environmental attitudes and nature's respect for its features. In addition to protecting the environment, comfort is important for humans, and the result, a building designed with the smallest incompatibility with the natural environment around itself and in the wider area than the world. Now upcoming a question: is there a relationship between green architecture and vernacular architecture in the world's buildings? To answer it, this research is in the field of fundamental and theoretical and has been done based on descriptive-analytic method and library studies. That the important result is avoiding vernacular architecture now and the need more attention to green architecture as vernacular architecture.

Keywords: Green Architecture, Vernacular Architecture, Environment, Material, Energy

1. Introduction

Green Architecture is the first comprehensive guide to the work of architects and designers who represent the cutting edge of sustainable, or “Green” architecture.

Since the first humans decided that woven leaves would make a better rain shield than the more random protection of a tree, shelter in its many and diverse form has been key to cultural development. But, while we know and applaud the makers of the great buildings that come from these simple beginnings, the creators of the more humble “vernacular architecture” remain anonymous.

We humans have an amazing ability to innovate. Nowhere is this more apparent than in the world's diverse range of handmade or vernacular buildings.

Vernacular architecture is a subject that provides a window on the lives and traditions of the indigenous people of our world, and in so doing creates a mirror that reflects our own experiences. This, in turn, helps us to understand more clearly where

the buildings of our contemporary world spring from, or more importantly why such buildings so often fail to meet our fundamental human needs.

It takes little imagination to appreciate the disastrous long-term effects that for example, high-density, high-rise housing has had on the communities and social cohesion of our world's cities. The notion that houses should be “machines for living” long resonated in the mindset of money planners and architects. Education systems provided an aesthetic awareness and certain expertise. Rationally applied building technology and forms matched the required “function” of the building. Solutions were fixed, immovable and sold as a modern utopian ideal to the world's aspiring urban classes.

However, if we look at both current and historical vernacular building traditions, there exist opportunities to learn of solutions to our housing needs that draw less on limited resources available to us. These impact more gently on our fragile ecosystems, offering solutions that

engender a profound connection between the builders, their environment, the material used, and the wider community. Much has been written and indeed understood, about human-scale architecture and the need to limit the environmental impact of the building industry. However, the truly sustainable practitioners are still widely ignored by the majority of the establishment, where the champions and practitioners of the vernacular building are still marginalized, either through misinformed opinion or by the forces of property speculation and planning policy.

It may be that notion of tradition leaves people feeling uneasy, with associations to a world of convention and constraint, such that tradition belongs to a place in the past, inhabited by the ghosts of disapproving ancestors. However, tradition can also be our guide and teacher, and provide the template for architectural solutions that can stretch the imagination far beyond the seemingly rational.

In a world where the politicians and the policymakers are struggling to find effective solutions to the problems that threaten the very existence of our world, it is time for an individual to take the initiative and look seriously at the creativity inherent in the vernacular buildings of our world.

In recent years, the reason for sustainability concept has become the common interest of numerous disciplines is top form the sustainable development. Green architecture strives to minimize the number of resources consumed in the buildings construction, use, and operation, as well as curtailing the harm done to the environment through the emission, pollution, and waste of its components.

Sustainability is comprehensive therefore a complex subject. It is of vital importance to all because it deals with the survival of

human species and almost every living creature on the planet. Sustainable and eco-friendly architecture is one of the main aims that humans for creating a better life have made as the ultimate model for all their activities. For this reason, moving toward a greener architecture is well-thought-out the main goal of the present architecture of our time.¹

Green architecture, or green design, is an approach to building that minimizes harmful effects on human health and environment. The “green” architecture or designer attempts to safeguard air, water, and earth by choosing eco-friendly building material and construction practices.²

2. Literature Review

2.1. Definition of a green building:

A green building can be loosely defined as one that has minimal impact on the environment. Also known as green construction, a sustainable building refers to both a structure and the using of processes that are environmentally responsible and resource-efficient throughout a building’s life-cycle: from sitting to design, construction, operation, maintenance, renovation, and demolition. Ideally, the green building preserves and restores the surrounding habitat that is vital for sustaining life and then becomes a net producer and exporter of resources, materials, energy, and water (rather than being a net consumer). Green building construction and operation assures the healthiest and most efficient (meaning least disruptive) use of land, water, energy, and resources.

2.2. Green architecture’s characteristics (features):

- Ventilation systems designed for efficient heating and cooling.
- Energy-efficient lighting and appliances.
- Water-saving plumbing fixtures.

- Landscapes planned to maximize passive solar energy.
- Minimal harm to the natural habit.
- Alternate power sources such as solar power or wind power.
- Non-synthetic, non-toxic materials.
- Locally-obtained wood sandstone.
- Responsibly-harvested woods.
- Adaptive reuse of older buildings.
- Use of recycled architectural salvage.
- Efficient use of space.

Most green buildings do not have all of these features, the highest goal of green architecture is to be fully sustainability.

2.3. Elements of green building design:

- Site and its surroundings
- Energy Efficiency
- Water Efficiency
- Material Efficiency
- Indoor Air Quality
- Waste Reduction
- Low maintenance costs

2.3.1. The principles of green building design:

The process of green building design with an intimate understanding of the site in all its beauties and complexities. An ecological approach to design aims to integrate the systems being introduced with existing on-site ecological functions performed by Mother Nature.

These ecological functions provide habitat, respond to the movements of the sun, purify the air as well as catch, filter and store water. Designers can create features in their buildings that mimic the functions of particular eco-systems. Species that thrive in natural ecosystems may also utilize habitats created in man-made structures. Creating new habitat on structures in urbanized areas is especially important to support bio-diversity and a healthy ecosystem.³

- Water System
- Natural Building
- Passive Solar Design
- Green Building Material
- Living Architecture

2.3.1.1. Water System:

Water - often called the source of life - can be captured, stored, filtered, and reused. It provides a valuable resource to be celebrated in the process of green building design. only about six percent of the water we use is for drinking. There is no need to use potable water for irrigation or sewage. The Green Building Design course introduces methods of rainwater harvesting, greywater systems, and living pools.

The protection and conservation of water throughout the life of a building may be accomplished by designing for dual plumbing that recycles water in toilet flushing or by using water for washing of the cars. Waste-water may be minimized by utilizing water conserving fixtures such as ultra-low-flush toilets and low-flow shower heads. Bidets help eliminate the use of toilet paper, reducing sewer traffic and increasing possibilities of re-using water on-site. Point of use water treatment and heating improves both water quality and energy efficiency while reducing the amount of water in circulation. The use of non-sewage and greywater for on-site use such as site-irrigation will minimize demands on the local aquifer.⁴

2.3.1.2. Natural Building:

A natural building involves a range of building systems and materials that place major emphasis on sustainability. Ways of achieving sustainability through natural building focus on durability and the use of minimally processed, plentiful or renewable resources, as well as those that, while recycled or salvaged, produce healthy living environments and maintain indoor air quality. Natural building tends

to rely on human labor, more than technology. As Michael G. Smith observes, it depends on "local ecology, geology, and climate; on the character of the particular building site, and on the needs and personalities of the builders and users."⁵ The basis of natural building is the need to lessen the environmental impact of buildings and other supporting systems, without sacrificing comfort for health. To be more sustainable, the natural building uses primarily abundantly available, renewable, reused or recycled materials. The use of rapidly renewable materials is increasingly a focus.

2.3.1.3. Passive Solar Design:

Passive solar design refers to the use of the sun's energy for the heating and cooling of living spaces. The building itself or some element of it takes advantage of natural energy characteristics in its materials to absorb and radiate the heat created by exposure to the sun. Passive systems are simple, have few moving parts and no mechanical systems, require minimal maintenance and can decrease, or even eliminate, heating and cooling costs. Homes in any climate can take advantage of solar energy by incorporating passive solar design features and decreasing carbon dioxide emissions. Even in cold winters, passive solar design can help cut heating costs and increase comfort.⁶

2.3.1.4. Green Building Material:

Green building materials are generally composed of renewable rather than non-renewable resources and are environmentally responsible because their impacts are considered over the life of the product. In addition, green building materials generally result in reduced maintenance and replacement costs over the life of the building, conserve energy, and improve occupant health and productivity. Green building materials can be selected by evaluating characteristics such as reused and recycled content, zero or low off-gassing of harmful air

emissions, zero or low toxicity, sustainably and rapidly renewable harvested materials, high recyclability, durability, longevity, and local production.⁷ The materials common to many types of natural building are clay and sand. When mixed with water and, usually, straw or another fiber, the mixture may form cob or adobe (clay blocks). Other materials commonly used in the natural building are earth (as rammed earth or earthbag), wood (cordwood or timber frame/post-and-beam), straw, rice-hulls, bamboo, and stone. A wide variety of reused or recycled non-toxic materials are common in natural building, including urbanite (salvaged chunks of used concrete), vehicle windscreens and other recycled glass.⁸

2.3.1.5. Living Architecture:

The environment like our bodies can metabolize nutrients and waste. Living Architecture focuses on these processes, integrating ecological functions into the buildings to catch, store, and filter water, purify air, and process other nutrients. Living Architecture also addresses biophilia, the documented health benefits associated with being in touch with living systems in the built environment.⁹

Throughout history greening of outside walls and roofs of buildings has taken place. Reasons for doing so were the increase of insulation (keep cool in summer and keep cold out in winter), improved aesthetics, improved indoor and outdoor climate, reduce the greenhouse gases such as Carbon Dioxide (CO₂), Carbon Monoxide (CO) and Nitrogen Dioxide (NO₂) as well as increasing ecological values by creating habitats for birds and insects.¹⁰

3. Research Methods

This fundamental and theoretical research in the field and the descriptive-analytic method and library studies conducted. Accordingly, the recognition of the green architecture and its features in relation to

vernacular architecture has been considered.

4. Analysis & Results

4.1. Green Building In The World:

No one knows exactly, or even approximately, how many buildings there are in the world, but estimates of well over a billion have been made. Of these, eighty percent or more are estimated to be vernacular buildings. Put another way, buildings designed and built by professional architects and builders constitute only small part of world's built infrastructure. The vast majority of people in the world live in homes and use buildings that they and their friends and family have built themselves.¹¹

This is obviously more true in some countries and regions than in others. In the part of the world, planning restrictions limit self-building, the land is expensive and the traditions of forebears and ancestors have been marginalized (exploited), their skills lost and forgotten. In the large parts of the world, people are closer to their vernacular architecture, and in many cases are still living in it and building it. However, the situation is changing fast. The rush (offense) to modernization means that more people than ever before are moving cities, where vast numbers now live in squatter settlements where they construct houses from waste and scrap. This is the new vernacular architecture of our time.

All over the world, meanwhile, traditional vernacular architecture is disappearing, not only the building forms themselves, but also the knowledge, skills, and customs behind their creation.

Any examination of the vernacular building is full of surprises and, by its very nature, is interdisciplinary. These buildings do not exist in a vacuum – they are built as part of people's lives and culture. These structures are shaped not only by physical

circumstances and available materials but also by the beliefs, myths, customs and traditions of the tribe, clan or group that builds them. Early vernacular shelters were more respect, nothing the ingenuity employed to fashion functional and aesthetically pleasing structures with simple tools.

The vernacular design must be fit for purpose. Nomadic peoples build lightweight structures, which can easily be packed up and reassembled; sedentary peoples build permanent homes that can last five hundred years, during which time they are constantly renewed and adapted to suit changing requirements. As a general rule vernacular builders aim to stay warm in winter and cool in summer, and they have devised numerous ingenious techniques for achieving those ends.

4.1.1. Building of Europe & Eurasia:

Researcher's journey across Europe and Eurasia commences in the far north with the different forms of shelter used by the Sami people. They highlight two forms of earth buildings, found at the extreme ends of their territory, and the cruck timber frame, of which Britain has the greatest density in the world. They profile the giant house barns of northern Germany and the unique wooden churches of Ukraine, as well as the many forms of izba, found across vast swathes of Russia. In addition, they admire the working windmills of the Netherlands and the practical and elegant hayracks and bee-houses of Slovenia.¹²

4.1.2. Building of The Mediterranean & Middle East:

The Mediterranean is ringed with cave dwelling and cave houses of various form, many which have ancient roots. Drystone architecture is another widespread building type, most beautifully expressed in the Trulli of southern Italy. The ubiquitous black tent serves not only the Bedouins, but nomadic groups across a huge area of northern Africa, the Middle East and

beyond. It survives in the modern age, unlike the reed houses of Marsh Arabs of Iraq, whose whole culture is under threat. The impressive earth towers of Yemen and the ingenious wind catchers of Iran offer lessons for modern architects seeking to build in hot, inclement climates where water is scarce.¹³

4.1.3. Building of Asia:

The beautiful traditional building and woodworking skills of Japan are highlighted in our profiles of townhouses and urban minkas. We investigate tulou of Fujian, fortified buildings large enough to hold an entire clan of people. On the roof of the world, we visit the gers of Mongolian, supreme examples of nomadic shelter, and celebrate the conservation and the restoration of some remarkable buildings in old Lhasa in Tibet. India's wealth of vernacular structures is represented by the impressive stepped ponds and stepwells of Rajasthan and the barrel-vaulted huts of the much-studied Toda people in the south.¹⁴

4.1.4. Building of Africa:

One of the most impressive buildings in the whole of Africa, the Great Mosque of Djenne, symbolizes and celebrates the innovative earth architecture of Mali. The distinctive toleks of the Mousgoum people and the Batammaliba roundhouses display similar qualities on a human scale. Stilt dwellings are the only housing solution for the people of Ganvie, dubbed the "Venice of Africa". The Rendille herders shelter in wheel-shaped tents, while the Zafimaniry people of Madagascar build houses from bamboo and wood that evolve into a more permanent form as the relationship of its married owners deepens. In the south, the Zulu's beehive indlus and the painted houses of the Ndebele are widely celebrated as expressions of their differing, but equally vibrant, cultures.¹⁵

4.1.5. Building of North America:

The Inuit igloo and the plains Indian tipi have immediate cultural resonance and both are justly recognized as supreme examples of simple shelters of great ingenuity. Less well known are the striking forms of the Haida plank houses, decorated with vibrant paintings and crowned with the first totem poles. Log cabins come in all shapes and styles, as do the big barns of the North American landscape and the early settlers building forms – the I-house, cracker house and saltbox house. The shakers devised their own architectural language of un-adorned shape and form, which remains highly influential. The adobe houses of New Mexico, designed for desert climates by the Pueblo peoples, have now become an internationally recognized style.

4.1.6. Building of Latin America:

In the mountains in south of Mexico, the Tzotzil people live in small villages of thatched dwellings with four-sided roofs, while in the Amazon the Yanomami combine their individual dwellings into one huge circular shabano. In the Caribbean, former African slaves invented the first mobile home, the chattel house, which could be disassembled and moved at short notice. In the highlands of Colombia, unique buildings combining bamboo structures with adobe and stone are being studied for their ability to survive earthquakes. High on lake Titicaca in the Andes Mountains, the Urus people live on floating islands in houses made of reeds. And in southern Chile, a unique set of wooden churches has been recognized by UNESCO as a World Heritage Site.¹⁶

4.1.7. Building of Australasia & Oceania:

The scattered islands of Oceania have each developed their own style of vernacular buildings, they range from the octagonal house of the Kalinga, and the umbrella-

shaped fale tele of Samoa to the boat-shaped dwellings of the Toraja and the extraordinary spirit house of the Abalam. In Bali, Courtyard houses encompass an entire extended family's dwellings. In New Guinea, the Korowai people are still living in treehouses. In Australasia, the Maori meeting-houses are still alive and vibrant in modern times, whereas the many and various Australian Aboriginal shelters have virtually disappeared.¹⁷

4.1.8. Modern Vernacular Architecture:

By far the most numerous vernacular buildings of the modern age are the ad hoc constructions of the millions of urban squatters living in urban environments across the developing world. In the west, the pressure is on to develop forms and styles of building in tune with the environment, which is energy-and water-efficient, made of low carbon and non-toxic materials. Earthships use waste tires filled with rammed earth for walls and there is a long tradition of buildings made from bottles. Virtually all the material for Ben Law's Woodland House in West Sussex, England, came from the wood itself or the surrounding area. The interest in reviving old vernacular building skills is illustrated with the cob revival and an African scheme to build vaulted roofs without using wooden supports.¹⁸

5. Discussion & Conclusion

Green design is practical to solve problems, in which natural resources before, after and during production and manufacturing process to the least damage, plus in the course of this action materials should be useful, have a long shelf life and can be reversible to the cycle of nature. Life-long things are useful and the biggest obstacle to waste products and squander, and this is better than reuse or recycling.

Now is the time when resources are in decline, when architects, landscape architects, urban designers, engineers and

building specialists are fundamentally concerned about the future. Designer specialists should expand their field of expertise and expertise in this field, protecting them from sources and supporting the future of children, grandchildren, and future generations.

Buildings must be designed to be able to use the climate and local energy sources. The shape and manner of deployment of the building and the location of its interior spaces can be such that it improves the level of comfort inside the building, while at the same time reducing the consumption of fossil fuels through the proper insulation of the structure. These two processes have inevitable overlaps and common points.

Today, each building should be designed in such a way as to minimize the use of new resources and, after destruction, also be the source of other structures, given that there are not enough resources to create artifacts in the world that can be used to reconstruct each A generation of buildings used a new amount of them can be achieved by reusing recycled spaces and materials.

Reasonable use of natural resources and proper construction management helps to maintain limited natural resources and reduce energy consumption and improve the quality of the environment. The design quality is stable. Good quality regardless of nature and the use of durable materials should also be considered.

Achieving the highest standards of quality, safety and comfort that actually provides human health are one of the major goals of green architecture that is achieved through the use of efficient management and the use of the latest technologies.

Today, our architecture tries to be redesigned with the design of vernacular architecture. So we have to learn more

about this architecture and use it all over the world.

We must know that vernacular architecture is an introduction to green architecture.

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A CONCEPTUAL MODEL FOR SOCIAL DESIGN OF URBAN PARK TO GENERATE SOCIAL INTERACTION

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Abstract

Social interaction is a subscribed engagement among city dwellers in their routine activities within public open spaces. Urban parks have an essential role in engaging people in social interaction. This paper attempts to establish a conceptual model for social design of urban parks by relating three relevant concepts; first the notion of social interaction, second social activity. Third, the concept of users' experience, as way-finding. Until recently, research on socio-spatial aspect of environment has mainly focused on social ties, place attachment, and human well-being; thus disregarding the spatial aspect of urban park design. The findings suggest, a legible path structure of the park as an effective model to generate social interaction. The components of social experience are introduced as paths, nodes, landmarks and social activities organized within path structure. The model bridges the gap between social and perceptual dimensions of urban design theories.

Keywords: Social Interaction, Path Structure, Social Activities, Way-finding, Urban Park

1. Introduction

Urban parks, in essence, are social spaces with the role of socializing urban residents which is regarded as one of the important aspects of urban civilization [25, 8]. The perceptions of urban parks in terms of social interaction and activity is the result of people's interactions with their environmental setting [19, 46].

Good quality urban park design could cater for public needs and satisfaction. Careful design could enhance social interaction among people [38] by providing meeting opportunities [5]. Also, it accommodates psychological fulfilment of urban residents [45, 25].

However, in this current decade, despite being planned with modern infrastructure, the design of urban parks could not support the function in terms of encouraging social interaction among people [18, 43]. It means designs of these urban parks would not support the users' social experience.

Until recently studies on urban parks mainly concentrated on the importance of

social sustainability in different aspects of the quality of life. Examples include ensuring healthy city environments by protecting urban biodiversity [31] or the evaluation of park accessibility and its use [3, 44]. However, there have been less studies to generate social interaction in urban parks.

Social interaction is commenced with unexpected eye contact in a fleeting moment and acted by at least two people who are present in the space. Therefore, at first, people need to become aware about the presence of other people in urban parks. But how could this awareness be shaped and enhanced through social design of urban parks? This paper raises the examination on how the social interaction would be generated within legible path structure of urban parks through contribution of social experience.

2. Literature Review

2.1 Path Structure

This study considers the social interaction within legible path structure of urban parks. Introducing this attribute of social

experience begins with referring to the definition of space. Space is defined by voids which are made with obstacles. From morphological point of view, the arrangement of these spaces unites in a particular form and draws path structure. This structure organizes as a whole and it is perceived as more than the sum of parts [1]. A similar explanation might also be related with the aggregation of the mass of each settlement like buildings within cities or plants in urban parks as barrier shapes the path structure moving between blocks. This structure as skeleton connects the origins to the destinations and produces patterns of demands through movement. Subsequently, the settings become socialized. In this vein, path structure is defined as a spatial arrangement of functions [26, 9, and 4].

2.2 Social Activities

The primal definition of social interaction is stated through structuration theory. In structuration theory, humans are agents (not all agents are human). Agency, as Giddens calls it, is the human action [22]. The foundation of Giddens' structuration theory for introducing social interaction is based on occurrence of social action within specific time with geographical reference [24]. Giddens argues that social actions include whole human activities in everyday social life, and social interaction as a face to face interaction is one of their products [13]. In social theories of urban design, social actions are indicated as social activities encouraging people to social interaction within urban parks. Social activities are outdoor spatial activities which depend on the presence of people [21]. Meanwhile, social activities are shaped simultaneously through bodily observation of other users while the experiencing of public spaces (urban park) occur through movement within path structure and staying within wide common arenas naming activity nodes [35, 25, and 48]. Attractive social activities are offered through fundamental spatial activities like walking, standing, sitting, etc.

These activities are mostly the preliminary point of almost all activities [20].

Accordingly, the spatial organization of these basic activities within path structure of urban parks, shapes the bodily experiences and thereafter, social interactions will happen. This is in consensus with Giddens and other well-known social theorists in the social science field including Bourdieu, Foucault, and also Lefebvre. However, these social theorists just mention the spatial aspect of social interaction in an implicit way. Even though they discuss about the social interaction derived from spatial distribution of social actions, this is related to the spatial position of different strata influencing their interactions [22, 29].

For instance, Emile Durkheim [16] to achieve solidarity among laborers suggests configuring these people in an organic way for producing face to face interaction naturally.

On the other hand, although social theories in urban design have mentioned that public spaces have two interwoven dimensions: spatial and social [10, 38] the process of shaping social interaction via social activities is less considered. Their explorations have been limited to assessing the use of public spaces with different methods like observation and their recommendations are confined to some guidelines in having safe, comfortable and sociable public spaces [17]. To figure out how social interaction is engendered through social and cognitive aspect of environment, this paper elaborates the way-finding notion with consideration of social activities.

2.3 Way-finding and Social Interaction

Cognition or perception means "the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses" [54]. Furthermore, spatial cognition initially means as the internal reflection and

reconstruction of the structures and relation among spaces in thought and remembering information to assess the built environment [57, 1].

On the other hand Goffman [23] introduces, the experiential aspect of social interaction as the reciprocated perception among people that causes them to become aware of each other in passive and active ways. He mentions that without this awareness, social interaction could not happen [22, 35]. However to perform social interaction, humans must be motivated, knowledgeable and become able to justify the actions and monitor them [22, 24].

Kevin Lynch proposed the theory of “the image of the city” in the primary period of cognitive theories. He defined the image of city as a consequence of mutual interaction among human and environment through perception. This interaction and experience is as a result of legibility of environment [15, 43].

Kevin Lynch introduces five legible elements including paths as channel of movement such as streets, boulevards, highways, etc. Edges depict the borders or restrictions between urban distinct areas. Nodes identify intersections or convergence of at least two paths. Districts are the detectable areas or zones within the cities. Landmarks are the sole anchor or focal points for orientation [37, 56].

This study, just considers the paths, nodes and landmarks organized within path structures and it does not concern about edges and districts. Because edges are more related with built public open spaces and, the districts are more related to the scale more than urban parks such as neighborhoods.

This article argues that, in addition to make legibility through distinctive landmarks, paths and nodes, the locations of activities within nodes which we call them activity

nodes, also should be legible and provides visual accessibility. A legible environment also supports way-finding ability.

Way-finding is the ease of movement through legible landmarks within path structure and activity nodes and encourages people to experience the environment [7]. With this regard, social interaction is defined as people watching in passive way while people move within path structure naturally or whether they gather together within activity nodes. Path structure configures the paths, nodes and landmarks. The integration of uses and activities within path structure causes people to see and memorize legible elements through linking them to their social usage. In this vein, these constituents obtain the functional cues and movement towards them could be boost up [55, 61]. This possibility helps people to make more accurate decisions in way-finding and sketch mapping [6, 61]. Accordingly, way-finding is a sense-based process by connecting mental image with social interaction [2, 52]. Although theorists state that the differences in age, gender, ethnicity, lifestyle, past experience and culture have effects on cognitive representation of perceiving environment, the spatial elements coined by Lynch are the common environmental experience among people. Besides, while the image of cities is criticized due to not presenting a precise exact expression of the world by distortions in scales by widening or compressing distances or twisting directions, it is argued that the image, by keeping the topological characteristics of each space and maintaining the sequences among legible elements, could overcome this weakness [41, 34]. So, the scattered districts and torn relations between legible elements drawn by people could be sewn back together within an integrated form. Therefore, this value is important for examining whether or not people could find their ways [27, 2].

Social interaction has been less considered in relation to legibility of path structures

and way-finding notion and within the context of urban parks [14, 42].

Way-finding through legibility just considers spatial forms by isolating them from their social context and fails to assess the cognitive characteristics of legibility elements in terms of evaluating social interaction [30]. Moreover, legibility of environment without consideration of legibility of activities could have negative influence on human natural movement by making the environment homogeneous and boring [47, 29, 58, and 32]. Thus, way-finding and orientation depends on functional motivations rather than simple physical stimuli [40]. Furthermore, Allan Jacobs and Donald Appleyard, by proposing the term activity in giving social life to the legible elements, had emphasized on distinctive social functional aspects of paths, landmarks and nodes, which makes traveling more attractive within each environmental setting [28, 53].

3. Findings

In light of the above descriptions, it is found that the design of vibrant and memorable path structures which remain in parks users' perception, motivate them to interact with other park users. As illustrated in following figure, this paper proposes a conceptual model regarding to the fact that nodes, paths and landmark within urban parks in addition to social activities facilitate ease of movement and motivation to experience urban parks. As a result, the fundamental function of social experience is defined by giving information to people to find the location of activities through legible path structure. Subsequently, the interaction among people whom find their ways toward destinations spontaneously happens.

This finding is in agreement with William H. Whyte's view [60] as he mentions 'people-watching' attracts people to use and visit the urban public spaces [36]. Subsequently, as both social theories in urban design and social science emphasize, social interactions are both the sources and

consequences of social activities. Therefore, watching people give them information to become involved in activities [39, 61].

Also, the findings of this study are parallel with studies on the legibility aspect of environment imply a relation between legible and social environment [50] specifically within urban parks in Malaysian context [43].

The statement of this study also agrees with the findings from place experience studies consider the relationship among activities, experiences (imageability) and physical features [56, 11].

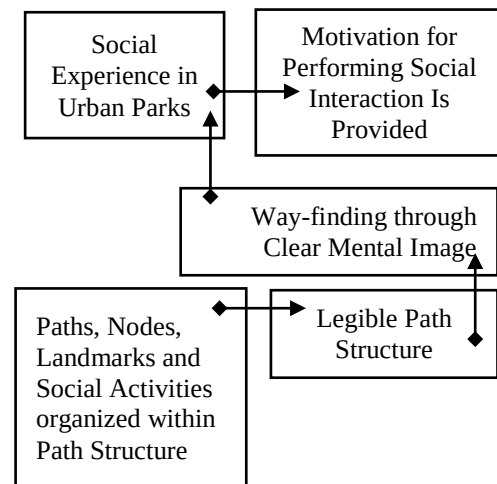


Figure 1: A Conceptual Model for Social Design of Urban Park

However, these studies mainly stress the effect of inter-relations between image and phenomenological terminologies such as place identity, meaning and attachment [49], most of these studies have dependency on peoples' emotional bonding to places [51, 33]. Moreover, until recently, even if these relations have assessed different sorts of activities within urban parks, such as leisure activity [45] they have considered social activities less in terms of social interaction. On the other hand, the effects of these relationships have been seen to solve social segregation among people via social integration [12]. In addition, the contribution of social interaction and place

attachment have been mentioned for improving social cohesion [46, 59].

In light of the above statements, this paper fills this gap among social and spatial studies by introducing another term- social experience, which is placed against legibility in landscape studies which introduce legibility just through legibility elements. Moreover, this study introduces elements of legibility of urban parks as paths, activity nodes, landmarks and social activity to generate social interaction among park users.

4. Conclusion

According to the theoretical reviews, it is demonstrated that there is a lack of emphasis on the social and spatial dimensions of urban parks and how it contributes to the sociability of these spaces. Therefore, in order to improved social design of urban parks; this paper conceptualizes the legible path structure as a model for designing urban parks.

This model is based on the way-finding notion and social activities by distributing these activities throughout the path structure of the urban park. The key elements of this structure are paths, nodes, landmarks and social activities. It is proposed that the path structure could engender a sense of improved movement and activity nodes could support engagement through the process of way-finding. Landmarks have the role of orientation in this process. All three elements of path structure support social activities that could shape a clearer mental image of our urban parks. This clear image besides informing urban park users about the presence of other people and locations of activities creates seamless use and social interaction within urban parks. This paper emphasizes that urban parks should serve for the social-spatial characteristics of urban parks allowing social interaction in a well-qualified structure.

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INDOOR AIR TEMPERATURE ANALYSIS TO STUDY INDOOR ENVIRONMENTAL QUALITY OF A DETACHED SINGLE STORY LOW-COST HOUSE IN MALAYSIA

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Abstract

Thermal comfort is an important factor for a good indoor environment quality (IEQ) of a house. Generally, in low-cost housing development, thermal comfort issues are neglected. This is due to many factors but mostly for the constraint in construction cost. Poor thermal comfort could lead to an unhealthy indoor environment thus could lead to poor occupants' health. Measurement of indoor thermal comfort is essential to understand the existing situation of indoor environmental quality of low-cost houses. Therefore, the objective of this paper is to measure the thermal comfort focusing on air temperature of a selected existing detached low-cost house in Malaysia in order to determine the indoor environmental quality (IEQ). The methodology applied in this research is field measurement where a detached low-cost house was selected for measuring the thermal comfort using the thermal comfort meter and a weather station. Afterwards, a simulation has been done with IES<VE> software to validate the field measurement data. It is important to have a careful deliberation before designing or building a detached low-cost house due to its poor indoor thermal condition. Even though there is a limitation of a construction cost, the orientation of the building and planning of internal layout as well as other low-cost design strategies can be taken into consideration to build low-cost energy friendly house under Industrial Building System (IBS).

Keywords: *Indoor environmental quality (IEQ), thermal comfort, field measurement, detached low-cost house, Malaysia.*

1. Introduction

In Malaysia, low-cost housing always has been given least importance by both government and private sectors. Nowadays in Malaysia, housing rules have been developed and executed for mass people. To create easy access to housing facilities Malaysian government is giving the effort to provide housing for all. Besides that, another important factor is government housing policies should be reasonable in price, suitable for society and compatible with technology to achieve sustainability. According to 7th Malaysian plan [1]; 8th Malaysian plan [2] and 9th Malaysian plan [3], the Malaysian government had definite attention towards low-cost housing.

today in Malaysia. Despite all the efforts of government, occupants are still experiencing overheating problems in these houses. Most of the existing low-cost houses are having a high temperature during the daytime because of poor design [4]. Previous researchers have found that thermal comfort levels of low-cost houses are not satisfactory due to ineffective thermal design [5-7]. This paper elucidates the necessity of thermal comfort parameters to study the indoor environmental quality of low-cost houses in Malaysia. For assessing the present situation, field measurement has been done to collect the data of different parameters of thermal comfort.

On the other hand, thermal comfort scenario in low-cost housing is a concerning issue

2. Literature Review

Many studies already showed that thermal comfort is one of the most important aspects to assess IEQ of a residential building [8].

2.1 Thermal comfort

Thermal comfort refers to a physical state of ease which is directly related to outdoor and indoor environment. American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) Standard 55-66 (1966) described, "Comfort is the condition of mind which expresses satisfaction of an individual according to the thermal environment". It is quite impossible to predict that a person would rather have the feeling of warmth or coolness. Moreover, it depends on physiology, age, adaptation and sex [9]. Holopainen [10] stated that, "Thermal comfort describes the synthesized feeling about the body's thermal state". Hensen [11] defines, "Thermal comfort is a state in which there are no driving impulses to correct the environment by behavior and strongly related to the thermal balance of the body, which itself is influenced by environmental and personal parameters [11]. "If the indoor environmental conditions are favorable people can perform all the activities smoothly otherwise it can negatively affect the physiological and psychological states of human being" [12, 13].

2.2 Parameters of thermal comfort

There are two types of parameters which determine thermal comfort [10, 14] . Such as:

2.2.1 Environmental parameters:

- i. Air temperature; the dry-bulb temperature of the environment.
- ii. Mean radiant temperature; the uniform black-body temperature that would result in the same radiant energy exchange as in the actual environment.
- iii. Air velocity; a measure of the air speed.
- iv. Relative Humidity; percentage of water vapor in the air.

2.2.2. Personal parameters:

- i. Clothing Insulation; the thermal resistance of the clothing (Icl).
- ii. Metabolic rate (met); the energy generated from the human body.

2.3 Thermal comfort models

2.3.1 Predicted Mean Vote (PMV) Index

In accordance with ASHRAE thermal sensation scale the PMV index predicts the mean response of a large group of people[9]:

Table1: Predicted mean vote sensation scale

Value	+3	+2	+1	0	-1	-2	-3
Sensation	Hot	Warm	Slightly warm	Neutral	Slightly cool	Cool	Cold

Source: [9]

Mathematically, P.O. Fanger expressed PMV as:

$$PMV = (0.303e^{-0.036M} + 0.028) L$$

where M = metabolic rate

L = thermal load;

which indicates a comfort value of skin temperature and evaporative heat loss by sweating of a person in actual activity level which is obtained from the difference between the internal heat production and the heat loss [9, 15, 16].

2.3.2 Adaptive model

For naturally ventilated spaces ASHRAE 55 standard replaced PMV model with adaptive model in 2004 [17]. The popularity of adaptive model expanded quickly because of simple equation. For predicting the comfort range, adaptive model only needs the outdoor temperature value and historical monthly data [18].

2.4 Low-cost house in Malaysia

According to Economic Planning Unit (1965,p. 182), low-cost housing was first time initiated for the well-being of low-income people in Malaysia (Malaysia 1965-First Malaysian Plan, 1966-1970). The state was responsible for the plan implementation with the financial support of the federal government. Throughout the duration of First Malaysian Plan (1966-1970) maximum low-cost housing was built for relocating the scattered town people and

for providing them houses on rent. Distribution of housing is divided into two sectors in Malaysia. One is the public sector which is conducted by multiple ministries and federal agencies. And another is the private sector where housing developers built houses under local authorities with government's surveillance [19].

In Malaysia, Syarikat Perumahan Negara Berhad (**SPNB**) is one of the companies building low-cost housing which is owned by the Malaysian Government, under the supervision of the Ministry of Finance (MOF Inc.). This company started its journey to supervise low-cost development projects and now they are building low-cost detached houses all around Malaysia for low-income people [20]. In 2002, under SPNB another scheme was started in Terengganu, named **SPNB Mesra Sdn. Bhd.** under the Rumah Mesra Rakyat 1Malaysia (RMR1M) program which is now building low-cost detached houses for those who do not have own house or have defected house.

Beside this, another organization named **RISDA** (Rubber industry small holders development authority) is giving services to rural people to build their own houses under Ministry of Rural and Regional Development [21]. 'Rumah Bina Negara' is a latest project of RISDA which has three bedrooms and two bathrooms.

Table 2-Detail specifications of 'Bina Negara house' are as follows:

SPECIFICATION		PACKAGING
1	WALL	SIMPLE BONE STONE EXTERNAL / IN PLASTER EXTERNAL PAINT
2	TOILET/BATHROOM	WALL: CERAMIC WALL TILES 5' FLOOR: CERAMIC TILES
3	ROOF	METAL DECK FRAME (STRUCTURE OF IRON)
4	CEILING	4'X4' CEMENT FIBRE PAINT
5	FLOOR	CEMENT
6	DOOR	SOLID DOOR (TIMBER) IRON FRAME
7	WINDOW	CASEMENT WINDOW



Figure 1: Plan and specification of Rumah Bina Negara. Source: [21]

2.4.1 Standards for planning and designing a low-cost housing

Low-cost housing has some standard guidelines for construction which is noted as CIS 1: 1998 which is for 1-2 story buildings and another is CIS 2: 1998 for high rise flats composed by the Construction Industry Development Board Standard (CIDB) stated by Ismail [22]. Ismail also described CIDB has some specifications for designing and planning of a low-cost housing. Housing estates for low-income dweller is developed to minimum standards suitable for human habitation [19]. Moreover, CIS 1 and CIS 2 include requirements on layout, space and configuration between four aspects of habitation – safety, adequate infrastructure, physical and mental health, and community. Present guidelines of CIS includes:

1. A minimum floor area of 63 m2
2. Three bedrooms
3. Kitchen
4. Living and dining area

5. Store room
 6. Bathroom
 7. Toilet
- Source:[23].

2.4.2 Typical layout of low-cost housing

The government has decided that the area of the house would be 1,000 sq. ft containing three bedrooms and two bathrooms.



Figure: 2

Source: SPNB Mesra Sdn. Bhd. (2015)



Figure:3

Source: [21]

Currently, in Malaysia people-friendly home is known as the 1Malaysia people-friendly home (RMR1M), which is under the low-cost housing development. All 1Malaysia People-Friendly Homes (RMR1M) will be built using the 'Industrialized Building System' (IBS) technology with a larger built-up area without incurring additional cost to the applicants.



Figure 4: Typical floor plan layout
Source: SPNB (2015)

LAMPIRAN 2

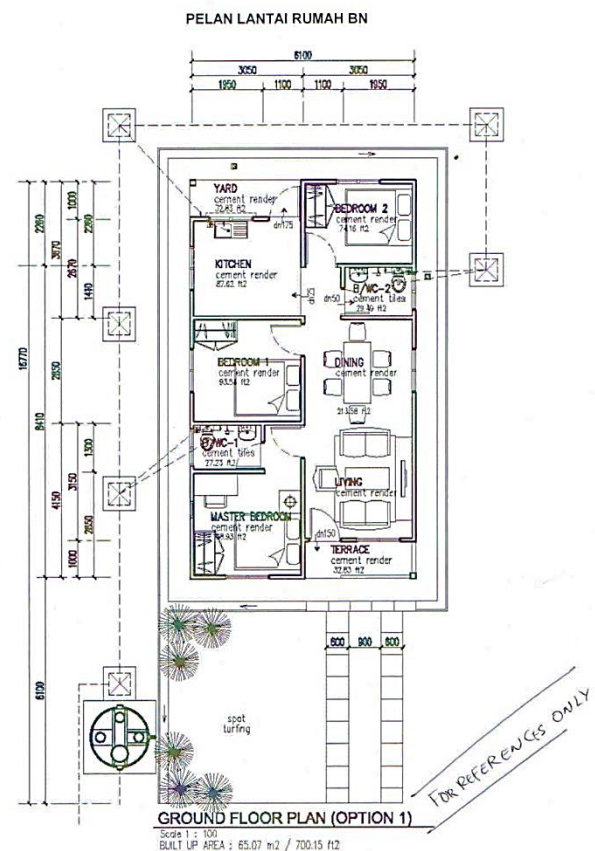


Figure 5: Typical floor plan layout
Source: [21]

3. Research Methods

Taking into account different methods of analysis, the methodology chosen for this study was field measurement where a detached low-cost house was selected for measuring thermal comfort with Delta ohm comfort meter and weather station.

This was built by RISDA which is one of the old designed houses. It is important to refer that this study only focused on the thermal comfort assessment of the selected low-cost detached house based on several parameters like air temperature, wind speed, relative humidity, clothing insulation and metabolic rate to find out the indoor environmental quality of the house.

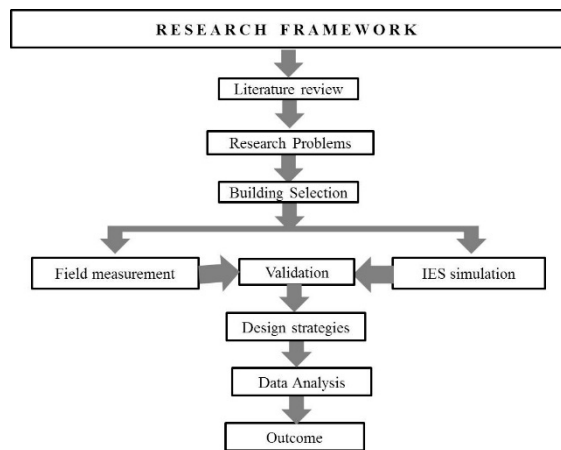


Figure 6: Research framework

3.1. Equipment calibration

Before starting the on-site field measurement, equipment were calibrated in the indoor controlled environmental atmosphere to find out the errors.

3.2. Field measurement

Field measurement has been conducted on a RISDA built low-cost single story detached house in a village named 'Kampung seberang parit' located in 'Kuala Pilah'. The house was around 623 sq. ft. having three bedrooms, one bathroom, one toilet, kitchen, dining and living room.

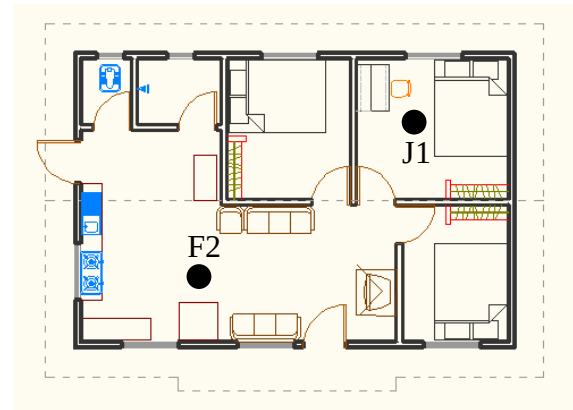


Figure 7: Placement of thermal comfort meters



Figure 8: Measured low-cost detached house. Source: Author

During field measurement, one weather station was set outside of the house and three thermal comfort meters were set in different rooms of the house. The measurement was conducted during 8.15 am to 7.15 pm. Two thermal comfort meters F2 and J2 was located in between living and dining room. Another one J1 was set in the master bedroom. As shown on the plan (figure 7) the node points of thermal comfort meters which were set 1.5m above from the floor level.

3.3. Data collection

At the end of the field measurement, measured and transferred data have analyzed and compared. Data collection was done in two different conditions. For each condition, data were collected for three days. These are the two conditions:

Condition 1: **Window** and **door** closed and **fan** off.

Condition 2: **Window** and **door** opened and **fan** off.

Air temperature, wind speed, relative humidity and PMV data were collected for these conditions.

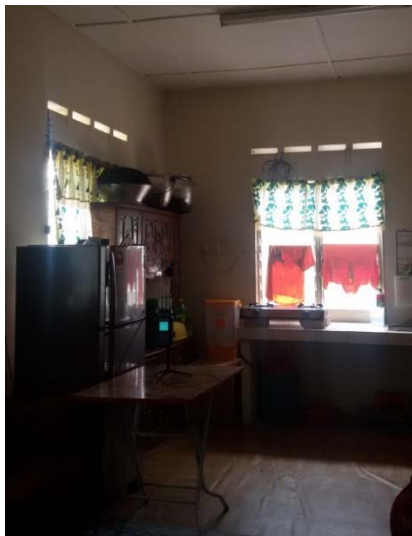


Figure 9: Position of F2

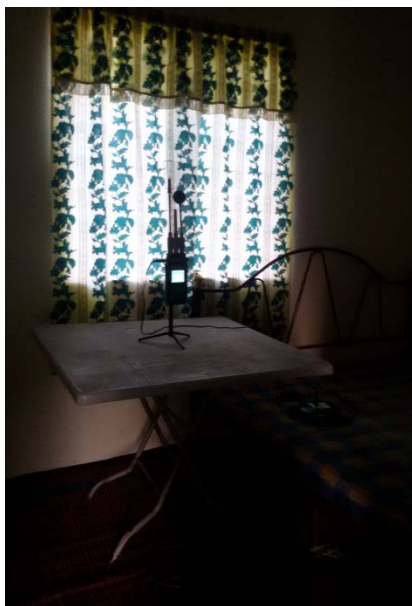


Figure 10: Position of J1

4. Analysis & Results

In this paper, the main emphasis is on indoor air temperature of the selected low-cost house. The results have been analyzed to compare the indoor air temperature of condition 1 and condition 2 with the recommended temperature.

4.1 Validation of IES<VE> model

The field measurement and IES<VE> model obtained data compared to do validation that will help to modify the

model to give further design suggestions. Table 3- Uncertainty estimation of the air temperature (°C) sensors as calibrated:

Sensors	F2	J1
Diff of temp (°C)	3.2	0.7
Deviation (%)	9.1	2.3

Maximum uncertainty in calibrated data found ± 3.2 (°C) where standard deviation was $\pm 9.1\%$ (Table 3). The weather station was excluded from uncertainty estimation. The result revealed that the deviation(%) between IES<VE> model and field measurement data for F2, J1 are 9.1% and 2.3 respectively. This shows a balance between simulation modeling and field measurement.

4.2 Comparison between indoor air temperature and recommended temperature

According to the guidelines (Department of Standard Malaysia, 2010), for Malaysian climate, recommended temperature range for standard indoor environment design is 23°C - 26°C. That means the average standard indoor temperature is 24.5°C. For condition 1 and 2, indoor air temperature of three different times have been sorted out to compare with the recommended temperature (table 4,5 and figure 11,12).

Table 4- Condition 1: Indoor temperature and recommended air temperature (°C):

Condition- 1 Fan off and window/door closed	Indoor air temperature (C)	Indoor recommended temperature
Morning 9 am	29.2	24.5
Noon 12 pm	31.2	24.5
Evening 5 pm	33	24.5

For condition 1 and 2, respectively 29.2 degree Celsius and 29.7 degree Celsius are the lowest indoor temperature found at morning (9am) which is still higher than the recommended indoor air temperature (table 4 and table 5).

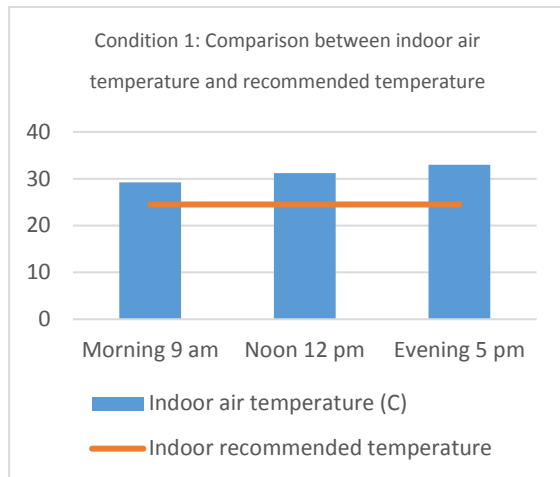


Figure 11- Condition 1: comparison between air temperature (T_a) and recommended temperature

Table 4- Condition 2: Indoor temperature and recommended air temperature ($^{\circ}\text{C}$):

Condition-2 Fan off and window/door opened	Indoor air temperature ($^{\circ}\text{C}$)	Indoor recommended temperature
Morning 9 am	29.7	24.5
Noon 12 pm	33.1	24.5
Evening 5 pm	31.4	24.5

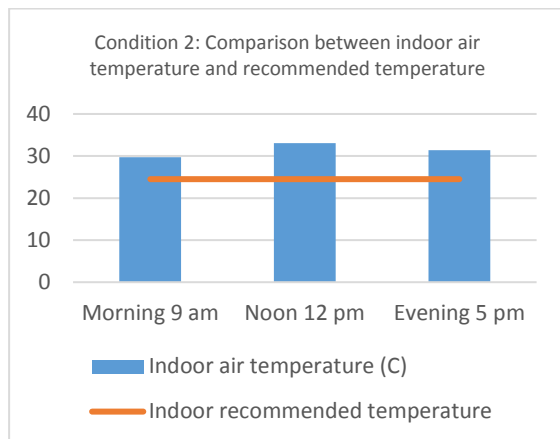


Figure 12- Condition 2: comparison between air temperature (T_a) and recommended temperature

In both conditions, the indoor temperature is not in the range nor comfortable.

4.3 Indoor air temperature in different conditions

Table 5 shows, maximum indoor air temperature for condition 1 found 34.8°C and minimum 28.5°C . After opening the windows, during condition 2, the maximum temperature dropped down 3.2°C . Interestingly the minimum temperature dropped only 0.9°C during condition 2.

Table 5- Indoor air temperature in different conditions ($^{\circ}\text{C}$):

Condition 1- Window close & Fan off (12 Aug-15 Aug)	T_a (9am)	T_a (12pm)	T_a (5pm)
13.08.2016	28.5	31.9	33.6
14.08.2016	30	33.2	34.8
15.08.2016	29.7	33	34.2
Condition 2- Window open & Fan off (23 Aug- 26 Aug)			
24.08.2016	27.9	30.4	31.5
25.08.2016	28	31.5	31.3
26.08.2016	27.6	31.6	28.5

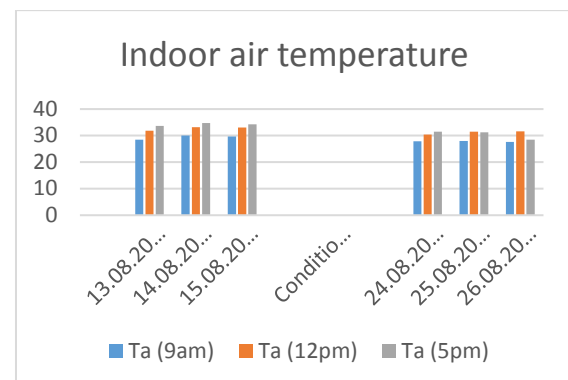


Figure 13- Indoor air temperature (T_a) analysis

5. Discussion & Conclusion

This paper concludes with the discussion on the investigations on indoor temperature to show the present scenario of typical low-cost houses. The results show that the indoor temperature is not in the range of recommended temperature. For improving the indoor environmental quality of a low-cost house indoor air temperature should be reduced for better productivity of the occupants. Though after opening the windows and door the temperature dropped but the situation is not satisfactory nor in the range. Hence, there is a need of alteration in

the materials and design strategies to make the IEQ of the house more livable. This finding will help the investors and the builders to make the low-cost houses more efficiently. This paper only focused on the indoor temperature issue of low-cost houses. Therefore, further research should be carried on in future in order to have a brief understanding of IEQ of low-cost houses in Malaysia.

6. Acknowledgement

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DEVELOPING AN EEG-BASED BUILDING MANAGEMENT SYSTEM TO ENHANCE BUILT ENVIRONMENT ACCESSIBILITY FOR DISABLED USERS

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Abstract

Nowadays, research on improving built environment accessibility have a significant effect on occupants' daily life, especially for disable occupants. The existing smart building facility smart control solutions enhance the built environment accessibility, however, fail to consider the disables. In this regards, electroencephalogram (EEG) technology is raised up to provide specific care for the disables. It involves a Brain-Computer Interface (BCI) which processes the data received from an enhanced or wired brain and sends signals to external devices. This paper proposes an adapted framework to enhance the capabilities of the multidimensional building information model integrated knowledge-based building management system for disabled users. This conceptual framework is established through reviewing the existing applications of smart built environment accessibility concerning EEG, BIM and building automation technology, respectively. This research identifies the significance and feasibility of proposing an EEG-based Building Management System (EBMS).

Keywords: Electroencephalography (EEG); Building Information Modelling (BIM); EEG-based Building Management System (EBMS); Smart Accessibility

1. Introduction

Enhancing built environment accessibility is an open research objective offering a significant impact on building users' daily life [1], especially for disables. Involving cut-edge techniques such as Virtual Reality (VR), Building Information Modelling (BIM), Building Management System (BMS) in facilitating building accessibility becomes a trend in smart building establishment. However, rare research focuses on developing the smart buildings for disables. Therefore, this research proposes to developing a smart building system to enhance built environment accessibility for disabled users.

2. Literature Review

The use of standard Graphical User Interface (GUI) for current smart building facility control platforms aims to enhance built environment accessibility yet it is challenging for many disabled users [2]. Conventional VR interfaces still need more complex manipulation in Human-Computer Interaction (HCI), and physical features that non-disabled people are accustomed to can present serious problems for the disabled. A number of smart buildings currently support increased accessibility by integrating almost all the operations within a smartphone. However, it is a tough challenge for anyone with arm amputations. The application of EEG has the remarkable potential to enhance the accessibility of smart, personalized systems for amputees

[3]. EEG technology depends on a Brain-Computer Interface (BCI), which processes the data received from an enhanced or wired brain and sends signals to external devices. Such a friendly interface eliminates the dependence on finger operations.

3. Research Methods

This research adopted principles of grounded theory to develop the proposed framework. Based on the results, a functional modeling for the proposed system was conducted. In the course of this analysis, this study demonstrated that by the adoption of EEG techniques, the existing building management system can be applied for facilitating the building accessibility for disables.

4. Analysis & Results

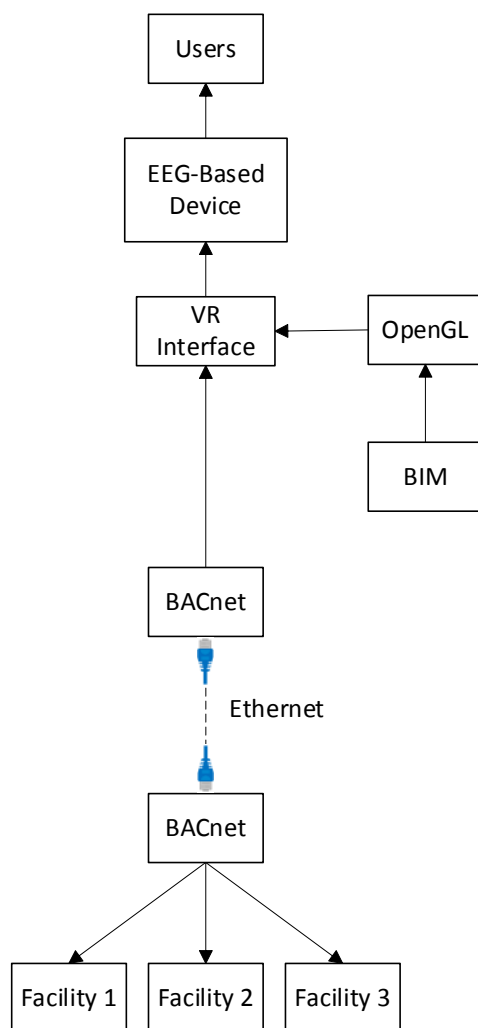


Figure 1 The Proposed Framework

This paper proposed an updated framework to enhance the HCI capabilities of multidimensional building information model integrated knowledge-based building management system (nD BIM-IKBMS) [4] for disabled users through utilizing EEG headsets. This conceptual framework was established through reviewing the existing applications of smart built environment accessibility concerning EEG, BIM and building automation technology, respectively. This research identified the significance and feasibility of proposing an EEG-based Building Management System (EBMS). (See **Figure 1**)

5. Discussion & Conclusion

Emerging in VR environments, a user-friendly interface can facilitate the recognition capacity for the disabled users. During this research, a BIM database, used for creating VR environments, was cataloged into a component-based hierarchy with multiple dimensions. Catalogued building facility information can be reasoned through simple pick operation through variable input devices, especially EEG headsets. As a bridge between users and real-world facilities, BMS is monitoring and controlling a building's facilities including: mechanical, electrical, and plumbing (MEP) systems. With the help of EEG headsets, users with certain types of disabilities can also take advantage of the proposed BMS. They are able to directly control facilities in modernized sensor-embedded houses, such as curtains, lights, HVAC, etc., by just using their brain cells [5]. Effective deployment of the proposed system is expected to enhance building accessibility, specifically for arm amputation disabled users. In the traditional system, they had to be accompanied to perform some activities of daily living (ADLs). By using the proposed system, ADLs can be carried out independently. Additionally, compared to other healthcare facilities, the cost of adopting the proposed system is affordable for the disabilities' daily use. However a

number of challenges exist, the diversity of obstacles faced by users with different disabilities makes it difficult for the proposed system to satisfy all possible users, in particular, brain dysfunction users. Normal EEG controllers have not proven effective for this group yet. Also, users of the proposed system vary with brain coverage and impedance. This divergence can have a negative impact on the accuracy of EEG sensors. Another factor that influences the adaptability of the proposed system is that individual variables in psychology can fluctuate the recording length required. Insufficient training time can reduce the trustworthiness of output data. This research anticipates future studies to focus on examining and validating the application of us the proposed system for people with a wide range of different types of disabilities.

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ESTABLISHING A KNOWLEDGE BASE SYSTEM (KBS) FOR POST-CONSTRUCTION BUILDING FACILITY MAINTENANCE

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Abstract

With the increasing need for energy efficient occupant comfort, the maintenance process becomes a key factor. Aspects including failure response time, maintenance treatment time and maintainability have a great influence on the building occupant comfort. Normally, the efficiency and effectiveness of maintenance process largely rely on the knowledge the maintenance workers have and the right notifications. However, occupants are not generally skilled in such field, and they most likely send the wrong information while failing to find the right person in charge. That will cause the longer response time. In this regards, this study intends to develop a building facility maintenance Knowledge Base (KB) more visually. Particularly, OpenGL was used to make the process of case-based reasoning directly perceived through senses. Meanwhile, using Building Information Models (BIM) simplified the process of developing a 3D Knowledge-Based System (KBS). Moreover, Microsoft Access database was set up to provide search and update functions for the KB. The efficiency and effectiveness of the proposed system was examined by this paper. However, the proposed Knowledge-Based System is limited to the complexity in facility manufacturers, protocol used and discreteness in hardware. Moreover, the operation conditions of building facilities vary in different projects. Therefore, the accuracy and volume of the KB should be further optimized. In futuristic research, more real-world buildings will be applied on to validate and improve the proposed system.

Keywords: Knowledge Base System (KBS), Building Information Models (BIM), Facility Maintenance, Post-Construction Lifecycle

1. Introduction

There is evidence that energy efficiency retrofit has emerged as a significant solution to fuel poverty and climate change [1]. However, one of the obstacles of promoting energy conservation comes from the trade-off with occupant comfort [2]. Uncomfortable living and working environment can lead to the inaccessibility [3], low working efficiency [4], bad moods [5], even disease [6, 7]. For satisfying both from a facility completion standpoint, an efficient Facility Maintenance (FM) process becomes a pivotal role in lifecycle perspective [8]. A primary concern of

failure response time, maintenance treatment time and maintainability have a great influence on energy efficient occupant comfort [9]. Post-construction facility maintenance and management activities account the highest proportion of the building lifecycle while those activities cost the largest expense in the property sustainment budget [10]. However, the amount of FM-related data has a serious effect on the efficiency and effectiveness of facility maintenance. Such data are normally maintained as either handwritten record books or repair records (Chen, Hou et al. 2013). On the other hand, the

successful facility operation and maintenance are also limited by the knowledge of the maintenance workers. Occupants are not generally skilled in such field, and they are most likely to send the wrong information while failing to find the right person in charge. Longer response time will be caused. The efficiency and effectiveness can be adversely affected under certain conditions.

While some researchers and companies have carried out on developing building facility maintenance and management system based on information technology (IT), such as AkitaBox [11] and MEX [12]. Such platform is not intuitive enough for particular data, such as maintenance tutorial and real-time facility usability information. Few 3D-based building management systems have been established such as IESVE [13]. Most of the studies in this field have only focused on the visualization of building entities, have made it too complex for a non-skilled staff to use [14]. Honeywell has attempted to achieve energy efficient occupant comfort with a 3D visualized system. However, no current documents are found to show their maintenance reasoning concern.

There are two primary aims of this study: 1. To investigate the significance of proposing a more visual building facility knowledge-based system in energy efficient occupant comfort perspective. 2. To ascertain the feasibility of using current techniques to satisfy the requirements of the proposed system.

2. Literature Review

As an artificial intelligence (AI) approach Case-Based Reasoning (CBR) is developed for reasoning and learning from past experiences [15]. CBR was first defined in Schank's research at Yale University in the early 1980s. Schank's model [16] of dynamic memory was the rudiment of CBR systems. The earliest CBR systems are Janet Kolodner's CYRUS [17] and Michael

Lebowitz's IPP [18]. During 1980-1990, numbers of AI and expert systems were established, including KB-Reducer (KBR) [19], the "M" directory [20], the Rule Checking Program (RCP) for the ONCOCIN expert system [21], CHECK, ARC, and EVA5, Rob Acksyn's and Don McCracken's Knowledge Management System (KMS) [22].

Referring to Thomas's research [22], Knowledge management (KM) was first defined in 1991. In 1994, the International Knowledge Management Network (IKMN) was released online [22]. In 1995, KMS received increasing attention when the European Community began offering funding for KM-related projects [22]. In 2004, feature construction methodology was proposed facing new attributes in the KBS [23]. This methodology significantly simplifies data dimensionality and promote prediction performance. Researchers develop KMSs in a wide field such as railway scheduling [24], manufacturing [25], maintenance planning, space transportation [26], health sciences [27], and AEC/FM industry [28]. In 2015, searchers developed a knowledge-based expert system to assess the building sustainable performance[29].

3. Research Methods

Framework Formation: This research adopted principles of axiomatic design [30] to develop the nD BIM-IKBMS framework. Axiomatic design provides a scientific base for system research and development that supports the creativity of designers. Additionally, it reduces the random searching process, shortens the iterative process of trial and error, clarifies the assessment principles of design, and endows the computer with the capacity to create [31].

Functional Modelling: Next, the study conducted a comprehensive functional modeling for the proposed system using Integrated Computer-Aided Manufacturing

DEFinition for Function Modeling (IDEF0) diagrams. This was done based on independence axiom, information axiom and their inferences for axiomatic design. IDEF0 is a function modeling methodology that consists of a hierarchical series of diagrams, text, and glossary cross-referenced to each other [32] (See **Figure 1**).

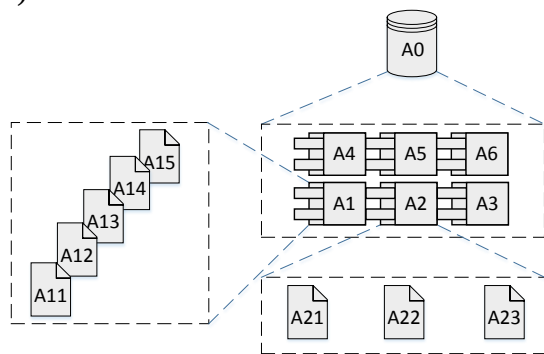
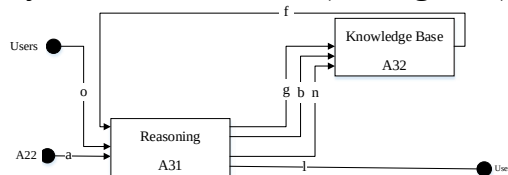


Figure 1 Hierarchy for All Context Diagrams for nD BIM-IKBMS

4. Analysis & Results

As the establishment of the proposed KBS is a part of our research nD Building Information Model Integrated Knowledge-Based Building Management System (BIM-IKBMS), the index for KBS module is defined as A3 among the six modules. The proposed KBS includes two parts: Reasoning (A31) and Knowledge Base (A32). Firstly, reasoning is about to find the solution and to update the records as well. Secondly, Knowledge Base (KB) is the database for the maintenance case, maintenance tutorials, maintenance records sequenced by the User-Perceived Quality (UPQ) scores. The proposed module can carry on a user-interaction (See **Figure 2**).



(A22: Fault Diagnosis and Detection Module; a: Diagnostic result; b: User Input.; c: Similarity function; d: Class identification; e: New cases/final UPQ scores; f: Matching cases; g: Perceived quality (UPQ) scores)

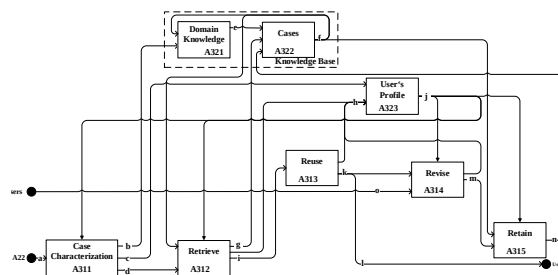
Figure 2 The Proposed Framework for KBS.

Taking KBS on board, the proposed system can accurately locate the fault facility from OpenGL based visual building entities and obtain the solutions from past case by effective reasoning. The fault will be described in the Fault Diagnosis and Detection (FDD) process, and the descriptions will act as key clues for searching similar building maintenance cases in the KB and get the solutions. Motawa and Almarshad [28] showed that the KBS could provide a good collection of past cases, operation and maintenance records, maintenance tutorials for the building facilities so that the maintenance staff can get response to the operational faults more efficiently. Hence, solutions can be selected in maintenance scheduling. Highlights of the fixed case will also be kept in the KB for future use. Furthermore, based on Sampaio's works [33], UPQ scores are used in the KB. Fixed cases include highlights of an operational fault, successful solutions, and the UPQ scores. The process is depicted in Gu's works [34], including a reasoning cycle consisting five sub-modules of Retrieval, Reuse, User's profiles, Revise, and Retain. (See **Figure 3**) In this cycle, maintenance staff can easily find similar solutions through the KB. Meanwhile, solutions can be reused for future cases. In addition, UPQ scores should be updated according to the users' feedback. Such scores coupled with its case will be retained in KB.

Following the rules above, the proposed KBS is working as an AI controller that can undertake continuously self-update. From the KB, operation and maintenance staff can classify features from the operational fault and reasoning solutions easily. When a solution is nominated, the UPQ scores will be updated based on feedbacks. In case no solutions satisfy the requirements, users will have to find solutions as usual. Then, such new case coupled with respective solutions will be stored into the KB with a dedicated new UPQ score.

In order to make the process of CBR directly perceived through senses, OpenGL, known as a graphical application programming interface (API) [35], is used for reconstructing 3D entities. OpenGL is widely used in 2D/3D graphical operating system development [36].

Furthermore, Building Information Models (BIM) has been imported into the system to facilitate the graphic reconstruction process. Such models have integrated multidimensional building facility information and largely shorten the work volume of establishing the proposed system. In addition, Microsoft Access database is used to maintain and update the KB. Such database can be linked with the BIM, which will update building information in real time.



(A22: Fault Diagnosis and Detection Module; a: Diagnostic result; b: Class identification; c: User's profile identification; d: Case's attribute weights; e: Catalog; f: Matching cases; g: Similarity function; h: Update; i: Similar cases; j: User's profile; k: Actual scores; l: Perceived quality (UPQ) scores; m: Adjustment of UPQ scores; n: New cases/final UPQ scores; o: User Input.)

Figure 3 The process of reasoning by using UPQ scores.

5. Discussion & Conclusion

With the increasing operational faults, maintenance staff always cannot the response the failures in time [37]. This study was set out to establish a visualized KBS to facilitate the energy efficiency occupant comfort. Although the proposed system may not be capable of addressing the whole failures, it considerably reduces the repetitive works for the maintenance staff. This study has shown that the visualized KBS is essential in facilitating proactive maintenance decisions by the resourceful solution retrieving. Providing a

visualized KBS can largely promote the efficiency of maintenance and occupant service [38]. It also stops similar failures from early stage [8]. Particularly, the proposed system plays a significant part in standardizing maintenance process and avoiding inevitable human errors. Additionally, by using the KB, the proposed system can raise the possibility of finding the right solution robustly and significantly decrease the unfruitful information.

However, the proposed KBS is limited to the complexity in facility manufacturers, protocol used and discreteness in hardware. Moreover, the operation conditions of building facilities vary in different projects. Therefore, the accuracy and volume of the KB should be further optimized. The reader should bear in mind that the study is based on the ND BIM-IKBMS. It is beyond the scope of this study to examine the effectiveness of the proposed system in case of projects with other existing BMS, multiple BMSs and no BMS respectively. In futuristic research, more real-world buildings will be applied onto validating and improve the proposed system.

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REVISITING MODULAR DESIGN IN A CONTEMPORARY SOCIOTECHNICAL CONTEXT

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Abstract

The current housing market reflects a need for diversity and human centered design strategies. Similar housing conditions during the Post-war period during the mid 20th century experimented with modular design as an affordable and easy to manufacture housing typology. However, shifting attitudes during Postmodernism dismissed modularity as an inhuman design strategy. Recent social attitudes and growing technologies, however, have created a unique opportunity to further explore the true potential of modular design as a flexible, user-centered design method. Through analysis of previous modular methods, a contemporary modular design strategy was formulated. New production methods, computational design technologies, and distinctive designer-user relationship has allowed modular design to fully engage its diversity, adaptability, and customizability. The contemporary modular method looks at building from the inside out, analyzing the user lifestyle to inform the final output. Contemporary design culture is the perfect set of socio technological conditions to explore modularity as not only a production method, but a complete design strategy.

Keywords: modular architecture, modularity, Modernism, contemporary housing, user-centered design

1. Introduction

Housing has always been an integral clue in understanding the lifestyle, environment and cultural trends prominent in a society. The recent shift from a family orientated lifestyle to a more individual focused, single-member household culture is likewise evident in the current housing market- with its oversaturation of poorly constructed, highly repetitive housing options. These housing options reflect a dependence on mass production, trend sensitive attitudes, and economic optimization. Such consumptions patterns are the leading cause of the environmental deterioration in the Anthropogenic Era [6]. There have been numerous technological advancements in recent years that have allowed designers to develop mass customization strategies to help better the quality of life, yet little has been done in actualizing the socioeconomic desire for a more adaptable housing solution. In fact, the culture has shifted to one of rapid consumption due to affordable building costs and faster construction techniques. It

has become economically beneficial to constantly replace low cost, short lifespan structures than to build more expensive, long term solutions.

Similar housing conditions dictated the post-war period during the rise of Modernism and Postmodernism in the 20th Century, reacting, mainly, to war time efforts and shifting ideas towards industrialization in the Machine Age. Post-war scarcities and increasing stress on housing options led architects to explore the concept of modular design as a way to simplify the production process for a quick, easy to produce and build housing option that utilized the machinery of the war and the lack of skilled labor forces. However, the method was quickly dismissed with the growth of Postmodernism and more organic methods of design, leaving modularity as a brief design trend rather than a fully functional design system.

Henceforth, modular design has become a fragment, or an icon of modernism, that

quickly faded into design history without realization of the true potential behind the building methodology. Today, there is an increasing demand for a simplified building system that can encompass the potential and flexibility of mass customization, the affordability of mass production, and simplicity of a kit-of-parts design methodology.

The purpose of this paper is to twofold. First, is to provide the foundation definition of modularity as relevant in space design. Revisiting the ideas of modular design in Modernist and Post-Modernist architectural thinking will provide a way to understand the value of modularity in the framework of present day design. Specific case studies will also help inform the different sociotechnical reactions to modular design during the initial growth of modular design trends.

Second, analyses of previous modular methods will be used to inform a contemporary modular design approach that can best support the current housing market trends. Looking at the current sociotechnical climates, a new modular design method will be introduced to be tested in future research.

2. Research Methods

In order to properly define modularity, this paper will look at the different contexts in which modularity was used as a design method throughout the mid 20th century. Looking at the historical development of modular design, the analysis can inform the most plausible future form that modular design will take in the current sociotechnical context. Taking the characteristics specific to modularity as a design tool, rather than modularity as a cultural trend, we can reassess the value of modular design in a design culture that is better suited for such design strategies.

Specific case studies focusing on three distinct aspects of modular design- human

scale, system, and production- were analyzed to understand the aspects of modular design that were related directly to the sociotechnical temperaments of the generation as opposed to a reaction to modularity as its own system. Categorizing the case studies provides a way to better pin point the specific intentions of the project and thereby address the successes and failures in relation to the specific problems each project sought to address. Understanding the successes and failures of the different conceptualizations of modular design in real life situations can bring to light the concerns revolving modularity's seemingly limited flexibility.

3. Literature Review

As Human Scale. Human scale in space design is not a revolutionary concept. Rather, human proportions have always been deeply embedded in architecture from the construction of the earliest dwellings. Having been the first units of measure, human proportions provide an opportunity to introduce a "humanization of space." [11] In other words, human scale provides a point of reference that gives measurements a physical embodiment and sense of realism.

The term 'modular' in reference to human scale is most often associated with Le Corbusier's work on *The Modulor* published in 1950. Here, Le Corbusier explores a mathematical approach to the standardization of architectural design methodologies while relating to human proportions as the base unit of measure. The term 'modular', as used by Le Corbusier, is "the fusion of the notion of module with the notion of the golden section," as a design standard [4]. In other words, modularity is a measurement tool that combines mathematical laws, such as the golden ratio or Fibonacci sequence, with human scale.

Le Corbusier's work on the development of the human based module form will later inform a large part of the Modernist

movement and further explorations of modular design methodologies. Such modules based on human scale offer a better understanding of human relationship with spatial qualities and thereby better influence the theories that form the foundation of human factors and spatial behavior theories. Further developments using human centered modules also increases awareness with the user in the identification of spatial relationships. Playing on this innate understanding, modularity provides a unity in terms of spatial language that can work to highlight the important spatial qualities that are distinctive in a given space.

Following deductive reasoning, spaces that develop from a human based module must also reflect the same human-space relationship that informs the base module itself. In other words, the properties of the module transfer into the system in which the modules apply.

As a Production Method. A base unit, or the module, and central network system, or the framework, react to one another in modular designs allowing for an easier production process regardless of the complexity of the design. The repeating module simplifies the overall production requirements and utilizes a standardized set of units. Similar to the assembly line production method, modular design takes the same core concepts of Fordism into different methods of architectural building technologies.

The initial growth of modular design in the late 1920's was driven by CIAM and, perhaps more notably, Le Corbusier, in trying to achieve total function and optimization [12]. Scarcity of materials and the high demand for housing pushed designers to pursue maximum efficiency through minimal living and faster production methods. Such social pressures provided an ideal atmosphere to celebrate the hero of the war- industry. The factory process was perfected during the War,

allowing for mass production to grow at an incredible pace. Rather than dismiss the developments of the war time culture, mass production of materials was a way to utilize the new technologies and adapt them to fit the immediate needs of the post war society. Therefore, mass production and modularity developed a symbiotic relationship in this time as a way to provide quick solutions in a fast paced environment.

Prefabrication and modularity, though often used interchangeably, are two distinct products of the industry. While prefabrication is the standardization of materials and styles, modularity is the standardization of a module- a module that is designed specifically for a certain spatial quality or programmatic use. Furthermore, modularity suggests a movement or interchangeability in post-construction due to the use of uniform parts. In other words, whereas prefabrication relates directly to a type of material, the modules refer to a larger unit, allowing for a system to adapt and rearrange itself as necessary on any given system. Furthermore, modules are not limited to the dimensions and base units of prefabricated materials, but rather are limited to the modules themselves. Therefore, there is a flexibility in the development and redesign of the overall modular system regardless of the pre-existing components saturating the market.

An important factor in the popularity of modularity in the mid 20th century was the economic conditions that demanded an affordable solution to a large housing crisis. Affordability was a major asset to the modular design system, in that the simplification of the manufacturing and construction process allowed a quick and simple solution to the high demands of the market. The simple construction process eliminated the need for skilled laborers, thereby significantly reducing construction costs.

System. Modules alone cannot determine a modular design strategy. Rather, the modules are part of a unifying system that utilize the modules in the design strategy. Modularity, thus, can be understood as an adaptation of the kit-of-parts design mentality.

A central system or framework, provides an important unifying tool that allows for individual components to have the freedom to adapt to varying needs and programs. In terms of spatial qualities, the modular system is what gives a sense of unity and wholeness to the arrangement of the smaller unit pieces. Therefore, the language of the individual modules transfers into a larger spatial relationship that encompasses the simplicity of a repetitive unit with a complexity of a much more organic method of designing.

Such a method of design allows for the design system to be applied to larger scale projects such as those of urban settings. An urban solution to unify a diverse set of building conditions without sacrificing the integrity of individualism can be designed using similar modular theories. This system “suggests a morphology of reemergence and reintegration, as inhabitants come together and apart separately and create groupings that are housed in an outwardly unchanging, conglomerate structure.” [8]

In connection to the organic implications of the modules, the modular system also reflects a similar biological interpretation in that it stems from the natural laws and natural order. The parameters of the network system act as the boundaries for an otherwise freeform organization and arrangement of modules, thereby pushing designers to truly understand the conceptual theme of the spatial relationships designed.

4. Analysis- Case Studies

Table 1.1

Title	Description	Module Type	Modular Process	Evaluation
Sears Catalog Home Sears, Roebuck and Company, 1908-1940	The Sears Modern Home was a series of mail-order plans and materials, popular in the early 20 th Century. Families could buy prefabricated materials to build their homes. Prefabrication was introduced during this time as a way to mass produce raw materials.	Production	A kit of parts design method that incorporates a DIY culture	+Ease of manufacture +Affordability -Short Lifespan -No longer relevant to current housing market -Lack of customization
Unite d' Habitation Le Corbusier 1953	An early exploration of modular design, the high density residential project incorporates vertically L-shaped modular layouts, creating a more diverse set of housing options. The entire project is made from fifteen standardized measurements and is a mixture of both modular and prefabricated forms.	Human Scale	A base module developed from a series of human measurements to standardize building process	+Diversity of modules +Community identity and engagement -Structural limitations -Repetitive language
Plug-in City Archigram	A conceptual experiment, the Plug-in City is a test of modular urbanism, playing on the	System	A central structural network that	+Potential for growth +Interchangeability

1964	limitations of building lifespans. With a central structure, the different layers of the city are constantly replaced with updated versions.		connects different hubs throughout the city	+Organic approach -Lacking practicality -Urban language not related to individual modules
K67 Kiosk Saša Mächtig 1966	A modular fiberglass series, kiosks were designed to have an infinite number of arrangements and compositions that could allow for the kiosk to play any role. It was a way to fully embrace the industrialization, mass production, and urban efforts of its time.	Production /System	A repeating module that is mass produced to fit into one another for expansion	+Standardized production +Ease of manufacture -Repetitive spatial language -Lack of customizability
Habitat '67 Moshe Safdie 1967	While it is often referred to as a modular system, Habitat '67 was an experiment in pre-fabrication before modular design. Using completely prefabricated units, the housing complex is composed of interlocking forms that have the same fabricated modules, but the apartment size and scale varies from residence to residence.	Production	A stacking of modular apartments, arranged so that each apartment has its own private outdoor space	+Diversity in language +Mixed private/public spaces -Structural issues -Lacking spatial organization
Nakagin Capsule Tower Kisho Kurokawa 1972	The Nakagin Capsule Tower focuses on the temporal nature of buildings and architecture. A central tower holds together concrete modules, or capsules, that act as temporary housing. Each capsule is interchangeable and easily adaptable to fit different requirements.	Human Scale /System	A Metabolist approach to modular capsules placed within a central tower	+Conscious of design trends +Production simplification -Relevance -Maintenance issues
Better Shelter UNHCR, Ikea 2010	Better Shelter is a contemporary emergency housing option for displaced residents. The kit of parts is designed so that a group of four adult men can create a shelter that can last up to three years. Different shelters can be connected to make hospitals, schools, and much more.	Production	A kit of parts that allows for easy transportation and construction.	+Ease of transportation +Easy to produce +Quick solution -Costs more than existing tents -Lacking in organization methods -No education process for future integration

5. Results

Contemporary Modules. The ritualization of human life is not a new understanding of the human character—humans have long identified as creatures of habit. In just the past decade, the relationship society has

developed with this ritualistic approach has recently become much more involved with the digital realm. Constant attachment to smartphones and the internet has made physical communication much more immediate, yet distant. The personal

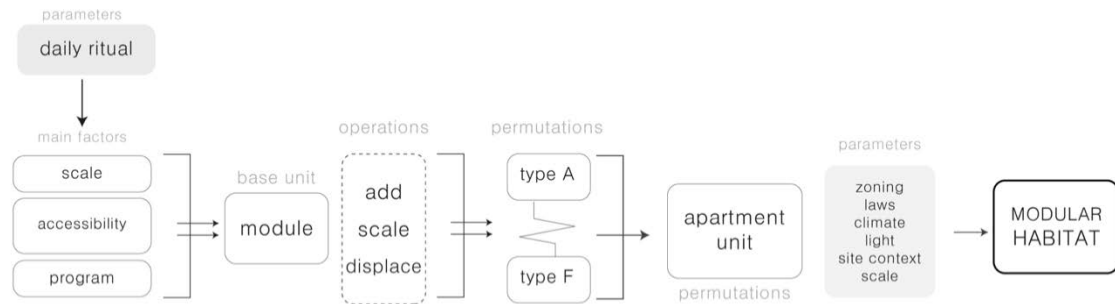


Figure 1. The Contemporary Modular Design Process

connections that were once established on a slow paced media has become an active, yet superficial, connection that reflects a desire for more, faster, and easier.

Therefore, our spatial modules are no longer family centered—rather the modules are spatially engaging while tied down to the immediate grid of the city. Grids, as the core foundation of planned cities, are not only an organizational tool, but rather the structural backbone for the city's energy, communication, and infrastructural requirements. In other words, the architecture of the city and the embedded spatial qualities are branches or nodes of the larger urban grid system.

Basic needs such as food, water, energy, and leisure remain the core aspects of a dwelling. These basic functions each encompass a unit module named bathroom, living room, storage, kitchen, and bedroom. Any combination of these units create the larger dwelling module. Different types of buildings have a unique composition and arrangement of these unit modules, along with additional unit modules depending on the type of structure. For instance, the office module can be composed of storage, kitchen, work room, and rest area. The way that these unit modules are interlocked is not directly related to the system in which the larger modules come together. Heavy emphasis is placed on the relationship of the system to the bigger modules, not the larger system to individual unit modules.

The contemporary module is developed to represent the different programmatic

elements of the dwelling, looking into the lifestyle of each user. By dissecting the lifestyle into different programmatic elements, there is an opportunity to create a kit of parts that give a power of choice to each given user. Rather than designing modules based purely on spatial qualities such as size or form, a program based module optimizes each module to the program while removing any dead space in the final composition of modules.

System. From the development of five unit modules, there are 120 different permutations available. Spatially speaking, the possibilities are much greater than mathematical calculations in that more operations are possible with each module type. Defining a set of operations that each module can undergo, adds to the possible variations. Rather than simply rearranging the modules, the operations can change the form of the modules themselves, to better adjust to the immediate needs of the uses. Through addition, scale shift, and displacement, we can begin to manipulate spatial qualities to best suit the personality of the user. The physical limitations of the site and initial massing operations will help to unify the language that these modules individually develop.

The relationship between modules can be simplified into three different operations—addition, scale, and displacement. With these different operations, a systematic language will be developed to simplify the production process and help in keeping within the boundaries of the architectural parameters for the project. The advantage of

utilizing permutation in design is the diversity that is created through the repetition of a singular element. This project will focus on these three operations, specifically, to simplify the systematic approach of the project and focus on the developing of the unit modules themselves.

Process. In essence, the module is a measuring unit for the arrangement of space and spatial qualities. There is a strong relationship between human scale and the module, and then the module to the site. This intermediate state of relationships is what allows for the user to become directly integrated into the site design process, to optimize the use of the space.

Rather than designing the module and adapting the system to a free site, this project will begin with a set of parameters to test the validity of the variability of modular design. Two factors arise in identifying the overall parameters for the project. First there is the issue of the site and the legal implications of the building codes. These restrictions will begin to inform the limits of the design configurations in terms of scale, composition, and orientation. The second restriction comes in the form of the massing studies of the architecture itself. Because the project is focusing on apartment style housing, a larger site must be broken up into a variety of different smaller units that then utilize the individual unit modules.

6. Discussion & Conclusion

The diminishing popularity of modular design methods largely been due to the socioeconomic climate as well as the technological limitations of the 20th century. Recent advancements in building technologies, as well as a more environmentally centered outlook on the flexibility and adaptability of vernacular architecture offers an optimal set of conditions to continue the experimentations with modular designs. The kit-of-parts mentality of modular systems allows for

designers to engage in a much more organic method of thinking that also ties together the mass customization demands of contemporary design.

The true potential of modular design has been dismissed in previous years due to the change in socioeconomic and sociopolitical climates. However, globalization and technological advancements in the recent decades has given a new set of parameters that allow for modularity to be revisited as a capable design strategy. There is a growing demand to merge together the existing mass consumption patterns with the desire for a more ecological understanding of design.

The contemporary modular design method is composed of two main pieces- the modules and system. The modules are a reaction to the existing spatial culture in existing housing types and the changing demographic conditions. Different modules are designed for different functions of a dwelling such as living, working, or leisure that are then put through three distinct operations- addition, scale, and displacement. Through space syntax and optimization algorithms, a variety of permutations will be designed to then inform to larger structure. Each apartment unit is then arranged onto the site that best utilizing the landscape potential while respecting the zoning laws.

The proposed modular design methodology reflects the current social desires for a flexibility and environmentally conscious design solution and takes full advantage of the growth in building technologies. Currently, the role of designer is becoming much more intimate with that of user as the do-it-yourself culture and mass customization practices spread. Therefore, it is important to understand that the contemporary designer is no longer the sole designer in any given situation, rather they are the bridge between pragmatism and individuality.

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A STUDY ON THE VIRTUALITY IN SPATIAL DESIGN THROUGH IMMERSIVE MEDIA

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Abstract

Immersive media is becoming increasingly commonplace in a multitude of societal and cultural fields. For designers, the use of immersive media in spatial design and production is essential. Current studies have categorized immersive media based on the medium, technologies, or device. However, these categories are not suitable for immersive media in spatial design because of its complexity in generating experiential conditions. Therefore, in spatial design, the different types of user engagement and user experience should be the main classification factors. This paper analyzes various case studies and the technical devices and production practices of immersive media in virtual reality, augmented reality, and mixed reality to understand what facets of immersive media produce virtuality.

Keywords: Immersive Media, Virtuality, Presence, Immersion, Spatial design

1. Introduction

In today's society and culture, immersive media is becoming an important player in many different fields. For spatial design, immersive media is an essential tool in producing and designing a certain experiential moment within the space. Previous studies on immersive media have focused on the technologies and devices used as the major factors for categorization. However, in order for space designers to create successful spatial qualities, the different user experiences and cognitive perceptions play a larger role in determining the correct immersive media to be utilized in the design. Therefore, the existing categories for the immersive media limits the understanding of immersive media as a complex design tool.

2. Literature Review

Computer based immersive media allows for creative design to be possible and expand existing limitations in traditional design methodologies[1]. For instance, immersive media can be utilized in virtual reality. Users in virtual reality engage in a

much more comprehensive and layered experience[2].

3. Research Methods

This paper define what 'actual', 'virtual', and 'real' on the immersive media to consolidate the foundation of that meanings. Looking at the theory of Henry Bergson, Gill Deleuze, and Pierre Revy and clarify the idea of them in the area of the immersive media.

Specific case focusing on four distinctive types of the immersive media and categorizing the case studies of each section. Then analyze and summarize each section to the diagrams for visualization of this paper.

4. Analysis & Results

Immersive media, in order to categorize by the type of experience and cognitive perception, must first be classified by the environment and circumstance. In other words, there needs to be an underlying understanding of what is "virtual" versus what is "actual" in a given experience.

Customarily the opposite of virtual is perceived as ‘physical existing’, ‘real’ or even simply ‘existing’. However, according to Pierre Levy, a renowned digital researcher known for having defined collective intelligence of the Internet, looks to philosophers such as Henri-Louis Bergson and Gilles Deleuze to define the opposite of virtual. Levy argues that the opposite of virtual is ‘practical’, ‘currently viable’, or ‘realized’- looking more deeply at the concept of reality rather than the physical attributes it is normally associated with[3]. The complexity of virtual as a concept makes identifying the conditions equally complex in characteristics. Therefore, the different conditions, events, or entities involving a certain reality are simply tendencies of virtuality that result in actualization.

Virtuality and reality are not contradictory concepts. Rather, the relationship is better qualified as a type of illusion- a mirrored image. Therefore, computer generated virtuality is an opportunity to expand the illusion of an environment[4]. Actual objects and virtual objects are determined by an optical relationship. In other words, when an object is virtual, the image becomes real, or actualized. These distinctions correspond to the contextual interactions within the space[5]. The following, figure 1 and figure 2, demonstrate this idea.

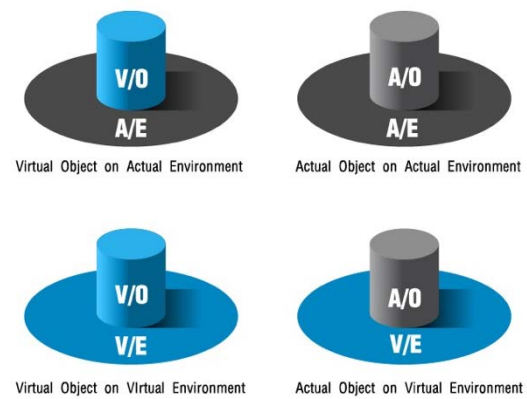


Figure 1. The relationship between environment and object in actual and virtual conditions.

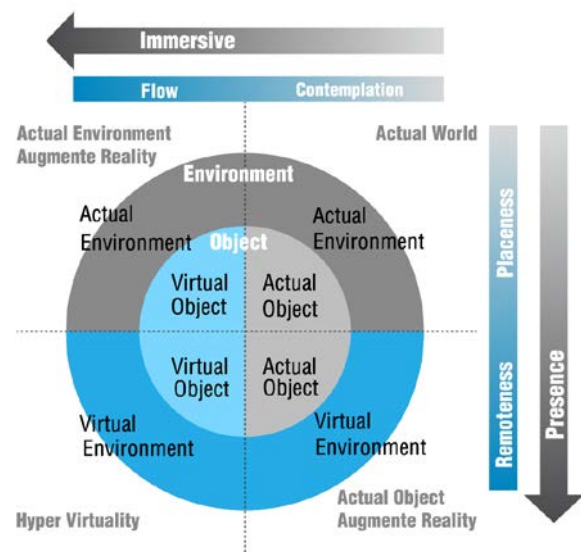


Figure 2. The relationship between environment and object in actual and virtual space.

The above diagrams demonstrate four conditions in which virtuality and actualization exist based on how illusions are set up. Each typology is indicative of a specific device that can be used to best utilize the narrative technique and production style.

5. Discussion & Conclusion

In many cases, mixed reality is often used synonymously with augmented reality (AR) and is often understood as the combination of ‘augmented’ and ‘virtual’. While mixed reality has similar characteristics as that of AR, it is difficult to simplify mixed reality as a consolidation of AR and VR. Currently the technologies and the devices used to express the conditions are often used to distinguish VR and AR. However,

a system uses head mount displays and a real environment as a background may not necessarily be qualified as VR or AR. Therefore, there is a need to introduce an understanding of perception and environmental experience in determining what is reality and virtuality in spatial design.

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STRENGTH AND STABILITY OF REINFORCED BEAM-COLUMN CONCRETE ELEMENTS UNDER DYNAMIC LOADING WITH FIRE EXPOSURE CONDITIONS

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Abstract

This article gives the method of dynamic calculation of reinforced beam-column concrete elements for dynamic loadings varying with time. The results of experimental researches of reinforced concrete elements under dynamic loading in fire exposure conditions are presented, and dependence of the dynamic strengthening coefficient of the elements at a temperature up to $T = 900^{\circ}\text{C}$ is obtained. The main scenarios that can arise in high-rise buildings with progressive fracturing are developed. The analytical calculation of the change in the load-carrying capacity of reinforced beam concrete column is carried out for different thermal-force actions. Numerical analysis of a multi-storey reinforced concrete frame in the Sap 2000 software complex is carried out, taking into account the change in the strength and deformation properties of load-carrying elements for different temperature actions by means of the plastic hinge function.

Keywords: reinforced concrete columns, beam-column elements, dynamic strength, fire exposure conditions

1. Introduction

One of the most important tasks of buildings' stability is the development of methods for calculating load-carrying structures, which make it possible to most accurately assess their ability to resist various influences. One of such scenarios can be dynamic loading of the reinforced beam-column concrete elements (after removal of one of the columns) in fire exposure conditions, which is the closest to reality scheme for calculating progressive fracturing.

Analysis of possible consequences provides information for designing more stable structures, finding cost-effective solutions, increasing their safety, and strengthening already fractured buildings and structures [1].

Methods of dynamical calculation of reinforced concrete structures beyond the natural elastic limits are mainly based on idealized schemes of rigid-plastic or elastoplastic material, and in the case of high-strength reinforcement - on the models of non-linearly strained systems.

The normalizing values under dynamic loading are selected in such a way that they can be found by existing calculation methods and that they are convenient for experimental determination.

Since the currently used calculation methods allow one to determine moments of flexion, deflections, expansion angles in the plasticity hinges, the ultimate values of these quantities are taken as the normalizing ones.

For reinforced beam-column concrete elements with large eccentricity, the state 1b is usually used to characterize as the extension angle in the plasticity hinge, in which the strain of the concrete of the compressed zone reach the ultimate values. The researches show that it is more convenient to normalize the ultimate state 1b of beam-column elements by the plastic angles of expansion in plasticity hinges that arise during the construction work only in the plastic stage.

The structural strength condition (with the formation of n -plasticity hinges in it) takes the form:

$$\psi_i \leq \psi_{i,u} \quad (i=1,2,3,\dots,n). \quad (1)$$

Here ψ_i and $\psi_{i,u}$ are the plastic extension angles in the i -hinge of plasticity, obtained from the dynamic calculation in the plastic stage.

The procedure for determining the $\psi_{i,u}$ value for different structures varies, depending on the ultimate strains of the concrete and the length of the plastic zone. Achieving by stresses of the ultimate state does not lead to complete fracture of the material, since the behavior of the concrete and reinforcement under loading is characterized by plastic strains. After reaching the ultimate state, the material of the element is capable of absorbing a part of the loading and fracturing until the fracturing reach an ultimate value, after which a complete shutdown of the structure takes place. Therefore, as a criterion for the fracturing of a reinforced concrete element, it is more expedient to take the ultimate fractures of concrete with compression and tension ε_{cu} , $\varepsilon_{cu,d}$, and reinforcement $\varepsilon_{su,d}$.

The ultimate value of the plastic extension angle in the plasticity hinge for beam-column elements is determined by the formula:

$$\psi_u = \left[\varepsilon_{cu} / \xi_d - k_{sd} R_s / E_s (1 - \xi_s) \right] C_M C_B \left(1 + \frac{N}{2N_u} \right) \left(\frac{l_0}{h_0} \right)^{1/4}, \quad (2)$$

where ε_{cu} - ultimate strain of the edge fiber of the concrete of the compressed zone, depending on a number of factors, including the e_0 value; for practical calculations, it is recommended to take $\varepsilon_{cu} = 320 \cdot 10^{-5}$.

ξ_d - relative height of the compressed zone.

C_M, C_B - coefficients depending, respectively, on the shape of the moment curve and class of the concrete.

l_0 - length of the section of the structure adjacent to the hinge, on which the bending moment keeps the sign.

N_u - ultimate load-carrying capacity of the element under central compression:

$$N_u = k_{d,b} R_b b h + k_{d,s} R_{sc} (A_s + A'_s). \quad (3)$$

2. Literature Review

The stiffness of beam-column elements after the formation of cracks is a variable value that depends on the change in the value of the longitudinal force $N(t)$ in time. Since the analytically constructed strain diagrams (Fig. 1), which have a curvilinear outline, are difficult to express by one common function, a simplified "M-1/r" diagram is used in the form of a broken line consisting of three straight lines (diagram "a", Fig. 1).

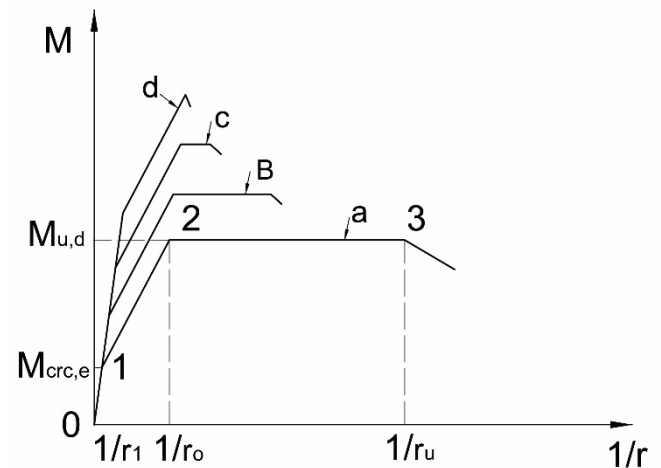


Fig.1. Diagrams "moment-curvature" of beam-column elements reinforced with A500 steel for various eccentricities: "a" - e_{01} ; "b" - e_{02} ; "c" - e_{03} ; "d" - e_{04} ; $e_{04} < e_{03} < e_{02} < e_{01}$

To construct simplified strain diagrams, let us consider beam-column element loaded with a longitudinal force $N(t)$ with eccentricity e_0 and reinforced with steel with a physical yield point (A500 class) for which the following condition is met:

$$\xi \leq \xi_d \quad (4)$$

If the condition $\xi > \xi_d$ is met, then a brittle fracturing of the structure occurs at the ultimate strain of the concrete of the compressed zone and at the absence of plastic strain in the stretched reinforcement is taking place. The strain diagram of such elements does not have a plastic section and corresponds to the case of brittle fracture (Fig. 1, diagram "d").

To calculate it, two types of dynamic loadings, varying in time are accepted.

1) $N(t) = \frac{N}{(1-t/t_{ef})}$ - the form of a linearly increasing function;

2) $N(t) = N_m e^{-\frac{1}{E} \left(\frac{t-t_{ef1}}{B} \right)^2}$ - the form of exponential function.

3. Research Methods

Let us consider the case of an eccentrically applied longitudinal dynamic loading with eccentricity e_0 .

The equation of motion of the column in the initial-elastic stage, looks like:

$$B_1 \frac{\partial^4 y_1}{\partial z^4} + N(t) \frac{\partial^2 y_1}{\partial z^2} + m \frac{\partial^2 y_1}{\partial t^2} = 0 \quad (5)$$

where:

B_1 - stiffness of the element in the stage without cracks (elastic stage) $B_1 = E_b I_{red}$ (work on the section 0 - 1, Fig. 1);

$N(t)$ - short-term dynamic force

applied with eccentricity e_0 ;

m - mass per column;

y_1 - deflection of the column in the stage without cracks;

z - coordinate of the cross section along the length of the column.

The solution of equation (5) can be represented as the sum of the functions of deflections from static action of the longitudinal load y_{st} and the dynamic deflection y_d ;

$$y_1(z; t) = y_{st} + y_d \quad (6)$$

The function y_{st} is found by means of integrating equation

$$B_1 y_{st}^{IV} = 0 \quad (7)$$

Substituting the boundary data according to the conditions of the support fastenings, we find the value of the static deflection.

Dynamic deflection is found by solving the equation:

$$B_1 y_{st}^{IV} + m y_d = 0 \quad (8)$$

where y_d can be represented as the form of a trigonometric series:

$$y_d(z, t) = \sum_{n=1}^{\infty} T_{n1}(t) Z_n(z) \quad (9)$$

where $Z_n(z)$ - deflection function, which is represented in the form:

$$Z_n(z) = \sin \frac{n\pi}{l} z \quad (10)$$

$T_{n1}(t)$ - dynamical function that can be obtained using the Bubnov-Galerkin variational method, depending on the type of loading and the initial conditions.

The deflection and bending moment in the sections of the column from the action of static and dynamic loading is determined [2,3]:

$$y_1(z, t) = \frac{N e_0}{2 B_1} (l z - z^2) \left(1 - \frac{t}{t_{ef}} \right) + \sum_{n=1,3,5,\dots} \sin \frac{n\pi}{l} z \cdot T_{n1}(t) \quad (11)$$

$$M_1 = N e_0 \left(1 - \frac{t}{t_{ef}} \right) + B_1 \cdot \frac{\pi^2}{l^2} \sum_{n=1,3,5,\dots} \sin \frac{n\pi}{l} z \cdot T_{n1}(t) \quad (12)$$

We determine the time of formation of normal cracks from the condition:

$M_1(l/2, t_1) = M_{crc,e}$, here $n=1$ leads to the solution:

$$N e_0 \left[\left(1 - \frac{t_1}{t_{ef}} \right) + \frac{4}{\pi} \left(\cos \omega_1 t_1 - \frac{\sin \omega_1 t_1}{\omega_1} \right) \right] = M_{crc,e} \quad (13)$$

The equation of the column motion in the elastoplastic stage (section 1-2) looks like:

$$B_2 \frac{\partial^4 y_2}{\partial z^4} + m \frac{\partial^2 y_2}{\partial t^2} \left(-\frac{\partial^2 M_1}{\partial z^2} + N(t_1) \frac{\partial^2 y_1}{\partial z^2} \right)_{t=t_1} = 0 \quad (14)$$

B_2 - the dynamic stiffness of the column in the stage with cracks in the stretched zone,

for simplicity assumed as constant, is calculated by the formula:

$$B_2 = \frac{M_u - M_{crce}}{1/r_0 - 1/r_1} \quad (15)$$

M_u - moment of internal forces in the element when the yield point in the stretched reinforcement is reached (point 2):

$$M_u = k_{bd} R_{yd} b x_d (h_0 - x_d / 2) + k'_{sd} R_{sc} A'_s (h_0 - a') - N(h/2 - a) \quad (16)$$

$1/r_1$ - curvature in the middle axis of the element (in stage I) is determined as:

$$\frac{1}{r_1} = \frac{M_1}{B_1} \quad (17)$$

$1/r_0$ - curvature of the curved axis of the element when the yield point in the stretched reinforcement is reached:

$$\frac{1}{r_0} = \frac{M_s}{B_{0,lon}} - \frac{N}{h_0 E_s A_s} \quad (18)$$

$B_{0,lon}$ - stiffness of the element at the time of yield occurrence in the reinforcement.

The deflection and bending moment in the sections of the column in the elasto-plastic stage (section 1-2) are determined:

$$y(z, t) = y_1(z, t_1) + y_2(z, t), \quad (19)$$

$$M(z, t) = M_1(z, t_1) + M_2(z, t), \quad (20)$$

The solutions of equation (19) are obtained as:

$$y_2(z, t) = \sum_{n=1}^{\infty} T_{n2}(t) \sin \frac{n\pi}{l} z, \quad (21)$$

$T_{n2}(t)$ - dynamic function, determined depending on the type of loading in stage 2 (with cracks), when

$$\omega_{n2} = \frac{n^2 \pi^2}{l^2} \sqrt{\frac{B_2}{m}}, \quad (22)$$

$$M_2(z, t) = B_2 \frac{\pi^2}{l^2} \sum_{n=1,3,5,\dots} n^2 \sin \frac{n\pi}{l} z T_{n2}(t). \quad (23)$$

The bending moment at the end of the elastic stage in the span section $z_0 = l/2$ is equal to:

$$M(l/2, t) = M_1(l/2, t_1) + M_2(l/2, t) \quad (24)$$

The maximum value $T_{n2}(t)$ is defined for $t = t_{m1}$

The plastic stage is formed if $z = z_0$

$$|M(z_0, t_{m1})| > M_u \quad (25)$$

When $z_0 = 0,5l$

$$M(z_0, t_{m1}) = M_{crce} + B_2 \frac{\pi^2}{l^2} \sum_{n=1,3,5,\dots} n^2 \sin \frac{n\pi}{l} z T_{n2}(t) \quad (26)$$

At calculation it is necessary to consider not less than 3 n values.

With the hinged support of the ends of the column, the plastic hinge arises only in the span, therefore, the plastic stage occurs immediately after the elastic one. With rigidly clamped ends, it is necessary to find the transition time from the elastoplastic to the plastic stage.

The time of the elastoplastic stage is determined under the condition:

$$|M(z_0, t_2)| = M_u, \quad (27)$$

The strength of the column is verified from the condition

$$\psi_{ma} \leq \psi_u \quad (28)$$

Dynamic calculation of load-carrying reinforced concrete elements in fire exposure conditions is a difficult task and differs from calculations under static loading.

To determine the influence of fire exposure on the physical and mechanical properties of the concrete and reinforcement under dynamic loading, and to obtain the coefficient of dynamic hardening, concrete cubes and prisms were heated up to 300, 500, 700 and 900°C, and reinforced concrete beams and columns – up to 500 and 900°C in the standard fire mode and they were tested under static and single dynamic loading [4].

The received results have shown that:

- the strain (the value of the relative elongation δ) of reinforcing steel in normal conditions at a pressure up to 700 MPa increased to 9%; after heating up to 500 °C the pressure decreased up to 550 MPa and the stress by 6,8%. After heating up to 900 °C, the pressure decreased up to 400 MPa, and the strain decreased by 5,5%;

- the modulus of elasticity of concrete after heating up to 500 °C decreased by a factor of 3, and after heating up to 900 °C by a factor of 5 compared with its parameters without fire exposures.

For the calculation of the reinforced concrete structures for dynamic effects, it is necessary to know the determining values of the coefficients of dynamism of materials K_d for compression and tension, determined only experimentally [5,6].

4. Analysis & Results

The values of the dynamic hardening coefficient of concrete and reinforced concrete samples as a function depending on the loading time in normal conditions and at different temperatures are presented in Table. 1.

Table 1

The dynamic hardening coefficient of dynamic hardening (K_d) of concrete cubes in normal conditions and under temperature influences.

Sample series №	Temperature, °C	Loading, kN			Dynamic hardening coefficient, K_d	
		static	dynamic		0,07sec	0,1 sec
			0,07sec	0,1 sec		
1	20	351,72	424,46	423,67	1,206	1,204
2	300	335,02	323,97	322,37	0,967	0,962
3	500	282,84	238,06	236,93	0,841	0,837
4	700	79,63	46,83	45,90	0,588	0,576
5	900	39,72	19,42	18,78	0,489	0,473

For the dynamic hardening coefficient of concrete prisms at the temperature of $300^{\circ}C \leq t \leq 900^{\circ}C$, the following dependencies are obtained.

– at a loading time of 0,07 sec.:

$$K_d = 1,303 + 1,9375 \cdot 10^{-7} t^2 - 0,001117 t \quad (29)$$

– at a loading time of 0,1 sec.:

$$K_d = 1,2413 + 1 \cdot 10^{-7} t^2 - 0,000938 t \quad (30)$$

Based on the analysis of the experimental researches' results, it is established:

1. In normal conditions, with a decrease in the loading time, the dynamic hardening coefficient (K_d) reaches up to 1.2-1.3.

2. When heated up to 500 °C, the concrete strength decreases sharply, especially the dynamic strength, which was equal to the static, and with increasing temperature up to 900 °C the dynamic strength decreased by a factor of 2 compared with the static strength.

3. The modulus of elasticity was 35 000 MPa and decreased up to 15 000 MPa and at 500 °C - up to 9 000 MPa.

4. The stress and modulus of elasticity of the reinforced bars after heating up to 900 °C turned out to be 1.4 times less than in the reinforcement not subjected to fire exposure.

5. The dynamic hardening coefficient of concrete cubes and prisms when heated up to 500 °C reached a value of 0,84, after heating up to 900 °C - up to 0,48.

Figure 2 shows schematically the change in the carrying capacity of a structure under dynamic loading.

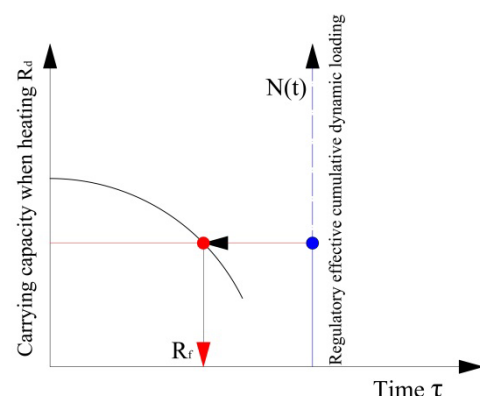


Fig. 2. Fire resistance of the structure according to the carrying capacity R under dynamic loading

Figure 2 shows that the dynamic effect on the construction reduces the fire resistance of the structure. The reduction depends on the type of dynamic loading.

Calculation of the reinforced concrete column is made as for a dynamic effect of the type

$$N(t) = N_m e^{\frac{1}{E} \left(\frac{t - t_{ef1}}{B} \right)^2}, \text{ when } t \geq t_1 \quad (31)$$

where: $E(t_1)$ - coefficient showing the intensity of the load increase, determined during the calculation

$$E(t_1) = 0,489 \left(\frac{t_1 - t_{ef}}{B} \right) \quad (32)$$

$$B = \frac{1}{\sqrt{2\pi N_m}}, \quad (33)$$

t_1 - the time of formation of normal cracks.

5. Discussion & Conclusion

Let us consider the main scenarios that can arise in high-rise buildings with progressive fracturing.

1. The explosive effect, which leads to the instant removal of one carrying element (the removal of the column of the 1st floor is considered as the worst case), as a result of which the remaining columns operate in normal temperature conditions with dynamically increasing loading. The dynamic factor of the loading varies $K_0, -1,2, \dots, 2$ depending on the number of stories of the building. This case is accepted as the main one in all calculations for progressive fracturing.

2. The explosive impact, leading to the removal of one vertical carrying element in time. The remaining columns work in normal temperature conditions. The recording of the removal time of the column in comparison with the "instant" removal has a number of specific features that directly affect the value of the natural frequencies, periods, and forms of vibrations of the remaining columns.

3. The explosive impact, leading to the instant removal of one vertical carrying element. The remaining columns work

under fire action in conditions of dynamically increasing loading.

4. The explosive post-inflammatory impact, leading to the instant removal of one vertical carrying element, which leads to a change in the strength and strain properties of the constituent materials and to a decrease in the dynamic response of the constituent materials.

The remaining scenarios can be a different combination of these options, taking into account the type of dynamic loading, duration and type of fire (standard, real).

For comparison, let us determine the load-carrying capacity of the reinforced concrete samples under static and dynamic loading in the conditions of a standard fire at a time of 1 000 seconds. Initial data: section $100 \times 100 \text{ mm}$; estimated length $L_0 = 600 \text{ mm}$; class of concrete B30, medium density in dry condition (granite crushed stone) $\rho_0 = 2485 \text{ kg/m}^3$, wet weight $w = 4,6\%$, reinforcement $4\phi 8 \text{ A500}$, thickness of the protective layer $\alpha_0 = 12 \text{ mm}$

Eccentricity $e_0 / h = 0,35$, the dynamic load is determined by (31) at $N_m = 61 \text{ kN}$.

The results of the calculation show that the time for the formation of the first cracks in the fire exposure conditions is 3,4 times faster than in normal conditions. In normal conditions, the stiffness of the element in the stage without cracks is 1,45 times greater than in the fire exposure conditions. The stiffness of the element in the second stage when calculated in normal conditions is 1,2 times greater than in the case of fire exposures [2].

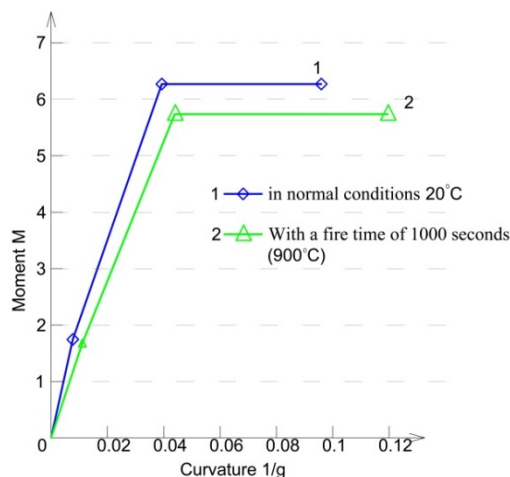


Fig. 3. The dependence "moment-curvature" in different work conditions of the element

For the column in question, the ultimate value of the extension angle is $\psi_u = 0,0172539$. Dynamic calculation of the column shows that in normal conditions the strength of the column is ensured, since the condition (28) is kept. In fire exposure conditions, the extension angle of the plastic hinge $\psi_{\max T} = 0,0454083$ is much larger than the maximum extension angle ψ_u , which indicates the fracturing of the element.

The calculation makes it possible to construct a "moment-curvature" diagram of an element operating in normal conditions and under fire exposure (see Fig. 3).

Further, rupture loads were calculated at eccentricities $l_0/h = 0,3; 0,35; 0,4$. Calculated and experimental results obtained for reinforced concrete columns under dynamic loading are shown in Table. 2.

Table 2

The results of the dynamic calculation of the reinforced concrete column in a standard fire, $\tau = 1000\text{sec}$.

Parameter	According to the experiment				By calculation			
	Central loading	Eccentricity			Central compression	Eccentricity		
		$l_0/h = 0,3$	$l_0/h = 0,35$	$l_0/h = 0,4$		$l_0/h = 0,3$	$l_0/h = 0,35$	$l_0/h = 0,4$
Rupture load (kN)	367,94	237,90	178,00	161,20	352,1	234,6	176,9	158,49
Deflection (mm)		3,54	3,71	4,02		3,31	3,39	3,9

The discrepancy between the experimental and calculated results does not exceed 5%, which indicates a sufficient accuracy of the calculation technique.

According to the calculation, the fire resistance of the reinforced concrete column at a standard load of 161,2 kN in a standard fire is 50 minutes. Taking into account, for example, that the dynamic effect is applied to the 30th minute from the start of the standard fire, and knowing the value of the dynamic factor for the material, we can construct Fig.4

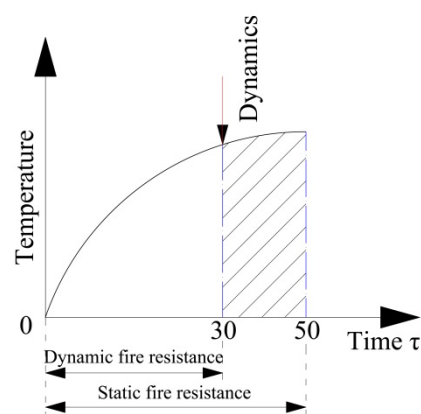


Fig.4. Change in calculated fire resistance under dynamic loading

Hitching marks dangerous zone, it shows that, after a dynamic effect, the reinforced beam-column concrete element ceases to meet the required fire resistance limit.

This stage presents the results of the calculation of reinforced concrete columns in the software complex Ansys Civil FEM, which accurately allows to determine the temperature in the section of the reinforced concrete column at any time during a standard fire.

During the calculation, changes in such properties of reinforced concrete as heat conductivity and heat capacity from temperature as well as coefficients $K_{s,T}$, $K_{d,T}$, were taken into account.

Calculation of the reinforced concrete column was carried out with quadrilateral heating of the column under static and dynamic loadings. Table 3 shows the results of the load-carrying capacity of the reinforced concrete column, calculated in the software complex Ansys 14.0.

Table 3

The results of the dynamic calculation of the strength of reinforced concrete columns in fire exposure conditions at an eccentricity of 3,5 cm

Temperature (°C)	With static loading and fire (kN)		With dynamic loading and fire (kN)	
	In the program Ansys 14.0	By means of the allowed methodology	In the program Ansys 14.0	By means of the allowed methodology
0°C	185,55	190,60	218,95	219,45
500 °C	145,40	146,80	135,70	135,40
900 °C	92,50	93,40	64,32	63,15

The calculation shows that under static loading, the reduction in the load-carrying capacity of the reinforced concrete column, with four-sided heating of the column, is 21,6% at 500 °C, and 50,1% at 900 °C. Under dynamic loading, it decreases: at 500°C - by 38,02%, at 900°C - by 70,6%. Let's research the behavior of the 25-storey monolithic frame building before and during fire exposures at different fire temperatures under dynamic loading by means of the Sap2000 SC version 12, which allows to solve a non-linear dynamic problem using the Newton-Raphson technique [7].

The purpose of the function Hinge - hinge for reinforced concrete elements has a very effective value, it allows to identify both static nonlinear reserves, fracturing of elements, and dynamic. As a result it reveals the reserve of carrying capacity of

reinforced concrete elements before the stage of fracturing.

Figure 5 shows the behavior of the plastic hinge from the load value according to FEMA 356 [8], which can be monitored by using the Sap2000 software complex.

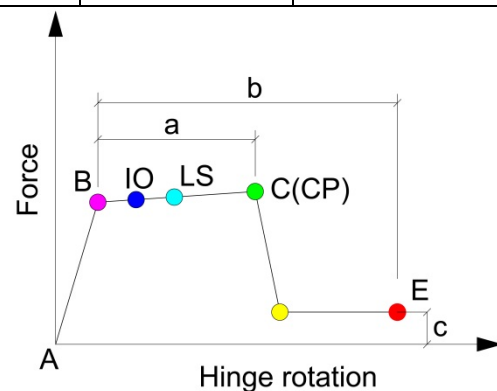


Fig. 5. Model of the behavior (work stages) of the plastic hinge

The stages of development of the plastic hinge are divided into:

- 1) $A > B$ - elastic stage;
- 2) $B > C$ - plastic stage; the loading resulting in the formation of a plastic hinge can not lead to fracturing depending on:
 - 2a) IO – constant loading;
 - 2b) LS – safe stage;
 - 2c) CP — prevention of fracturing;

3) $C \triangleright D$ – residual reserve;

4) $D \triangleright E$ – complete fracturing.

The software complex Sap2000 makes it possible to limit or expand the maximum extension angle of the plasticity of the elements, respectively, depending on the geometric dimensions, strength and fracture characteristics and work conditions of the elements.

When analyzing the frame of a building up to 500 °C with the static bending moments and transverse forces, the formation of unacceptable extension angles of the plastic hinge is absent - the safe stage "LS" in Fig. 5 (see Fig. 6a)).

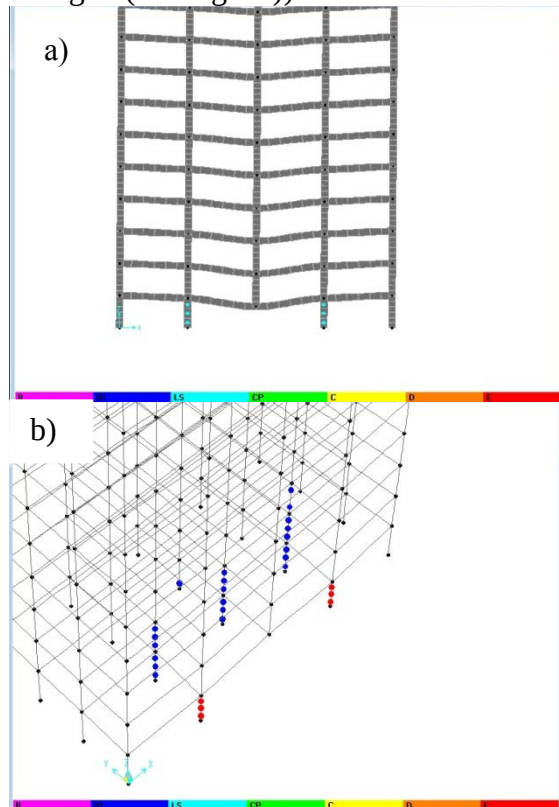


Fig.6. The state of the plastic hinges a) at a temperature 500°C, b) at a temperature 900°C

The performed nonlinear dynamic analysis at $T = 900^\circ\text{C}$ shows that the resistance to the progressive fracturing of this reinforced concrete frame is not ensured that is evidenced by the presence of unacceptable strains in the plastic hinges of the carrying elements if the frame - stage "E" in Fig. 5 (see Fig. 6b).

Thus, a detailed analysis of the development scenarios possible with the

progressive fracturing of the building, together with the change in the physicommechanical characteristics of the materials of the carrying vertical structures, both in dynamic power and in different temperature modes, allows more accurately assess the resistance of buildings to progressive fracturing, which increases safety and reliability of the designed buildings.

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INVESTIGATING THE EFFECTIVENESS OF ADOPTING BUILDING INFORMATION MODELLING(BIM) FOR THE REFURBISHMENT OF COMPLEX BUILDING PROJECTS: CASE OF AUCKLAND. A PRELIMINARY STUDY

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Abstract

Refurbishment projects are believed to be risky, complex, and fraught with many uncertainties. Some of these projects have reported substantial project delays, significant costs that sometimes overrun twice the budget, poor stakeholder engagement, and dissatisfaction with the project outcome by the refurbishment stakeholders. The introduction of BIM technology into construction practice seemed to be the game changer within AEC. However, despite the promising BIM benefits for the entire AEC, the adoption of BIM for refurbishment projects seems to be challenging due to the highly fragmented nature of construction practice which invariably creates difficulty in the integration of diverse information throughout the project life cycle. In this paper, we investigate the effects and challenges of BIM adoption in refurbishment projects across New Zealand, adopting literature review and preliminary interview methodology to this end. The result of the study shows that the refurbishment projects are unique in nature and differ from the construction of new buildings. They are also highly driven by the project cost and time of project delivery.

Keywords: Building Information Modelling; Refurbishment projects; stakeholder interactions, Environmental influence factors, complex projects

1. Introduction

Building information modelling (BIM) is one of the significant recent developments in the construction industry, heralding the introduction of new processes, technologies and healthy interactions into practice [1]. BIM is widely advocated as a platform to enhance information communication and reduce the project duration and cost in the construction industry [2]. A strategic approach to BIM adoption requires the incorporation of people, process, and technologies on timely bases and leads to capacity building through managerial improvements [3]. Notwithstanding the benefits of BIM [4], its uptake and delivery have been recently reported to be slow for the refurbishment of existing building projects [5]. But some concerted effort is being made to make BIM a standard in the industry. For instance, the UK government, as part of enhancing adoption of BIM in the

public sector, have targeted minimizing life-cycle cost by 20% and 80% reduction in carbon by 2050 [6]. Similarly, BIM is now a mandatory requirement for governmental projects towards energy refurbishment in the Netherlands, while the government requirement for BIM implementation since 2007 has influenced its use for energy efficiency target in Denmark [7]. In New Zealand, a previous survey regarding BIM adoption affirmed that, within construction organizations, 38 % used BIM for most projects, 20 % used BIM for few projects, while 42 % of organizations did not respond: a reaction that shows a low level of engagement in projects models among project stakeholders [8]. Furthermore, a response from the same survey indicated that 71 % of respondents disagreed that “BIM is only for a new build projects, not for refurbishment projects”, 14 % was neutral while 14 % agreed to the

statement. With this result, it is expected that BIM will be highly demanded in refurbishment projects. However, little or none has been reported in the literature.

With the conventional approach, some of these refurbishment projects have reported substantial project delays as well as significant cost overruns, sometimes about twice the budget [9]. There is also poor stakeholder engagement [10] followed by the dissatisfaction of the project outcome by the refurbishment stakeholders [11]. The adoption of BIM for complex refurbishment projects seems to depend on the project stakeholders' decisions. In addition, the project stakeholders have diverse backgrounds and interests. They are not only independent of each other but also have intricate relationships and interactions [9]. These portray an inability of stakeholders to hold a common ground and maintain healthy collaborations which hinders the flow of information and knowledge sharing within the project participants. Thus, the need to re-consider the culture and collaborative environment of construction firms to enhance adoption of BIM becomes obvious. The need to investigate how construction environment influences technology adoption has already been highlighted [1]. In this study, we aim at investigating the environmental factors that influence refurbishment project stakeholders' decisions towards the adoption of new technology such as BIM in the New Zealand construction environment.

2. Literature Review

2.1 BIM potential for refurbishment project

One potential of BIM adoption is to improve the refurbishment work flows so as to mitigate cost overrun, critical decisions, and time by project stakeholders [5]. There are authors that have contributed towards BIM adoption study for the refurbishment project. Volk, Stengel [12] focused on the technical problems related to BIM

implementation. This includes updating and handling of the uncertainty of data information of BIM in existing buildings. Also, a study proposed a framework to understand tools and drivers that motivate BIM adoption for refurbishment projects [13, 14]. In addition, a study also focused on the clients as homeowners' preferences and how it influences BIM adoption for refurbishment projects [15]. Furthermore, there is an investigation for the essential barriers to BIM adoption for housing refurbishment [16]. The barriers were from two major sources. The first is the clients indicating lack of knowledge about refurbishment technologies, while the second is the construction professionals indicating lack of skills, and also fragmented practices. Therefore, there is a tendency that these stakeholders may underestimate the real BIM benefit for refurbishment projects.

2.2 Characteristics of refurbishment projects

The lack of existing building information differs refurbishment projects from new buildings [17]. The former are characterized by complicated cost-sharing [18] and lots of stakeholder interactions [19]. Majority of these projects are fraught with single or multi-level construction, special purpose user requirement, complicated nature, challenging in-site configuration, multiple organization participation, multiple stakeholders participating, and larger span [10, 20, 21]. Although complex projects can contain simple subsets of simple projects, they should not be reducible to them [22]. Hence, complex projects are not always based on their scale, but based on the issue of coordination or specialized expertise [23].

2.3 The need for BIM adoption for refurbishment projects

Although BIM benefits are well known, researchers and practitioners show less concern towards this venture [24]. This

attitude towards BIM adoption is attributed to the complicated stakeholder requirements added to the highly fragmented construction sector [15]. Hence, the sector is in great pressure to update existing buildings and correct structural faults, including poor insulation [3]. For example, in Europe, the construction sector recorded 40% of energy consumption as 40 % of Europe's existing buildings were more than 50 years old [25]. In addition, 35% of existing buildings in the UK predates 1945, and this is likely to remain in use over the next 30 years [20], causing high energy consumption and a high carbon footprint [3, 15]. According to a report by Building Research Association New Zealand (BRANZ), the refurbishment projects represented about one-third the total value of the new dwellings with about 33,000 renovation consents [26, 27]. In addition, there is a need to improve the performance of existing building to reduce the demand for new building. This will help to check the Auckland housing crisis, predicted to increase from the current 1.4 million to 2 million in the next 20 years [28]. This shows the urgent need for a strategic change in favor of adopting BIM for refurbishment of existing buildings.

3. Research Methods

This study employed a literature review followed by a face-to-face preliminary interview to investigate the effect and presence of environmental factors that impact on the day to day activities of stakeholders who have interest in refurbishment projects in Auckland. Accessing research participants was difficult. This is because, coming mainly from the background of conventional refurbishment practice, the expected participants tend to shy away from the study. Because the research participants are “hidden” (relatively new to BIM), a snowball technique was adapted to facilitate the extraction of data. Therefore, the method of the study is developed in 4 steps namely as shown in the figure below;

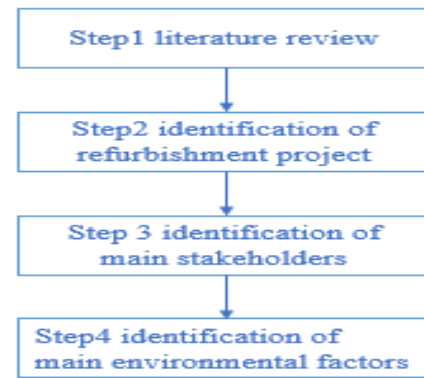


Fig 1: the research method

4. Analysis & Results

In this study, two previous refurbishment projects were identified due to the complexities encountered during the process of its execution in Auckland. Through these projects, the main stakeholders were identified and were approached to identify complexities and factors that could influence refurbishment projects, as well as how BIM adoption can be enhanced in New Zealand. Overall, the main stakeholders approached were 8 in number.

It was discovered that most refurbishment projects are driven by cost and time of project delivery as shown in figure 2. Table 1 shows the type of stakeholders that were involved in the two identified projects. Much of complexities were technical and structural complexities.

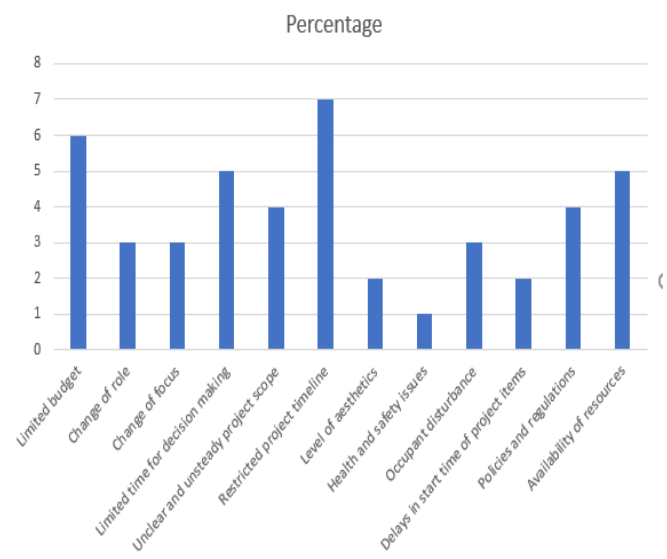


Fig 2: Environmental factors that impact on refurbishment project stakeholders

Table 1: refurbishment project stakeholders

No	Profession	Code
1	Project Managers	PM1, PM2
2	Main Contractor	MC
3	Sub-contractors	SB1, SB2
5	Managers	M1, M2, M2
6	Consultants	C1, C2
7	Architects	AR
8	Client representative	CR
9	Estimators	ES
10	Space Users	SU1,SU2,SU3,.....SUn
11	Value manager	VM

5. Discussion & Conclusion

The literature search and the preliminary findings revealed that refurbishment projects can be more challenging than new buildings in terms of IT adoption such as BIM. In general, most of the stakeholders in these projects mentioned that refurbishment projects are full of uncertainties. From figure 2, the respondents indicated that costs allocated to refurbishment projects are usually exceeded during the construction and there is limited time to execute these projects. Thus, there is an indication that there are less collaboration and information sharing within the refurbishment project subsector. In addition, these projects are subdivided into minor capital projects, yet, the collaboration and information problems have continued to exist. Therefore, these collaboration and information sharing should be a major driver for adoption of BIM. Hence, BIM adoption plan must be investigated through an interaction network of stakeholders to guide successful adoption of BIM for refurbishment projects in New Zealand.

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EXPLORING THE RELATIONSHIP BETWEEN MATERIALS PROCUREMENT AND WASTE MINIMIZATION IN THE CONSTRUCTION INDUSTRY: THE CASE OF EGYPT

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Abstract

Construction projects suffer from materials waste generated at different stages. This does not only lead to financial loss to construction companies but also lead to negative impacts on the environment. In Egypt, many megaprojects are currently being constructed as one of the main pillars of Egypt's sustainable development strategy (SDS) 2030. This means that significant amount of construction materials are likely to be generated as waste during their execution. There is very limited research exploring waste minimization during the materials procurement stage. Ineffective materials procurement strategies can generate waste due to poor planning and management. For example, materials procurement contributes 11.12% of materials waste in the UK and contributes up to 50% towards total project cost. This paper examines the relationship between materials procurement and materials waste reduction in the construction industry to develop an effective materials procurement framework drawing on the specific challenges and experiences in Egypt.

Keywords: Materials waste, Waste minimization, Materials procurement, Sustainable development, Egypt.

1. Introduction

The Construction industry is one of the most significant industries which lead to social and economic development of countries. It provides the citizens with high living standards through socio-economic infrastructure such as roads, hospitals, schools, etc. In Egypt, the construction industry contributes 5% of GDP and employs about 11% of the total population [10]. However, the construction industry is blamed for its negative impact on the environment as 40% of generated waste worldwide is caused by the construction industry [27]. In 2012, 89.03 million tons of solid waste was generated in Egypt in which 4 million tons were generated as construction and demolition (C&D) waste [29]. This means that C&D waste

contributes about 4.5% of the total solid waste generated in Egypt. This problem could be attributed to traditional practices in the Egyptian construction industry and the inability to handle the different challenges regarding waste generation and pollution of the environment. Materials waste is affecting both the environment and the economy, because materials waste means financial loss for construction companies. This is because the share of materials cost may be up to 40 and 70% of the total project cost [6].

Despite the efforts exerted by the Egyptian government to solve the solid waste management crisis (including C&D waste), inefficient waste management practices still present hazardous effects on the

environment and public health of citizens. C&D waste arises from the increase of construction activities which consequently lead to increase of construction materials waste generated. Due to the fact that the lifetime spans of buildings in Egypt are short because construction materials are not highly durable, and due to the fact that demolition follows construction, it is worth mentioning that the amount of waste that arises from demolition also increases [29]. In Egypt, only large construction companies are capable of properly collecting and disposing such waste. However, small contractors and the public tend to dump C&D waste on highways, public roads, undeveloped land and other sites near residential areas which causes serious hazards to public health and the environment as shown in Figure 1 [29]. Unfortunately, the recycling industry of C&D waste in Egypt is limited and is able to utilize a small amount of the total generated waste. Also, there is an extreme shortage of reliable data on C&D waste management in Egypt. It is worth mentioning that managing this waste properly would lead to cleaner sites, reduced air pollution, and reduced disposal sites. To solve C&D waste problem in Egypt, effective solutions have to be introduced in the Egyptian society [29]. Unfortunately, the Egyptian construction industry still relies on a traditional practice of dealing with materials waste by dumping it [1].

Recently, Egypt, in an attempt to improve the current environmental conditions, has introduced the Egypt's SDS 2030. The environment is one of the main pillars of the SDS in Egypt. The strategic vision of Egypt's SDS 2030 clearly states that "environment is integrated in all economic sectors to preserve natural resources and support their efficient use and investment, while ensuring the next generations' rights. A clean, safe and healthy environment is leading to diversified production, resources, and economic activities,



Figure 1. Construction Materials Waste Dumped on an Egyptian Public Road [4]

supporting competitiveness, providing new jobs, eliminating poverty, and achieving social justice." [23, p.236]. This vision also coincides with the UN sustainable development goals (SDGs) after 2015, which clearly states that environment is one of the main pillars of sustainable development. It is worth mentioning that C&D waste management is very important for sustainable development, which is about environmental, economic, and social development.

In recent decades, construction materials waste management research has explored different waste minimization approaches during design and construction stages, but very few researchers have exerted effort to explore or focus on minimizing waste during materials procurement stage [2], a critical interface between design and construction stages. Materials procurement process is one of the main causes of waste generation and it significantly affects the total project cost [3, 14].

This paper starts with a literature review to provide an overview of the meaning of C&D waste, different types of materials waste and the causes of materials waste generation. Also, it investigates different approaches of materials waste management, procurement management and materials procurement models, and materials procurement as an approach to minimize materials waste in construction projects. The need for a new approach in materials procurement to reduce waste in

the context of Egypt's vision 2030 will be explored drawing from the lessons learnt in developed countries. Finally, conclusion and recommendations for future research on the development of materials procurement framework for waste minimization in Egypt are also presented.

2. Literature Review

2.1. Definition of C&D Waste

C&D waste has been defined in many different ways in construction literature and there is no absolute definition for it. For instance, the Environment Protection Agency (EPA) in the US defined C&D waste as “waste that is generated from the construction, renovation, repair, and demolition of structures such as residential and commercial buildings, roads, and bridges” [8, p.2]. Alternatively, C&D waste was defined by Tchobanoglous *et al.* (1977) as “wastes from razed buildings and other structures are classified as demolition wastes. Wastes from the construction, remodeling, and repairing of individual residences, commercial buildings, and other structures are classified as construction wastes” [8, p.2]. Furthermore, Roche and Hegarty [25, p.1] defined C&D waste as “surplus and damaged products and materials arising in the course of construction work or used temporarily during the process of onsite activities”. It is clear that each study defines C&D waste based on the addressed research question. Any study of C&D waste management will have a clear vision and meaning by specifically defining C&D waste from its own perspective [21].

Lu and Yuan [21] stated that “C&D waste” term has been used extensively in the literature as an integral term to represent materials waste generated by construction activities without restricting it to a specific stage of construction or demolition. The term wastage refers to the variance, if any between the estimated and actual consumption of materials. Following the

definition of waste stated by Koskela [20], materials waste can be described as any inefficiency that results in the use of materials in larger quantities than those considered as necessary in the production of a building. In Egypt, Garas *et al.* [15] demonstrated in their study that materials waste during construction is the most frequent waste in Egyptian construction sites which leads to major financial loss and high impact on environmental pollution. Materials waste rates differ from one material to another [15]. For example, timber frameworks with an average waste of 13% and sand with an average waste of 9% showed the highest percentages of waste among all materials. While other materials such as reinforcing steel with an average 5%, cement 5%, and concrete 4% were within the acceptable waste rates of 7% steel and 5% cement.

2.2. Different Types and Main Causes of Materials Waste

Elgizawy *et al.* [8] identified a list of materials which could be wasted in most construction sites as follows: concrete, wood, metal ferrous (Steel) and metal non-ferrous (Copper and Aluminum), masonry (bricks and mortar), plastic (PVC pipes, plastic films for packaging, wall coverings), glass, ceramic tiles, insulation materials (mineral wool insulation, Styrofoam), drywall/gypsum board, filling materials (gravel, sand and soil), paper and cardboard, and marble and granite. Eze *et al.* [12] identified 20 main reasons for materials waste generation in construction sites as tabulated in Table 1.

Table 1. Main Causes of Materials Waste Generation [12]

Main Causes of Construction Materials Waste Generations
1. Frequent design changes and poor design
2. Poor materials storage system
3. Theft or vandalism
4. Poor site conditions
5. Poor strategy for waste minimization

6. poor procurement management (wrong purchasing order – quality, number, time of order)
7. Inclement weather
8. Poor and insufficient implementation of waste management plan
9. Poor materials handling on site
10. Poor quality and non-availability of equipment
11. Site management
12. Use of unskilled labor
13. Lack of workers' awareness and training on waste management practices
14. Poor coordinated documents
15. Long project duration
16. Traditional construction methods (labor intensive nature)
17. Time pressure
18. Waste resulting from poor packaging, delivery and transport
19. Lack of incentive for contractors to improve their practices
20. Poor segregation

2.3. Different Approaches of C&D Waste Management

Literature review revealed several approaches to manage C&D waste used worldwide. For instance, Zaki and Khial [29] stated that C&D waste can be managed using the waste management hierarchy which depends on the 4Rs' Golden Rule of Reducing, Reusing, Recycling, and Recovering of waste. **Reducing** of waste is defined by The Asia Foundation [26, p.7] as "any change in the design, manufacture, purchase, or use of materials or products (including packaging) to reduce their volume and amount of toxicity before they become municipal solid waste". **Reusing** of waste means usage of the same material in the construction process more than once either for the same function or a new function [28]. **Recycling** of waste is defined by Eurostat [11] as "any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes".

Recovering of waste is defined by Environment Agency [9, p.1] as "using waste to replace other non-waste materials to achieve a beneficial outcome in an environmentally sound manner". Yuan and Shen [28] stated that C&D waste can be managed using waste management hierarchy which depends on the following: the 3Rs' principles of Reducing, Reusing, and Recycling of waste, and disposal of waste. **Disposal** of waste is defined by Environment Agency [9, p.2] as "getting rid of waste in a safe and environmentally sound manner".

The components of the aforementioned waste management hierarchies are arranged in an ascending order according to their negative impact on the environment from low to high as illustrated in Figure 2 [28]. The main components of waste management hierarchies therefore tend to focus on reducing resource consumption and preventing environmental pollution, which are two of the main pillars of sustainability [28]. It has been mentioned in several studies that "reducing of waste" approach is the most effective approach for managing waste due to many reasons outlined as follows: (1) protecting the environment from pollution; (2) reducing the cost assigned for waste transporting, recycling, and disposing; (3) increasing profit; (4) enhancing the company's corporate image; (5) saving the loss of construction time; and (6) providing cleaner and safer site condition [12, 28, 29]. Since 2000, many researchers focused on "C&D waste reduction", which shows that C&D waste reduction is the most preferable way to manage C&D waste from the perspective of saving resources and protecting the environment [28].

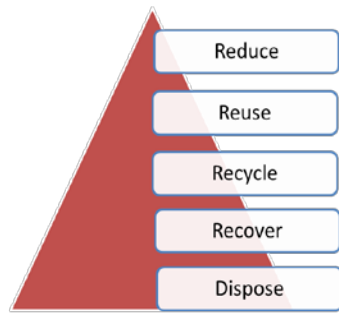


Figure 2. Different Construction Materials Waste Management Approaches

A number of visions, strategies, methodologies and action plans have been developed over the years to alleviate the materials waste problem in construction sites. They included for instance: Industrialization, Computer Integrated Construction, Constructability, Partnership, Robotized and Automated Construction, Lean Construction (LC), Building Information Modelling (BIM), Value Engineering (VE), Sustainable Supply Chain Management (SSCM), etc. [16, 22, 24]. These different approaches can reduce the generation of waste up to 70% [16]. In spite of the valuable contribution of these solutions, the performance of the Egyptian construction industry is considered very low in managing materials waste problem [1].

3. Procurement Management and Materials Procurement Models

Many construction projects encounter problems, such as time and cost overruns and materials waste generation, due to lack of proper materials procurement management. Zeb *et al.* [30, p.171] defined materials procurement as “purchasing of materials needed for execution of a project. Procurement is organizing the purchasing and scheduling delivery of materials to the suppliers”. Procurement is responsible for obtaining construction materials in the right quantity, quality, time, cost, and place [18].

Problems in materials procurement management are caused by lack of early planning before the start of the project, incorrect planning, late and wrong

deliveries, purchasing materials with nonstandard specifications, etc. Materials procurement management is the process needed for procuring products and service from outside the project team. It consists of four main steps as follows: planning procurements, conducting procurements, administering procurements, and closing procurements [18].

Planning procurements is the process of recording procurement decisions, determining the procurement approach, and identifying of potential vendors [18]. It is based on listing the required materials and the suppliers who can provide these materials for the particular project and at the lowest cost. This includes surveying and visiting sites and shops for suppliers to ensure their quality and performance [6].

Conducting procurements is the process of getting vendor responses, choosing a vendor, and awarding a contract [18]. Owners and contractors can get best price for the required materials by analyzing suppliers’ proposals. This analysis is based on cost, delivery, production capability, general laws and previous vendors’ background [5]. The proposal requests should mention that the vendor must submit specifications for materials and equipment which meets or exceeds the specifications required [19].

Administering procurements is the process of managing procurement relationships with vendors, monitoring the performance, and making corrections and modifications when needed [18]. This practice should ensure that the materials supplied meet the requested specifications at a good price and delivered on the specified dates. Tracking of vendor’s performance and maintaining a good relationship are considered the basis for sound purchasing technique [5, 6]. Finally, **closing procurements** is the process of completing procurement contracts with vendors [18].

In construction industry, there are different material procurement models. For instance, Daneshgari and Harbin [7] investigated three materials procurement models in the construction industry as follows: specialty contractor procurement model (SCPM), general contractor procurement model (GCPM), and owner procurement model (OPM). In **SCPM**, a specialty contractor is responsible for procuring materials for the project owner. The procurement process takes place once the specialty contractor is assigned. In this model, the owner and general contractor of the project mainly depend on the specialty contractor to procure all the materials for the project. Nowadays, project owners use this model over 90% of the time for materials procurement [7]. In this model, the specialty contractor has the privilege to review the design specifications, update the owner and general contractor of the project for any problem arising due to materials incompatibility with the design specifications, and give recommendations for any design changes. After finalizing the design, the materials order is issued by the specialty contractor to the vendors. Then, the materials are sent by the vendors to the specialty contractor at the jobsite.

In **GCPM**, the general contractor is responsible for procuring materials for the project owner. The procurement process takes place before the specialty contractor is assigned. In this model, the owner instructs the general contractor to procure all the required materials for the project. Nowadays, project owners use this model about 2% of the time for materials procurement [7]. Once the general contractor purchases the materials needed for the project without inputs from the specialty contractor, he/she may assign the purchase order to the specialty contractor. In this case, the specialty contractor carries the responsibility for receiving the materials on site, sorting out inaccurate orders, and rectifying the incompatibility of materials with specifications.

In **OPM**, the project owner directly procures the required materials from the vendors. The procurement process takes place before either general contractor or specialty contractor is selected. Nowadays, project owners use this model about 10% of the time for materials procurement [7]. In this model, the project owner depends on the design specifications produced by the engineering firm and his/her own experience to procure the required materials. Due to the fact that project owners may have individual relationships with speciality contractors, specialty contractors may give inputs and recommendations about materials procurement to the owner. Once the materials are purchased by the owner from the vendors, they are shipped directly to the site and stored until usage and installation by the specialty contractor.

Comparing the three models regarding waste generation, the **GCPM** was introduced to the supply chain to solve the waste generation problem. However, it has been proven to be more inefficient than **SCPM** [7]. Both models suffer from inadequate materials management process which leads to waste generation. The **OPM** is better than both models regarding waste generation aspect. Comparing the three models regarding the cost of procured materials, both models **GCPM** and **SCPM** are similar in materials cost. The **OPM** provides slightly less expensive costs of procured materials than **GCPM** and **SCPM** [7].

4. Materials Procurement and Materials Waste Generation

Materials waste occurs during the construction activities on site due to various actions and activities at design, materials procurement, and construction stages of a project. The literature is very rich on design and construction strategies for minimizing materials waste as outlined in the end of section 2.3. However, few efforts have been exerted to investigate

materials procurement measures to reduce waste generated by construction activities [2]. It is known that the wasted materials are purchased during materials procurement process. Additionally, materials procurement could contribute up to 50% towards the total project cost. Despite the fact that different studies [3, 14] have clearly stated that ineffective application of materials procurement process is a main cause of materials waste, procurement measures for materials waste reduction have neither been explored nor adequately addressed. According to Fadiya *et al.* [13], materials procurement contributes 11.12% of total materials waste generation among other eight factors contributing to waste in the UK as shown in Figure 3. This supports the claim that materials procurement is a main cause of materials waste.

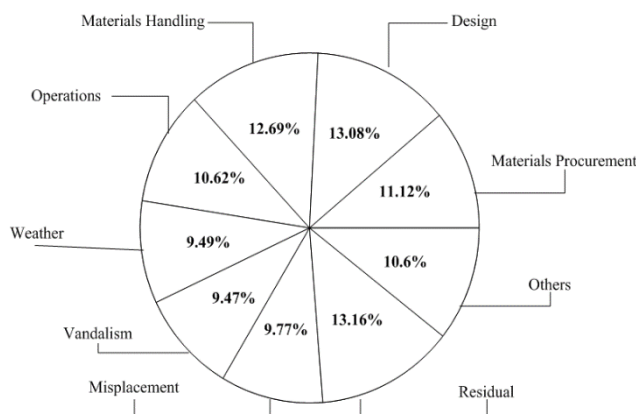


Figure 3. Contributions of Different Sources of Construction Materials Waste in the UK [13]

5. Need for a New Approach in Materials Procurement to Reduce Waste in Egypt

Materials procurement measures can be an effective approach to reduce materials waste in the Egyptian construction industry. This is due to the significant increase in the number of mega construction projects currently being implemented or planned in Egypt such as National Project for the Development of Sinai, National Projects for Roads, National Project for the Development of Upper Egypt, Establishment of New Cities

(e.g., New Administrative Capital, East Port Said City, The New Ismailia City, The New Alamein City, and an Integrated Vity at Al-Galala), The National Electricity Project, Al Galala Plateau Project, The Golden Triangle Project, North-Western Coast Development Project, The National Project for Social Housing, East Owainat Project, etc. [17]. Therefore, applying effective materials procurement practices may lead to lower rates of materials waste and better cost savings for these megaprojects in Egypt.

Different measures can be considered during the material procurement process to reduce the generation of materials waste in Egypt drawing on the lessons from developed countries. In the UK, Ajayi *et al.* [2] was able to define four clusters of strategies for reducing materials waste through materials procurement as follows: (1) suppliers' low waste commitment; (2) low waste purchase management; (3) effective materials delivery management; and (4) waste efficient bill of quantity. Each cluster consists of different measures which should be adopted to reduce materials waste generation. For example, **suppliers' low waste commitment** includes four main measures: suppliers' flexibility in supplying small quantities or modification to products in conformity, commitment to take back scheme (packaging, unused, reusable and recyclable materials), supply of quality and durable products, and usage of minimal packaging (without affecting materials safety).

Also, **low waste purchase management** includes five main measures: procurement of waste efficient materials/technology (pre-assembled/cast/cut), purchase of secondary materials (recycled and reclaimed), purchase of quality and suitable materials, avoidance of variation orders, and correct materials purchase. **Effective materials delivery management** includes four main

measures: effective protection of materials (during transportation, loading & unloading), effective onsite access (for ease of delivery), efficient delivery schedule, and usage of Just in Time (JIT) delivery system. Finally, **waste efficient bill of quantity** includes three main measures: accurate materials take-off, prevention of over/under ordering, and reduced waste allowance. These different measures can be considered while preparing for materials purchase and during materials purchase and delivery to the site. These measures can be adopted within various materials procurement models discussed to evaluate materials suppliers towards materials waste reduction in construction projects. Findings from the literature review and field studies to be carried out will provide the basis to develop a conceptual framework that will have a significant impact in reducing waste in the Egyptian construction industry and the achievement of Egypt's SDS 2030.

6. Conclusion and Recommendations

Egypt is currently progressing towards the sustainable development of the society by constructing various mega projects as planned in Egypt's SDS 2030. Unfortunately, the construction industry suffers from the generation of materials waste which has its negative impacts on the environment. Besides, materials waste leads to financial loss of construction companies. This paper has investigated the relationship between materials procurement and materials waste reduction in the construction industry to identify best practices that can be applied in Egypt. There are several materials procurement measures which should be considered in practice by industry professionals to mitigate the negative environmental and economic impact of construction materials waste. These measures guide the practitioners towards procuring construction materials in a waste efficient and cost-friendly manner.

Many research focused on construction materials waste minimization during design and construction stages, but the literature review revealed that few studies focused on materials waste minimization during materials procurement stage. Materials procurement plays an important role in materials waste generation and total project cost. As effective procurement process is efficient in reducing waste and the total cost of construction projects, it is therefore recommended that research should be focused on efficient materials procurement process to reduce waste. It is recommended to explore the materials procurement approach for minimizing materials waste in different situations to identify context specific measures that will be applicable in Egypt's construction industry.

This review is part of a PhD research project which will contribute to the existing body of knowledge for practitioners and academics. At the industry level, this research aims to develop an evidence-based conceptual framework which can guide practitioners and professional organizations in the Egyptian construction industry on adopting key measures for efficient materials procurement practice. At the academic level, this research will explore materials procurement practices critical at the interface between design and construction stages using strategies for reducing materials waste that is more suited to the Egyptian context.

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REBUILDING AHMADI TOWNSHIP ... AN APPROACH TOWARDS A SUSTAINABLE & SMART FUTURE

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Abstract

This paper offers a glimpse into the process of “Rebuilding” Ahmadi-Kuwait’s Oil Town, developed by the Kuwait Oil Company (KOC). The Company envisioned transforming Ahmadi into an oil town, which reflects modern sustainable values while taking into consideration and retaining the rich, historical heritage of Ahmadi and State of Kuwait. Core to the redevelopment is to incorporate a smart sustainable strategy that not only informs and connects KOC employees, residents, and visitors but also enhances the efficiency and functioning of the infrastructure and all other services across Ahmadi. This paper includes a comprehensive view to illustrate various aspects considered during the process of transforming Ahmadi Township into a sustainable smart town - such as the context, history, vision and objectives, issues and challenges faced, approaches explored and considered. The approach illustrates an enhanced corporate social responsibility in the region and uplifting the housing integrity in the surrounding context.

Keywords: Rebuilding, Ahmadi, Sustainable, Smart City, Oil town

1. Introduction

Rebuilding Ahmadi Township Project has resulted from the previous studies led by the KOC Ahmadi Township Redevelopment Steering Committee and conducted by international consultants (i.e. M/s Atkins, Gulf Consult and Ernst & Young). The need to redevelop the Ahmadi Township was identified as a top priority by the higher management of the Kuwait Oil Company with the main objective of carrying out total reconstruction of all Company Houses in Ahmadi and re-structuring the town into a modern oil town; complete with all amenities necessary for its effective functioning. Furthermore, one of the other prime reasons for the Rebuilding Ahmadi Township development program was addressing the issue of high and the escalating maintenance and operation cost of the dilapidating houses of the existing township in addition to, providing better housing facilities and environment for its employees and occupants.

2. Background Review

2.1.Site Location & Climate:

Ahmadi Town is located 40 km southeast of the Kuwait City center and is spread over an area of 5.12 sq km.



Location of Ahmadi Township, Kuwait.

Kuwait has an arid desert climate with a huge temperature difference between the

winter and summer months and some marginal rain during a brief period each year. Kuwait experiences soaring temperatures in summers with average summer temperatures ranging from 42-48°C. The highest ever temperature recorded in Kuwait was 54°C in July 2016, which is the highest recorded temperature in Asia and the third highest in the world.

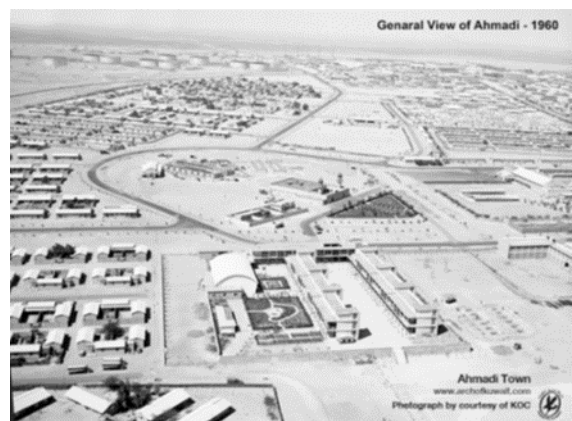
2.2. Historical Context:

Ahmadi is one of the most important suburbs of Kuwait City and has been crucial towards the development of the state of Kuwait.

Further to the discovery of oil in the region in 1930s, Kuwait Oil Company (KOC) was established in 1934 through a joint venture between British Petroleum and Gulf Oil to manage oil production in Kuwait. In 1938, one of the world's largest oil field was discovered at Burgan, in the southeastern desert. In order to support the oil production in the Burgan oil field, the township of Ahmadi was developed in 1946 and it became the Headquarters for the Kuwait Oil Company (KOC).

The township continued to expand including the administrative headquarters and offices for Kuwait Oil Company, housing for KOC employees, and supporting amenities including parks, sports centers, shopping, schools, and government functions. In 1975 with the transition of Kuwait Oil Company (KOC) to the full ownership of Kuwait Government, KOC retained the responsibility of Ahmadi Township including housing and various other facilities for its employees.

Ahmadi Township is strategically located in the Greater Burgan Oil Field area with proximity to the Ahmadi Port to facilitate the exploration and export operations.



View of Ahmadi Township in 1960s

The following salient features of the existing Ahmadi Township provides a rich heritage, unique character and importance, which needs to be preserved in future:

- i. Ahmadi illustrated a new way of urban designing and planning in Kuwait during that time. The whole system of construction in Ahmadi was different from the rest of Kuwait. In fact, the plumbing and the sewage system installed by the British in the township continues to be different until this day.

- ii. The town planning illustrates a very western layout that catered to the needs of the British expatriates and their families in the 1940s who lived there.
- iii. It was designed to be environmentally friendly and climate responsive.
- iv. It is famous for its vibrant green surroundings, beautiful parks and is one of the greenest settlements in Kuwait, which is a rarity in the given arid desert context.
- v. It is known in the region for its western architectural style with pitched roof detached housing units, front gardens and roads flanged with green shaded trees.



2.3.Evolution of the Urban Fabric:

Ahmadi was built on a slope facing the Arabian Sea located 11 km away with the orientation based on the cardinal axes (N-S & E-W). On the ridge of the hill, at the center of these cardinal axes, the main headquarters of the Kuwait Oil Company (KOC) was sited.

The town followed a grid pattern layout with roads laid out at right angles to each other. The main roads called 'Avenues' running down the slope in W-E direction (given numeric names i.e. 1st Avenue, 2nd Avenue etc.) and the Arterial roads called 'Streets' running in N-S direction (given numeric names i.e. 1st St North, 2nd St. South etc.).



The old town planning of Ahmadi town designed by the Company architect Wilson Mason & Partners illustrated a hierarchical layout with the street that ran across the top of the hill called "the main street" housing the upper echelons of the KOC including KOC Main Offices, and streets progressing down the hill with houses in order of KOC ranks.

Also planned within the town were other amenities like the Hubara Club - a complex of buildings with a swimming pool, meeting rooms, restaurants, squash courts, tennis courts etc. Other recreational facilities were designed towards the bottom of the 'hill' such as the 'souk' or shopping area; banks, cinema etc. with the easy access link to the areas outside the township.

3. Methodology

3.1.Setting up of Vision and Objectives:

In 2014, KOC decided to Rebuild Ahmadi Town and its future on the foundation of its rich historic past by setting clear vision and objectives/ goals.

The Company's vision was to transform Ahmadi into an oil town which reflects a modern oil industry image while taking into consideration and retaining the historical and cultural heritage of Ahmadi and its contribution to the oil industry of Kuwait.

The following objectives were set for the redevelopment of the existing Ahmadi town:

- i. **Redevelopment Stewardship:**
Company's aspirations to be an employer of choice by providing quality service to the employees in the form of a modern, safe, secured and healthy living environment.
- ii. **Preserve Historic Heritage:**
As it had been over 60 years since the inception of the township, the intent was to preserve/ enhance the township outlook by modernizing it, being in line with the other modern cities and to set a positive precedent in the region for sustainable and inclusive growth.
- iii. **Social Commitment:**
Illustrate Company's social commitment not just towards its employees by uplifting the housing integrity, but extending beyond and contributing to the communities beyond its premises and towards Kuwait.
- iv. **Support Kuwait's 2030 Vision:**
To extend its support and commitment to the Kuwait's 2030 vision by taking a lead to reduce energy and water usage per capita and increase the energy supply from renewables to 15%.

4. Analysis & Results

4.1.Development Strategies:

As part of the strategy to achieve these objectives, an initial study was carried out, to check the relevance of the various development approaches, options, models for the three project drivers namely, Finance, Logistics and Design.

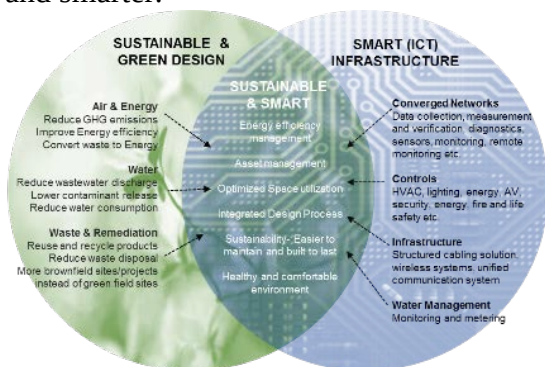
For the financial aspect, three approaches were considered for the study, namely the Built-Operate-Transfer (BOT) approach, Private Sector Partnership (PSP) approach and Do-It-Yourself (DIY) approach. Owing to the logistical and legal concerns highlighted during the study at that time, the BOT and PSP approaches were excluded and the Company decided to rebuild the township on its own following the Do-it-yourself (DIY) approach.

The logistical constraints included Rebuilding the entire township within 10 years timeframe while keeping the existing township and facilities operational at all times. In light of the above, a phased development strategy was considered including development of the vacant parcels of the land within the township initially in order to facilitate the subsequent evacuation and shifting of the occupants of the existing units as required to redevelop the existing developed areas of the township.

For the design aspect, the strategy included the study of the relationships and design components of the development models of various modern cities such as the Eco City, Green City, Sustainable City and Smart City/Digital City etc. This allowed the Company to pick the most comprehensive and relevant system applicable in the given context. The preferred components were then further analyzed for its applicability with respect to the site context, concurrence with the Company's objectives, cost implications and its

benefits. Another study was carried out for verifying the elements and facilities including services infrastructure in the existing Ahmadi Township that could be retained, enhanced or integrated with the proposed design resulting in optimized utilization of resources.

A holistic design approach was adopted using Sustainable & Green design principles with the Smart Technology (ICT) as an enabler to achieve a more comprehensive sustainable development that is more relatable, simpler, better, faster and smarter.



Fundamental to the strategy was an integrated design approach involving various disciplines & Company stakeholders in the design process from the beginning. The sustainable and smart design strategy was formulated to be applied at two levels, i.e. macro level (in master planning & urban design) as well as micro level (in detailed design of houses and various facilities) of the existing Ahmadi Township.

4.2.Design Considerations:

Sustainable design approach in urban planning at macro level included identifying the urban nodes and destination points in the existing Ahmadi Township and creating new nodes/hubs to ensure a good equal dispersion of retail, recreational, leisure, worship facilities across Ahmadi. This helped in easing or dispersing the traffic movement across the town, and ensuring that the residents across the town have easy access to these nodes/hubs.

The nodes help residents to orientate themselves, judge distances, act as points of reference and importantly give a sense of identity to their surroundings.

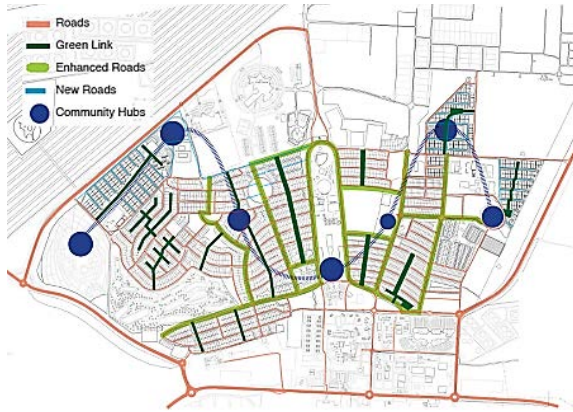
Furthermore, some urban nodes were designed to be more significant than others, to help draw visitors from the local vicinity and extended community participate and generate a vibrant environment. These nodes act as community hubs spread across Ahmadi to give a sense of cohesive identity to the town instead of their peripheral positioning in the old town layout.



Following the intent to further enhance one of its rich heritage of 'Green' Ahmadi, as it is known for in the region; these community nodes were connected through 'Green Links'/'boulevards' forming a well-connected green network of pedestrian walkways and bicycle lanes across Ahmadi. This helped to enhance social environment, add vibrancy to the internal streets of the township while ensuring pedestrian, and bicycle safety by including limited interaction with main vehicular traffic network. The existing green parks were also integrated to form part of this green network to increase its effectiveness.

In addition, the existing designated public open spaces and recreational areas were enhanced with the introduction of new functions and activities to meet the particular needs of Ahmadi residents.

Improvements were also designed in terms of legibility, accessibility and connectivity. Improved levels of planting local plant species further resulted in the creation of new habitats and enhanced biodiversity.



The urban design included a hierarchy of key spaces including squares, avenues, streets and parks that have a specific role and function to play within the landscape regeneration that have been bridged through these green links. Interventions such as widening of the existing pedestrian paths and defined site edges as well as the strategy for the formal arrangement of the hardscape and low maintenance softscape are introduced to create an elegant environment, while being easier to maintain.

Exciting public landscaped spaces create inspiring and animated environments as they act as focal points for communities, which are the fundamental platform for civic life.

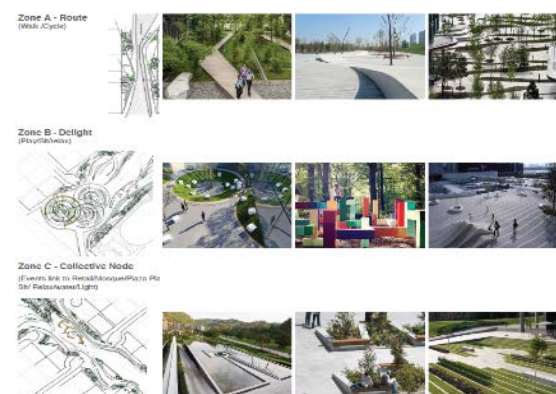
Within the green links, different hierarchies of the landscape zones are created which can be defined into three types:

Zone A - The 'route' typology, forming connections across the housing sites, connecting points of origin and destination and facilitating pedestrian journeys away from the highway network.

Zone B - 'Delight' spaces punctuating the routes, acting as highlights in a journey from one point to another. Designed to be

more lush, spatially contained and 'special', encouraging people to spend time in them rather than move through them. They were designed to include some sort of active function for community use, making them lively and animated places.

Zone C - Plaza spaces marking the arrival at a public destination in the community: a mosque and shopping precinct. They have a secondary role as a breakout space for the residents use and includes places for children to play and shaded areas for adults to rest.



Furthermore, this helps the neighborhood greenspace to support a range of formal and informal recreational activities. The plazas are designed as multifunctional spaces to be used for sport & recreational activities, outdoor markets and events held by the Company, which enhances the interaction of the community. The scale and design treatment of each of these spaces across the township reflect their intended function, creating a vibrant mix.

The proposed master plan also optimized the design interventions at macro level by retaining all the main streets & avenues of the existing urban fabric and restricting it to few minor enhancements to some roads and junctions required in order to cater to the future traffic for next 50 years based on traffic studies carried out for the township.

Sustainable design approach at building level included the following design considerations:

- i. Use of Renewable Energy Source- Solar PV cells for all houses and facilities without affecting the visual outlook from the streets and the character of houses. Achieving Minimum 15% energy saving (around 8MW approximately from the total houses power by use of Solar PV cells.
- ii. Proposed use of solar car parking ports to help achieve 15% of energy requirement for the facility/ office building in the township.
- iii. Provision of adequate front and rear gardens for the houses, green shoulders along the streets and shaded streets and walkways to help reduce the effect of the heat island effect.
- iv. Layout of houses and buildings, size and fenestrations of windows designed to optimize the use of natural daylight to reduce the energy consumption for general lighting and cooling loads without any additional cost.
- v. Use of 400mm thick insulated external walls with lightweight thermal blocks and sand lime bricks cladding with higher U values to help reduce the cooling loads inside the houses by 30%.
- vi. Use of existing sand lime bricks cladding to retain the character of the existing Ahmadi town.
- vii. Use of low maintenance landscaping and local trees and shrubs species reducing the irrigation water demand for the landscaped areas and using brackish water for irrigation to further reduce the use of potable water.
- viii. Use of locally sourced and manufactured building materials preferred and specified.

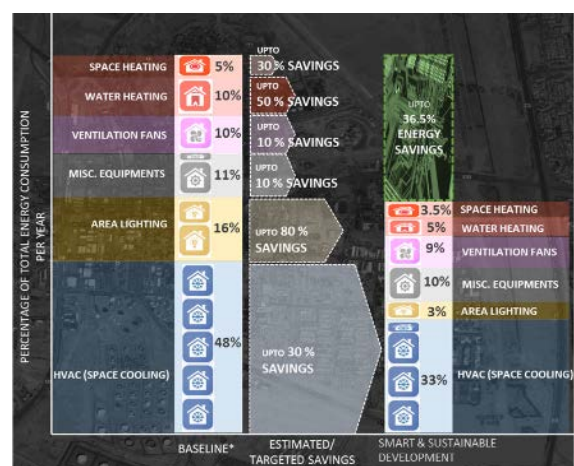
Smart Integrations were also considered along with the abovementioned Sustainable

design strategies to gain maximum benefits as envisaged. This included the following considerations:

- i. Optimize and upgrade the Main services infrastructure networks by including smart controls, meters etc. and GIS.
- ii. Provision of Home Automation system for houses.
- iii. Provision of Smart services such as Energy management system environmental monitoring system, KOC communication platform for community, Outdoor signage system, security system, street lighting remote control and waste management.
- iv. Provision of a centralized command and control center to control and monitor the operations of the overall town.

5. Discussion & Conclusion

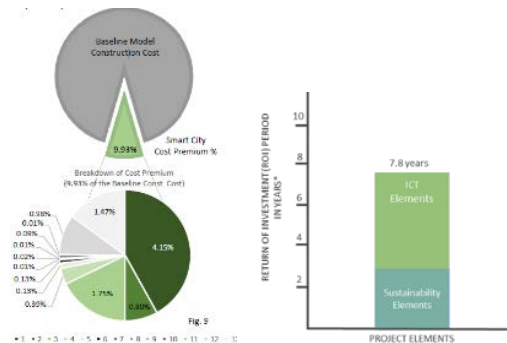
The factors driving the viability of this sustainable & smart approach with convergence of smart and sustainable building technologies and processes are as outlined below.



Energy Consumption: Comparison with other Residential buildings in Kuwait. [1]

1 Moncef Krarti, *Analysis of Economical and Environmental Benefits of Promoting Energy Efficiency - Case study Kuwait. United Nations Development Account Project, ESCWA*

- Energy efficiency and savings of 36.5%.
- Financial impact:
 - Up-front estimated cost premium (as compared to conventional system) – 9.93%
 - Returns on Investment- less than 8 years. (based on highly subsidized energy tariffs in Kuwait)



- Water conservation: 20% reduction of water consumption.
- Reduction in operation and maintenance cost.
- Enhanced Building transparency and visibility controlled by the Company through auditing, reporting and diagnostics

Furthermore, Smart and Sustainable development approach not only caters to the future trends but also supports the Company to achieve its goals through the following:

- Enhanced Livability:
 - Access to a comfortable, clean, engaged, healthy and safe lifestyle.
 - Access to diverse recreational and cultural options.
 - More reliable services to the occupants.
 - Improve the quality of the urban management and create new modern values in life.
 - Improve employees' quality of life by improving the efficiency of the services.

- Enhanced Health & Safety:
 - Enhanced vigilance and security aspects within the township.
 - Safer neighborhood and community.
 - Faster emergency response system.
- Enhanced Sustainability:
 - Planning for future while catering to the present needs of the Company employees and occupants.
 - Efficient use of natural, human and economic resources and promotes cost saving.
- Enhanced Employee Workability:
 - Efficient working environment and increased employee retention.
 - Easy Access to Company & Community services.
- Enhanced O&M efficiency:
 - Making services available to employees, company and authorities with reduction of the energy costs and operation/maintenance costs of the Company.
 - Reduced energy and water consumption.
 - Getting the Infrastructure do more and last longer for less.

The Rebuilding Ahmadi Township project exemplifies an approach and Company's commitment to extend support in all its endeavors and serve as a platform to showcase and set a positive example in the region- for a comprehensive, sustainable and inclusive growth and paving way for a sustainable & smart future by addressing the three pillars of sustainability.



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THE EFFECT OF BUILDING ASPECT RATIO ON THE ENERGY PERFORMANCE OF DORMITORY BUILDINGS IN COLD AND SEMI-ARID CLIMATES OF IRAN

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Abstract

This study investigates the effect of building aspect ratio on energy efficiency in the cold and semi-arid climate of Shiraz and proposes its optimal value for designing student dormitories in this city. A number of building models with different aspect ratios were developed and evaluated in two stages, using dynamic simulation tools. In the first stage, the models are characterized by larger windows at south and north facades while in the second, all facades were given an equal value of window to wall ratio (WWR). The results indicate that the optimal aspect ratio of a building can be different, when the WWR of each façade is changed. This has to be taken into account when proposing an ideal envelope design for buildings in certain climates and conditions.

Keywords: *Aspect Ratio, Energy Efficiency, Building Geometry, Design Optimization*

1. Introduction

The building envelope is the barrier that separates the interior environment from external conditions, providing thermal comfort for occupants. On the other hand, it can act as an obstacle to the entrance of daylight and solar radiation when needed. Thus, it can have both negative and positive effects on the energy requirements of a building and has to be carefully designed in order to reach high levels of efficiency.

Beside energy efficiency, building envelope design has to consider many other issues such as aesthetics and economic constraints. Thus, not only finding the optimal design that leads to least consumptions matters, but it is also important to know the extent of this influence. It will then be possible for the designer to reach a balance between energy performance and other design issues.

Different aspects of the design of the building envelope such as its shape and compactness and their effects on energy efficiency have been investigated in several previous studies [1-8]. It is

generally accepted that Rectangular shape is the optimal building shape for an energy efficient design [9]. On the other hand, finding the optimal rectangle with the ideal width to length ratio, also known as aspect ratio [10] is another objective in design optimization of buildings [10-12].

The aspect ratio of a building, affects its level of compactness and thus the amount of heat loss and gain [11]. An aspect ratio near 1:1 belongs to near-square shapes, which are more compact compared to elongated shapes with higher aspect ratios.

On the other hand, “the aspect ratio of a building along with its orientation, define the percentage of the facade exposed at each cardinal point” [13], which means it also affects how the building receives solar radiation.

Previous studies suggest that compact shapes are preferred in cold climates [1, 4], and the ideal aspect ratio in such places ranges from 1.3 to 1.5 [8]. In a comprehensive study, McKeen and Fung [11] investigated the effect of aspect ratio on energy requirements of multi-unit residential buildings in Canada and

confirmed that the 1.3 to 1.5 range is ideal in different cities of this country.

Inanici and demirbilek [12] also performed a similar study for different cities of turkey and suggested the aspect ratios of 1.2:1 and 2:1 for cold and warm climates of this country respectively, indicating that a more elongated shape performs better in climates with higher outdoor temperature. This is in line with the findings of Depecker et al. [1] and Albatici and Passerini [4], who observed that more compactness, does not necessarily lead to less heating energy demand in warm climates.

The present study, aims to test the findings of previous studies in the climatic conditions of Shiraz city. It investigates the optimal building aspect ratio as a part of a larger project, which aims to optimize the design of student dormitories in this city. The investigated models are thus, representatives of the current design and construction practices in these buildings.

The buildings used as reference, have less glazed surfaces on their east and west facades compared to the south and north ones. Such design can affect the optimal aspect ratio and the results cannot be used for buildings with equal WWR in all facades. In order to test different design alternatives and provide the ideal aspect ratio for each one, both types of façade design and their optimal elongations are investigated.

2. Research Methods

This study uses the parametric method to investigate the effect of aspect ratio on the energy requirements of buildings and provide its optimal value for student dormitories in Shiraz, Iran. Several Building models with different aspect ratios ranging from 1:1 to 4:1 were designed. Different characteristics of the models such as the plan design, and construction properties are selected based

on the current conditions of the built dormitories in Shiraz university campus.

The energy requirements of the models are tested in two stages. In the first stage, the west and east facades have a lower WWR than the north and south ones. In the second stage, the WWR of all facades were set to 20%.

In each stage, thermal performance of the models are analyzed using DesignBuilder dynamic simulation software tool [14]. The simulations are then followed by analytical comparisons of the effect of aspect ratio on the heating and cooling energy requirements.

2.1. Design of the models

The current condition of the dormitories of Shiraz University campus were first studied and the newest building was chosen to serve as the base case for simulations. Typical plan of this building presents a central corridor with bedrooms and other spaces on both sides of the corridor (see Fig. 1).

As can be seen in Fig. 1, there are several recesses in different facades of the building. These recesses increase the total surface area of the external envelope, resulting in an increased heat loss. As the aim of this study is to reach the ideal envelope configuration, the models are designed without these recesses and present the optimal rectangular shape.

Six rectangular models with aspect ratios ranging from 1:1 to 4:1 were developed in DesignBuilder simulation software tool. Table 1 compares the surface area of different facades of these models.

The models consist of four floors, all having a plan design similar to the plan presented in Fig. 1. Each floor has a gross internal area of 518.5 m² and includes 14 bedrooms each occupied by four adult individuals, a central corridor, a kitchen

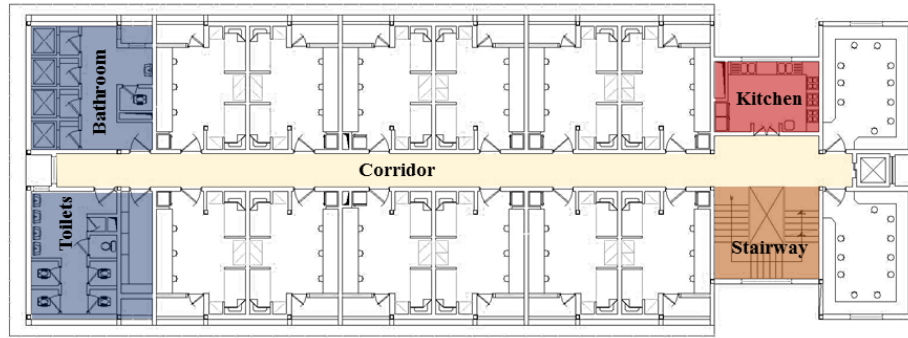
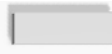
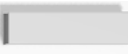


Fig.1. typical floor plan of the base case dormitory [15]

Table 1. surface areas of different façades of the models

						
Aspect Ratio	1:1	1.2:1	1.5:1	2:1	3.3:1	4:1
South/North façade surface area (m ²)	311.8	340.89	380.29	438.18	569.23	616.93
East/West façade surface area (m ²)	311.8	285.15	255.8	222.4	172.05	159.19
envelope surface area (m ²)	2330.18	2334.8	2355.72	2406.8	2573.44	2646.15

and a stairway. Fig. 2 shows the internal zoning for the extreme models with aspect ratios of 1:1 and 4:1.

The building is used throughout the year and all spaces except the stairways use an HVAC system to provide thermal comfort for occupants. Table 1 presents different characteristics of the HVAC system and internal gains from lighting and appliances.

WWR of the south and north façades were set to 20% in both stages of the study. In the first stage, the only windows on west and east façades were located on the external wall of the central corridor and had an area equal to 20% of this wall. In the second stage however, the WWR of the

east and west façades were set to 20 % as well (see Fig. 3).

3. Analysis & Results

3.1. Results for the models with low WWR in their east and west façades

The annual heating and cooling energy consumptions were calculated for models with aspect ratios ranging from 1:1 to 4:1. As shown in Fig. 4, for the cooling energy requirements, the square shape with the aspect ratio 1:1, resulted in the least energy need, and as the aspect ratio increased, the cooling energy consumption increased continuously.

The difference in the cooling

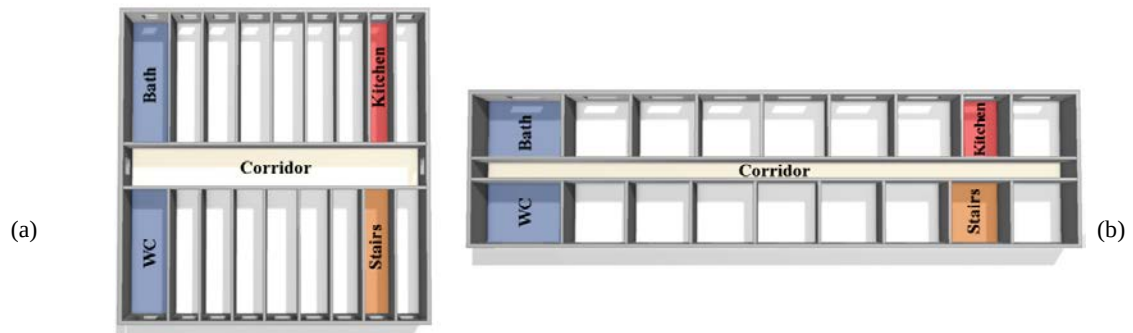


Fig. 2. Internal zoning of the models with different aspect ratios. (a) 1:1 and (b) 4:1.

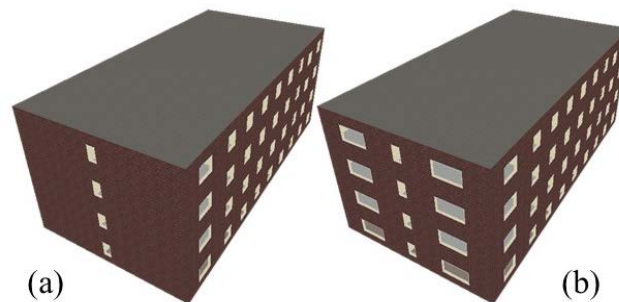


Fig 3. Example of façade designs in the firsts and second stage of the study. (a) first stage, (b) second stage.

Table 2. Model simulation parameters

Internal Gains from	Bedrooms: 8.90
Appliances (W/m ²)	Kitchen: 40.00 Corridor: 0.00 Bathroom: 1.60 Toilets: 4.00
Lighting Gains (W/m ²)	Corridor 5.80 Other spaces 3.36
Cooling system	Season: May 1 to September 30 Set point temperature: 26°C Cop: 4.6 Fuel: Electricity
Heating system	September 1 to May 31 Set point temperature: 20C Cop: 0.8 Fuel: natural gas
Supply ventilation (L/S per person)	Bedrooms: 2.5 Bathroom and toilet: 12 Kitchen: 10 Corridor: 0.3 (L/S per m ²)

Table 3. Construction properties

component	Construction	U-value (W/m ² K)
External wall	Concrete + insulation + lime stone	0.78
Roof	Light and dense Concrete (2 layers) + concrete blocks + insulation	0.56 1.47
Slab on grade	Light and dense concrete (2 layers) + Ceramic	
Window glazing	Double glazed (3mm), air filled (13 mm)	2.71 (SHGH = 0.764)
Window frame	PVC	1.8

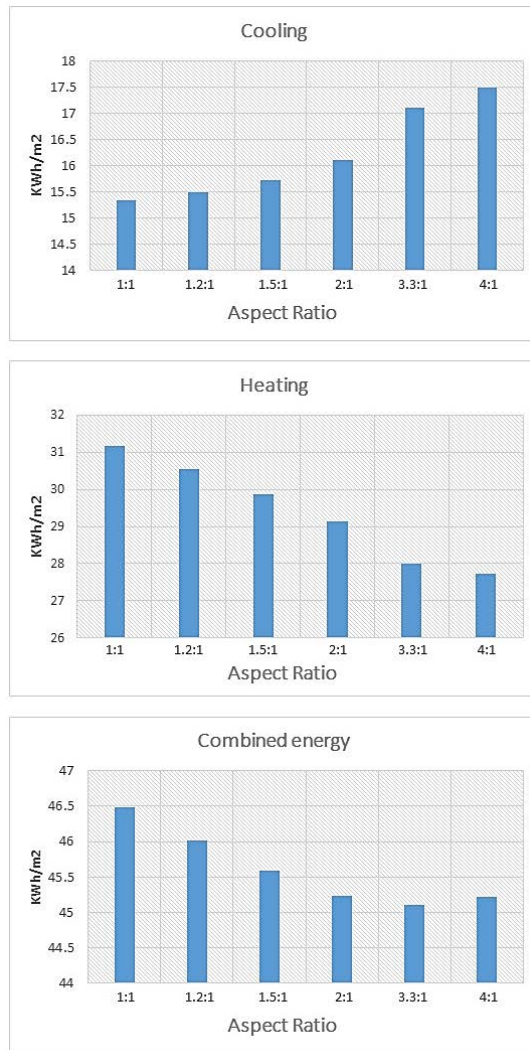


Fig.4. Annual cooling, heating and combined energy consumptions (KWh/m²) of the models with different aspect ratios.

energy consumption of the models with the best and worst performances is 12.3%.

On the other hand, the least heating energy consumption belongs to the most elongated shape with the aspect ratio 4:1. Strong solar radiation in Shiraz along with higher south façade areas in models with higher aspect ratios has resulted in a decrease in their heating energy consumption.

The difference in heating energy consumption of the models with the best and worst performances is 10.9%.

The most efficient aspect ratio is evidently one, which utilizes the least total energy.

The combined energy consumption, which quantifies the total heating and cooling consumption, is thus used to compare the efficiency of the models.

As can be seen in Fig. 4, the combined energy consumption is generally lower in models with more elongated shapes than the compact ones and the most efficient aspect ratio is 3.3:1.

The difference in combined energy consumption of the models with the best and worst performances is only 3%. This is a result of the fact that elongation has shown contrary effects on heating and cooling energy needs.

3.2. Results for the models with 20% WWR in all their facades

In the next stage of the study, all models were redesigned to have 20% WWR on all facades and their heating and cooling energy consumptions were recalculated. The results are shown in Fig. 5.

The least cooling energy consumption belongs to the model with the aspect ratio 1.5:1. When all the facades have an equal WWR, increasing the aspect ratio from 1:1 to 1.5:1 reduces the cooling energy consumption. This is likely the result of reduction in the west and east façade areas, which unlike the first stage will significantly reduce the window area in these facades.

However, increasing the aspect ratio above 1.5:1 will result in higher energy consumptions, which means that the reduction in solar radiation received, can no longer make up for the increase in heat gain due to larger external envelopes (see table 1). The difference in cooling energy need in models with the most efficient aspect ratio and the least efficient one is 4.5 %.

On the other hand, the heating energy consumption still decreases, as the aspect

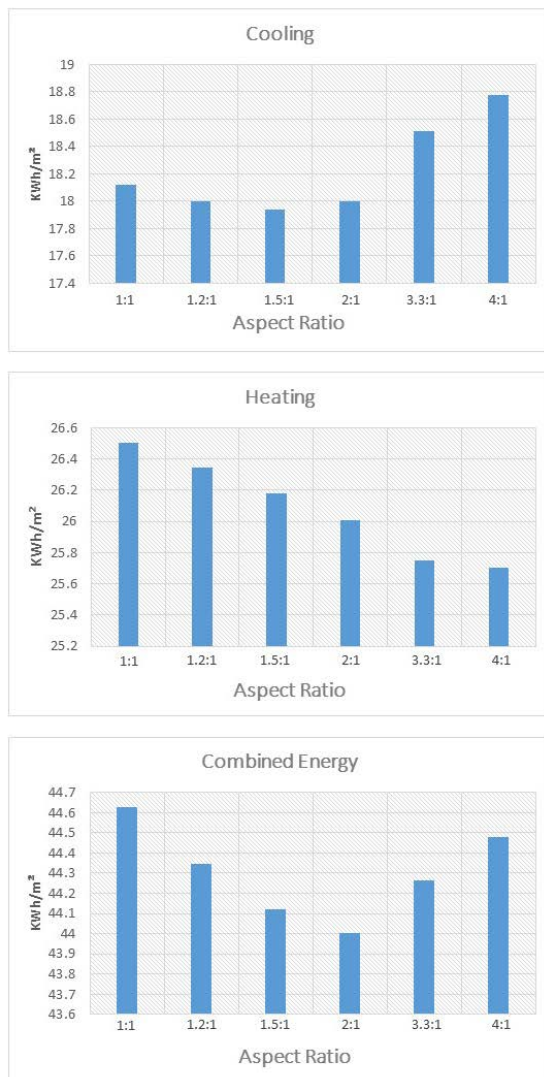


Fig.5. Annual cooling, heating and combined energy consumptions (KWh/m²) of the models with different aspect ratios.

ratio of the models increases, but the difference in heating energy need in models with the most efficient aspect ratio and the least efficient one is only 3% in this stage.

The combined energy consumptions of the models are also calculated and shown in Fig. 5. The combined energy consumption is lowest for the model with the aspect ratio 2:1 and highest for the square shaped model.

The results of this stage of the study is clearly different from the previous one, which shows that proposing one optimal

aspect ratio for all buildings in a certain climate, might be misleading in some cases. Further studies may be needed to test the effects of other design variables on optimal aspect ratio or test the findings of this study in other climates and conditions.

4. Discussion & Conclusion

This study investigated the effect of building aspect ratio on energy efficiency in the cold and semi-arid climate of Shiraz and proposed its optimal value for designing dormitories in this city. Two different façade designs were considered and the optimal aspect ratio was assessed for each one.

The aspect ratio of 3.3:1 was concluded to be optimal for buildings with small windows on their east and west facades while a less elongated shape with the aspect ratio of 2:1 was shown to perform better for buildings with an equal WWR in all facades. These findings show that the optimal aspect ratio of a building can be different when the WWR of each façade is changed.

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NUMERICAL STUDY ON HEAT TRANSFER PERFORMANCE OF GEOTHERMAL PILE-FOUNDATION HEAT EXCHANGER IN GSHP SYSTEM

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Abstract

Targeting the heat transfer performance of geothermal pile-foundation heat exchanger in ground source heat pump system (GSHP), the physical model of pile-foundation heat exchanger with treble U-shaped form of pipes in surrounding soil were established. CFD software was used to simulate heat transfer processes based on the Finite Element Method for Nanjing area. In cooling mode, heat transfer performance inside and outside of concrete pile was analyzed. Heat transfer flux per meter of the pile-foundation heat exchanger (Q , $W \cdot m^{-1}$) gradually decreases and eventually stabilizes at around $60 W \cdot m^{-1}$ with system running for one month. The higher thermal conductivity of pile-foundation heat exchanger contributes to the higher heat transfer efficiency than soil. Simulation results are approximate to the actual results and can be used as theoretical basis for the design and application of pile-foundation heat exchanger in GSHP system.

Keywords: Ground source heat pump, Pile-foundation heat exchanger, Heat transfer performance, Temperature distribution, Numerical simulation

1. Introduction

With the development of society and the improvement of people's living standards, energy consumption has been growing apace. Nowadays, urban heating has been accounting for the largest proportion of the total building energy consumption in China [1]. For the purpose of saving energy and protecting environment, geothermal energy has attracted increasing interest around the world as one of renewable energies. One of the main technologies of using geothermal energy is ground source heat pump system (GSHP), which has been widely studied and applied since the early 20th century. Compared to traditional air conditioning system, GSHP system has a lot of significant advantages. By extracting heat into and injecting heat from soil, GSHP system can avoid the impact of weather changes on system performance and run stably, which helps to meet the requirements of sustainable development strategy. Without material exchanges with the atmosphere, the pollution of waste heat, vapor and noise can be reduced. Moreover, GSHP system

has a great advantage in investment and maintenance costs [2].

However, the disadvantages of GSHP system cannot be ignored neither. To invest a new system, a large area of land is needed, and drilling holes costs additional investment. Consequently, geothermal pile-foundation heat exchangers in GSHP system with pipes laid inside the foundation and fixed via concrete are applied, which contribute to declining outlays, saving ground area and reducing thermal interference between heat exchanger [3].

For pile-foundation heat exchangers, there are many forms to choose from, of which different forms of pile-foundation heat exchangers have been put into use. The most widely seen and used forms are as: single U-shaped, single W-shaped, double U-shaped and treble U-shaped. The structure of single U-shaped form is simple, but the heat transfer efficiency is reduced. Compared to single U-shaped form, single W-shaped one enhances the heat transfer efficiency, but the gas accumulated in pipes remains another problem. The structures of double U-shaped and treble

U-shaped are more complex, and the latter one has the higher heat transfer efficiency obviously [4].

Currently, analysis method, numerical method and experimental method are the three main methods to study the heat transfer performance of heat exchangers. In comparison, the numerical method are more widely applied resulting from the authenticity of results, cost-saving and time-saving [5].

The heat transfer between the pile-foundation heat exchanger and soil is a complex unsteady process involving a long time scale and a large spatial area. Consequently, the actual heat transfer process cannot be fully realized by simulation. In order to improve the simulation speed and to ensure the reliability of simulation as far as possible, some hypotheses should be put forward before creating the model and simulating: All simulations were carried within designed size, with homogeneous and isotropic properties over the entire space; the thermophysical properties of the subsurface soil are considered uniform and constant; the initial soil temperature is considered uniform; the fluid flow rate and temperature of the same cross section are the same; the impact of groundwater is ignored; the contact resistance between different parts is neglected [6]. Physical parameters of materials used in simulation calculation are shown in Table 1.

In this paper, the treble U-shaped form of geothermal pile-foundation heat exchangers in GSHP system was selected and studied via numerical method. The object with pile-foundation heat exchanger buried in soil was established and meshed via Gambit 2.4.6, the simulation was carried out in Fluent 6.3.26 and heat transfer process was analyzed with Tecplot 2010 and Origin 9.0 based on the Finite Element Method for Nanjing area. In cooling mode, temperature distribution inside the concrete pile with time was researched. Soil temperature distributions at selected points or on created lines and

planes at different position or during different periods were studied. The heat transfer flux per meter of the pile-foundation heat exchanger every second was analyzed.

2. Literature Review

The research and application of ground source heat pump system have been carried out since 1912. Nowadays, the research on heat transfer performance and heat transfer processes via simulation, programming and experiment and related technologies has been relatively mature [7-10]. In 1994, steel pipes in pile foundation were applied to buildings for the first time, and then the concept of pile-foundation heat exchanger was proposed [11]. Compared with horizontal pile-foundation heat exchanger, vertical heat exchangers had better performance in heat transfer efficiency and land consumption [12]. Heat transfer performance of heat exchangers with different configurations including single U-shaped, single W-shaped, double U-shaped, treble U-shaped and spiral forms were studied and analyzed [13-14]. Heat transfer behavior around spiral form pile-foundation heat exchanger was studied detailedly based on numerical and experimental methods [15]. In practical engineering applications, stability and rigidity in pile-foundation heat exchangers were verified to be crucial to the efficient operation of system [16]. Focusing on the effect of groundwater advection on heat transfer performance of heat exchangers, Go et al. designed a novel hybrid algorithm and found that groundwater could enhance the heat transfer through attenuating thermal interference between piles [17].

Meanwhile, mathematical models and analytical solutions are also developed and improved. A large number of achievements in study of the heat transfer performance of pine-foundation heat exchangers with different configurations of pipes have been made [18-21].

Little research on the heat transfer inside of the pile-foundation heat exchanger has

been carried out. It is necessary to explore the characteristics relative to this aspect.

Table. 1. Physical parameters of materials

Materials	Density	Heat Capacity [J·kg ⁻¹ ·K ⁻¹]	Thermal Conductivity [W·m ⁻¹ ·k ⁻¹]
Water	1000	4200	0.6
HDPE	1100	1465	0.42
Concrete	2500	837	2.3
Soil	1847	1200	2.0

Table. 2. Model parameters

Parameter	h ₁ [m]	h ₂ [m]	h ₃ [m]	d ₁ [m]	d ₂ [m]	d ₃ [m]	l ₁ [m]	l ₂ [m]	k [m]
Value	30	28	27	20	0.60	0.02	0.20	0.10	0.003

This paper describes the related studies conducted to this end.

3. Research Methods

Physical model and specifications

The physical model and configuration of the created object with pipes, pile-foundation and soil are shown in the following Figure 1. Treble U-shaped form of geothermal pile-foundation heat exchangers in GSHP system was selected and modeled. The physical model is a vertical cylinder with the diameter of d₁ and depth of h₁. The concrete pile with treble U-shaped pipes was laid inside soil. It was modeled with diameter of d₂ and depth of h₂. Piles are high-density polyethylene (HDPE) with inner diameter of d₃, k thickness and depth of h₃, which were designed and fixed via concrete inside the pile. This construction was designed in Figure 1. The relevant model parameters are given in Table 2.

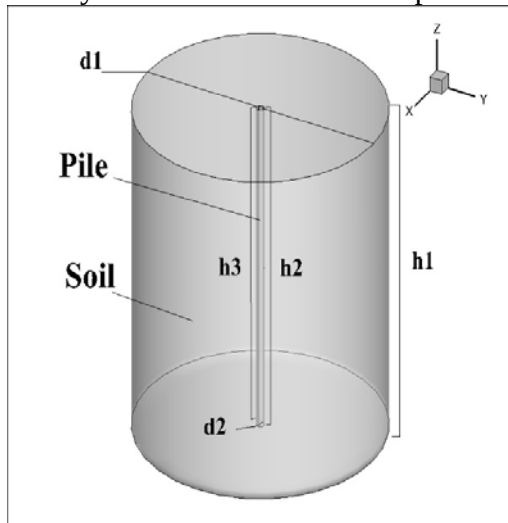
Solution and method

In this study, the object with pile-foundation heat exchanger buried in soil was established and meshed via Gambit 2.4.6, the simulation was carried out in

Fluent 6.3.26 and heat transfer process was analyzed with Tecplot 2010 and Origin 9.0 based on the Finite Element Method for Nanjing area.

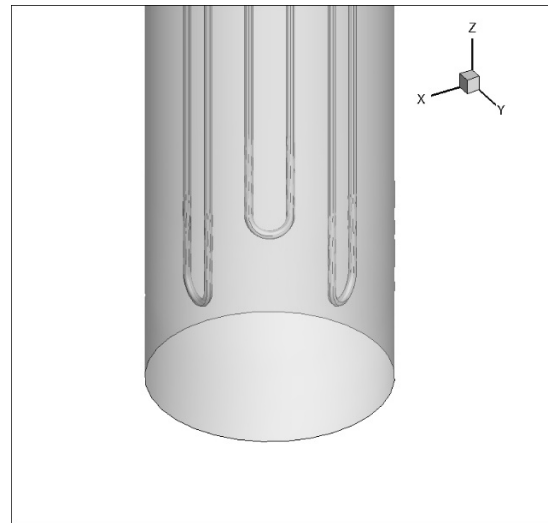
While simulation for heat transfer performance of pile-foundation heat exchanger was carried out, inlet velocity of water was set to be 0.6m/s. Inlet temperature was specified about 308K. The Reynold Number of flow in pipes was more than 7000, which meant water flow was turbulent. Consequently, standard k-ε was opted for simulation as well as energy equation. Turbulence intensity was calculated about 5% based on $0.16 \cdot Re^{-1/8}$ equation. For Nanjing area, the initial temperature of soil and piles was set to be 292K, and the temperature of outer surfaces of the model was treated as constant according to the Dirichlet Problem [22]. SIMPLE algorithm was selected to evaluate the pressure-velocity coupling in the flowing section. Relevant initial and boundary conditions were considered according to above description. Various mesh elements and types were applied in different parts of each configuration. Generally, the more the mesh number is, the more approximate to the actual results the simulation would be, but the slower the simulation process is. For the purpose of improving the

simulation speed and ensuring the reliability of simulation as far as possible,

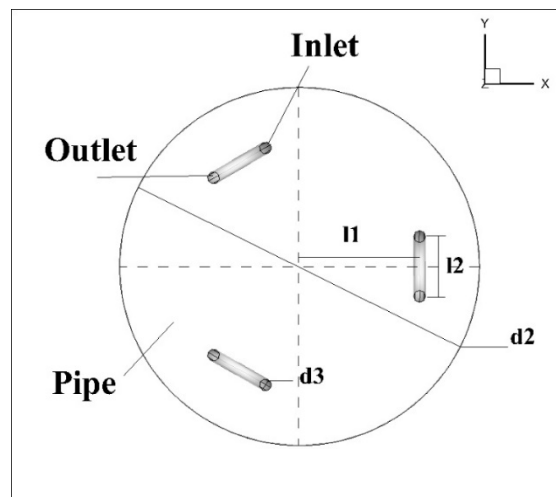


a

the model was meshed with dense grids in



b



c

Figure.1 Physical model and structure of pipes: (a) view of the whole model; (b) bottom of the model; (c) arrangement of pipes

complex structure inside and sparse grids in the other zone. Finally, mesh number for the created object with pipes, pile and soil is 866568. Structures of meshes on the model are depicted in Figure 2.

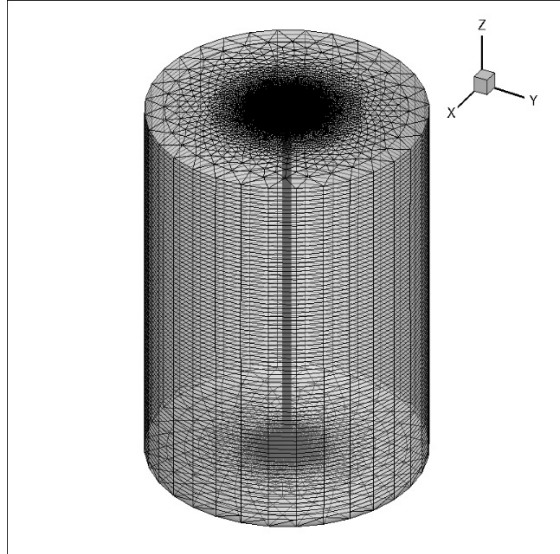
4. Analysis & Results

In order to observe and analyze simulation results, planes M1 ($Z=-15\text{m}$), M2 ($X=0.2\text{m}$), points P1 ($X=0.4\text{m}$, $Y=0\text{m}$, $Z=-15\text{m}$), P2 ($X=1.0\text{m}$, $Y=0\text{m}$, $Z=-15\text{m}$) and P3 ($X=1.6\text{m}$, $Y=0\text{m}$, $Z=-15\text{m}$) in the model were created.

In cooling mode, heat transfer simulation with system running for one month was carried out.

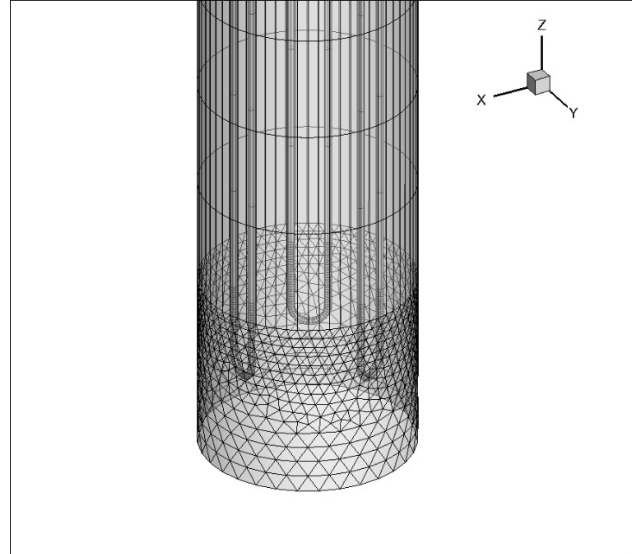
Temperature distributions of concrete pile in the early stages with system running are depicted in the following Figure 3, which reveal the high heat transfer efficiency of pile-foundation heat exchanger due to its higher thermal conductivity than soil. It is apparent that, heat exchange is limited to the area near the pipes in the first hour.

With system running, the thermal area gradually increases, and the temperature of

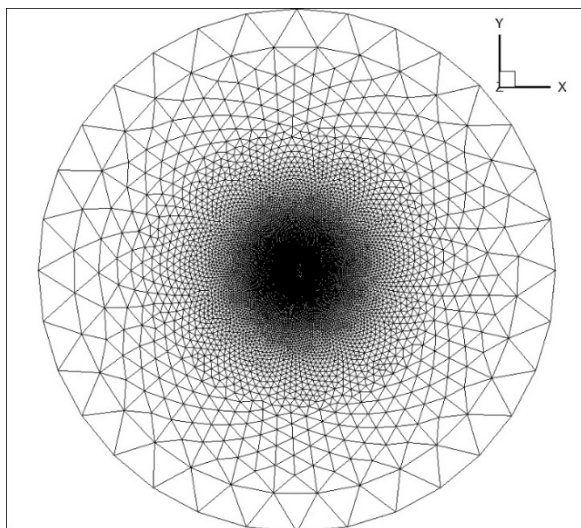


a

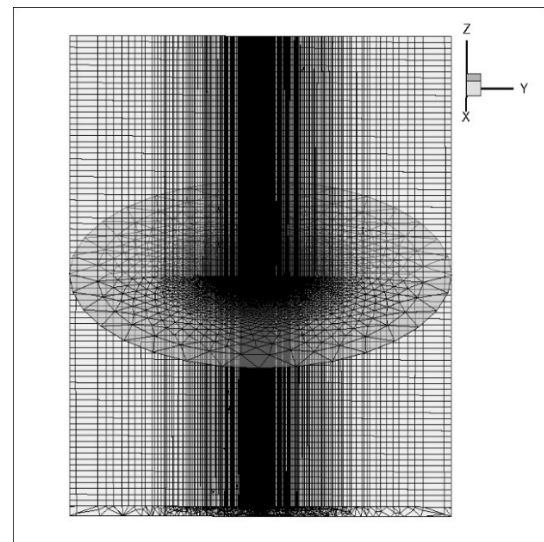
water in outlet pipes is rising. After 4 hours, the central area of concrete pile



b



c

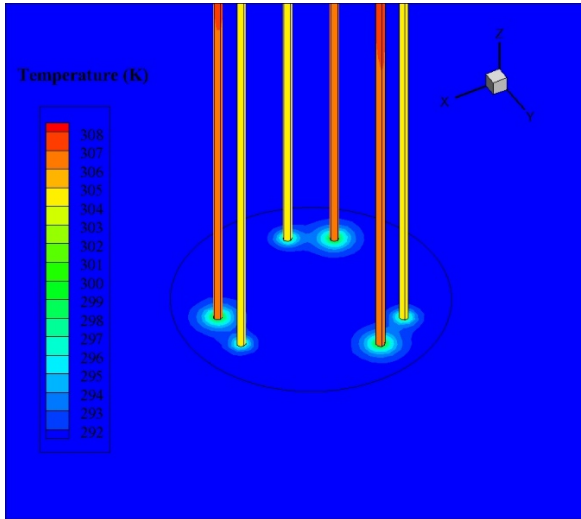


d

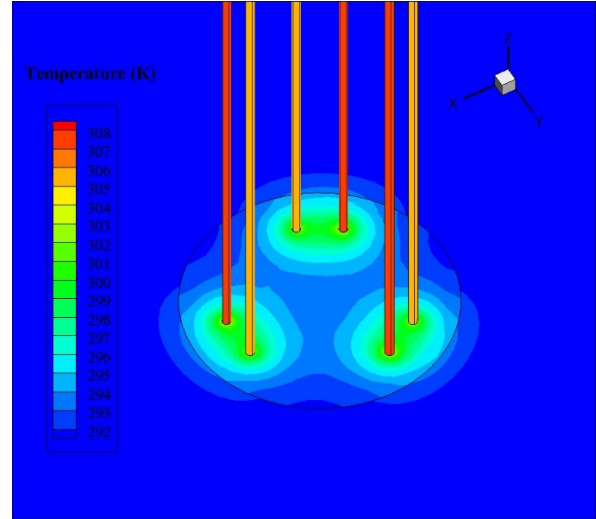
Figure.2 Structures of meshes on the model: (a) meshed on the whole model; (b) meshed on bottom of the model; (c) top view of meshed; (d) meshed on selected faces

begins to be affected by the thermal effect, which will result in the enhancement of thermal interference between different pipes. After 7 hours, concrete pile is completely affected, and heat is injected into soil through the pile-foundation heat exchanger in all directions. After the system running for 12 hours, the heat exchanger has been in a state with the

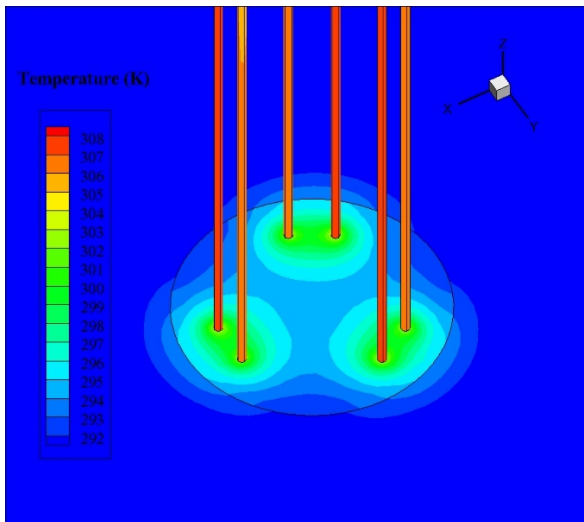
average temperature of 297K, resulting in the high heat exchange efficiency between the pile-foundation heat exchanger and soil. It can also be concluded that, the upward trend of increasing of thermal area gradually slows with time on account of temperature gradients in concrete pile and soil.



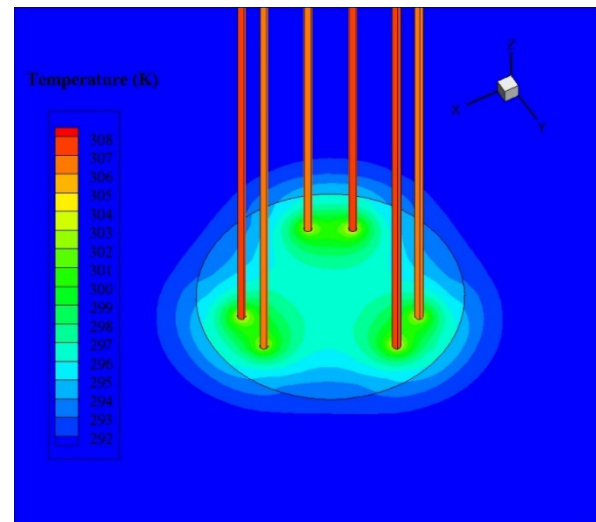
a



b



c



d

Figure.3. Temperature distributions of concrete pile on M1 with system running: (a) after 1 hour; (b) after 4 hour; (c) after 7 hour; (d) after 12 hour

Figure 4 shows the final temperature distributions of the pile-foundation heat exchanger after the system running for one month in cooling mode. The temperature distributions on line L in created model and in concrete pile with system running are depicted in the following Figure 5 and Figure 6. The position of concrete pile is between -0.3m and 0.3m. It can be concluded from the two figures that, the temperature in concrete pile is obviously higher than that in soil. Moreover, the

closer positions and pile surface are, the higher temperature is within thermal area in soil. Homoplastically, the closer positions and pipe surfaces are, the higher temperature is in pile area. In addition, the temperature in concrete pile and soil increases with system running, but the upward trend is reduced. After 10 days consecutively running, the temperature in the pile tends to be stable while the temperature in soil that away from pile

surface in thermal area remains slowly increasing.

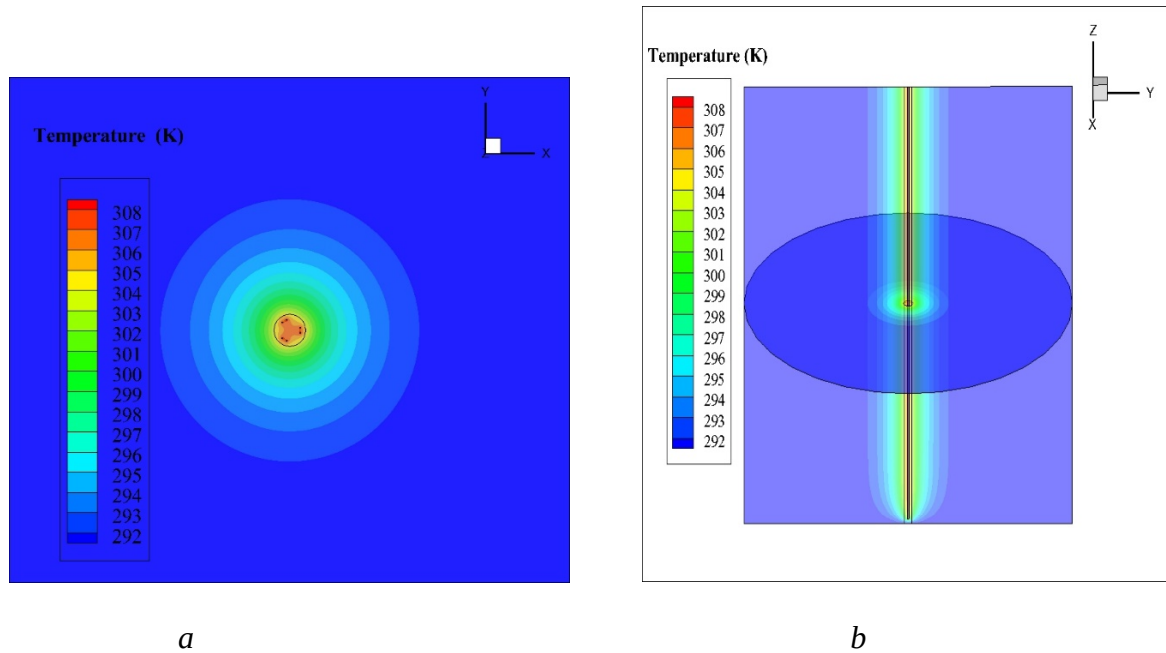


Figure.4. Temperature distributions after system running for one month: (a) on M1; (b) on M1 and M2

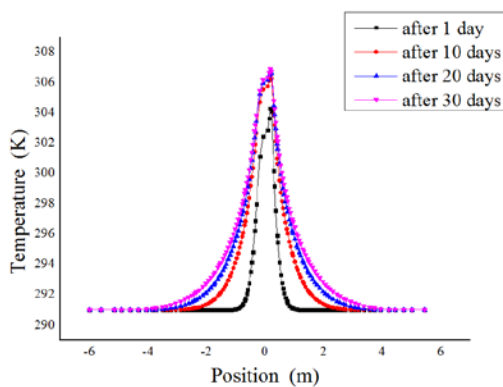


Figure.5. Temperature distributions on line L in created model

Figure 7 below depicts soil temperature distributions at created points P_1 , P_2 , and P_3 with system running. It can be concluded from the figure that, soil temperature at different points within thermal effect area gradually increases with time, but the upward trend is slowing down. The final soil temperature at different points tends to be stable. Nevertheless, the closer points and pile

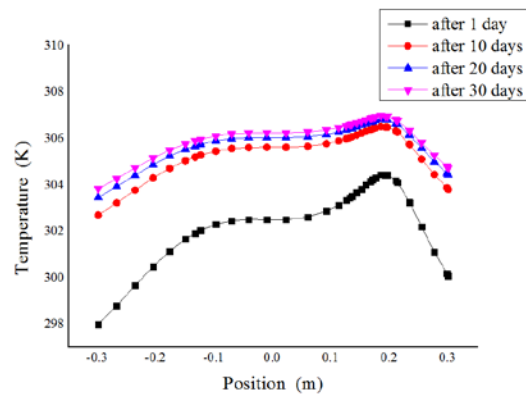


Figure.6. Temperature distributions on line L in concrete pile

surfaces are, the earlier soil temperature rises and the higher the final stable temperature is on account of soil temperature gradients.

Heat transfer flux per meter of the pile-foundation heat exchanger (Q , $W \cdot m^{-1}$) is depicted in Figure 8. It is apparent that the maximum value of heat transfer rate is about $118 W \cdot m^{-1}$ at the first day. However, it is decreasing with system running and

eventually stabilizes at around $60 \text{ W}\cdot\text{m}^{-1}$. In detail, the attenuation rate gradually

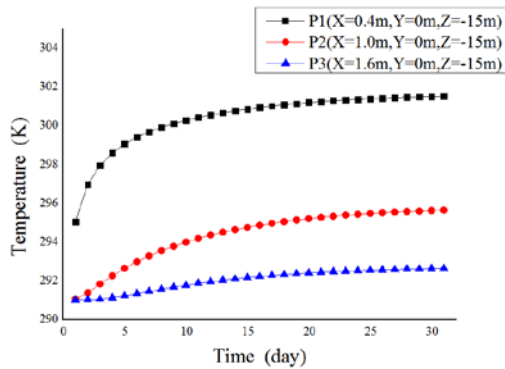


Figure. 7. Soil temperature distributions at selected points.

it decreases to about $1.53 \text{ W}\cdot\text{m}^{-1}\cdot\text{day}^{-1}$. And after 20 days, the attenuation rate can be bypassed.

In practical applications, the GSHP system will not be running without interruption. In most instances, the system will be operated under shut-down condition at night time. The temperature of soil and concrete pile will be recovering, which will be conducive to enhancing heat transfer efficiency in the next operation [23].

5. Discussion & Conclusion

In this paper, the treble U-shaped form of geothermal pile-foundation heat exchanger in GSHP system was selected and studied via numerical method. Simulation and analysis were carried by CFD software based on the Finite Element Method for Nanjing area. In cooling mode, heat transfer performance of the pile-foundation heat exchanger and temperature distributions in soil and concrete pile were studied. The results of the study are summarized as follows:

- Regarding the illustrations in Figure 3, Figure 5 and Figure 6, the higher thermal conductivity of pile-foundation heat exchanger contributes to the higher heat transfer efficiency than soil. The temperature in concrete pile is obviously higher than that in soil. After 10 days consecutively

goes down. In the first 5 days, it is around $6.95 \text{ W}\cdot\text{m}^{-1}\cdot\text{day}^{-1}$. In the next 15 days,

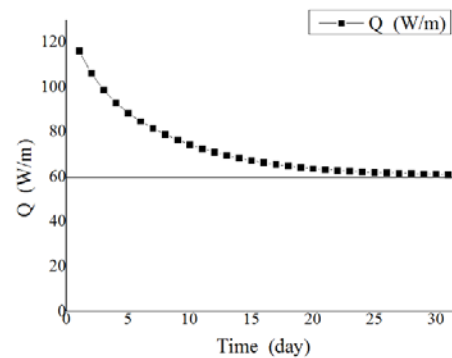


Figure. 8. Heat transfer flux per meter of the pile-foundation heat exchanger.

running, the temperature in the pile tends to be stable while the temperature in soil that away from pile surface in thermal area remains slowly increasing.

- On the basis of results in Figure 7, it can be concluded that soil temperature at different positions within thermal effect area gradually increases with time. The final soil temperature at different points tends to be stable. Nevertheless, the closer points and pile surfaces are, the earlier soil temperature rises and the higher the final stable temperature is on account of soil temperature gradients.
- Figure 8 reveals that heat transfer flux per meter of the pile–foundation heat exchanger gradually decreases, but the attenuation rate gradually goes down with system running. Eventually, heat transfer flux stabilizes at around $60 \text{ W}\cdot\text{m}^{-1}$ after system running for 20 days.

The study results in this paper are approximate to the actual results, and can be used as theoretical basis for the design and application of pile-foundation heat exchanger in GSHP system.

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SWEET SORGHUM BAGASSE BIOETHANOL (Sweet Sorganol) PRODUCTION BY SIMULTANEOUS SACCHARIFICATION AND FERMENTATION BY TRICHODERMA REESEI AND SACCHAROMYCES CEREVISIAE

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Abstract

Bioethanol production from renewable resources has received great attention because of the increasing petroleum shortage. Demands of renewable energy from agricultural field residues increase because high population growth nowadays. Sweet sorghum bagasse (SSB) is one of the main agricultural residues in Egypt. So this study was performed on sweet sorghum bagasse as a resource for production of bioethanol. Pretreatment method for sweet sorghum bagasse by sodium hydroxide (2%) hydrothermal and hydrogen peroxide (7,44%) in 6 hours with 120 rpm. Pretreated sweet sorghum bagasse was further enzymatically treated throughout simultaneous saccharification and fermentation (SSF). In previous studies, the hydrolysis and fermentation processes were performed separately using a separated hydrolysis and fermentation (SHF) technique. This study processes via a SSF technique which produced higher substrate efficiency, cell yield, and product yield compared to the SHF process. The characterization process showed that pretreated SSB contained higher cellulose than untreated cellulose. Sugar from the cellulose was produced by batch system cultivation for 84 hours using *Trichoderma reesei*. The highest sugar production was achieved during the 36 hours. The production of bioethanol by SSF using *Trichoderma reesei* and *Saccharomyces cerevisiae* for 60 hours was 4,08 g/L of bioethanol, with a yield of bioethanol per substrate use (Y_p/s) of 0,30 g ethanol/g substrate and a substrate conversion efficiency of 89,8%.

Keywords: Bioethanol, *Trichoderma reesei*, *Saccharomyces cerevisiae*, Simultaneous saccharification and fermentation, sweet sorghum bagasse.

I. Introduction

Biofuel, as an alternative renewable energy source, has been taken attention worldwide due to the negative effect of fossil fuel reserves and the rapid accumulation of atmospheric greenhouse gases.

The sweet sorghum (*Sorghum bicolor* (L.) Moench) is one of the potential biomass resources for fuel ethanol production, because of its adaptability to any conditions and it has high fermentable sugar content in. Furthermore it has high juice concentration and high yield of green biomass.

The juice can be readily fermented to alcohol, known first generation bioethanol (G1). The residue after extracting the juice, it called bagasse, can be hydrolyzed into sugar and further can be fermented to ethanol [1], and called as second generation bioethanol (G2) [2]. Nowadays, the production of the second generation cellulosic ethanol from those abundant and

inexpensive nonfood lignocellulosic biomass materials, such as agricultural residues and herbaceous energy crops, has become the focus of research because of its potential advantages [3].

After extracting process of the juice, the bagasse from the sweet sorghum stalks is a lignocellulosic material, which formed by celluloses, hemicelluloses and lignin. During simultaneous saccharification and fermentation (SSF), the sugars detached from the lignocellulosic biomass during hydrolysis by biocatalyst such as cellulolytic enzymes from fungi. During the SSF process, the sugar content, dry cell weight (dcw) of biomass, and the ethanol yield are measured for data analytical requirement.

The aim of the study to gain the accessibility and cellulose content of the substrate, a pretreatment method such as NaOH hydrothermal and H_2O_2 was

investigated in this paper. Performance improve hopefully can be increased in hydrolysis process. Taking SSB pretreated with simultaneous saccharification and fermentation (SSF) to produce Sweet Sorghum Bagasse Bioethanol (Sweet Sorganol) was researched in this study.

II. Literature review

Sweet sorghum bagasse, like other lignocellulosic materials, contains of considerable amount of carbohydrate polymers (cellulose and hemicellulose) and lignin. The carbohydrates can be hydrolyzed to fermentable sugars by acids or enzymes and then fermented to ethanol. Cellulose and hemicellulose can be converted to bioethanol involves enzymatic hydrolysis of the biopolymer soluble oligosaccharides followed by their fermentation process to ethanol. by the yeast. A further advantage of SSF over the Separate Hydrolysis and Fermentation (SHF) is the cost reduction resulting from use of only bioreactor.

Simultaneous saccharification and fermentation (SSF) integrates enzymatic hydrolysis and microbial fermentation into one step: the sugars produced from enzymatic hydrolysis are shortly consumed by the fermentative microorganism for ethanol production in this case that *Saccharomyces cerevisiae*.

Trichoderma reesei is moldy filament that well known as cellulolytic organisms and produce cellulolytic enzymes, including enzymes selobiohidrolase, endoglucanase and β -glucosidase [4]. The advantages of *Trichoderma reesei* besides producing complete cellulolytic enzymes, as well produces xyloglucanolytic enzyme [5]. The presence of this enzyme will make it easier cellulolytic enzyme in breaking cellulose.

Saccharomyces cerevisiae is the most prevalent microorganism for ethanol production from sugars (hexoses). However, comprehensive ranges of sugars, e.g., pentoses, are available in lignocellulosic substrates, which cannot assimilate to ethanol by *S. cerevisiae* some

advantages compared to other ethanol-producing microorganisms.

III. Research Methods

3.1 Preparation of Sweet Sorghum Bagasse as Media

Sweet sorghum bagasse (SSB) was obtained from Samirana Surya Semesta G19 and G20 varieties. SSB was dried in the air and then ground to pass through sieve with 40-60 meshes. After that it was washed using boiling water three times to substantially remove the major soluble sugars, present in the liquid phase stalk. The ratio of bagasse to water was 1:1 on a weight basis. At last, it was dried at 60°C and stored in plastic bag at room temperature to avoid possible interference in the evaluation of the enzymatic hydrolysis of the cellulose [6].

Ten grams dry sweet sorghum bagasse was slurried with 100 mL 2% (w/v) sodium hydroxide solution for 5 min in a 500 mL flask with a silicone stopple, and then autoclaved at 121°C for 60 min. The 7,44% (w/v) hydrogen peroxide was mixed into the pretreated slurry at 40°C and agitation for 120 rpm [7,8]. The residues were centrifuged and washed with distilled water until neutral pH was achieved and dried at 60°C.

3.2 Preparation Cultures of the *Trichoderma reesei* and *Sacharomyces cerevisiae*

The isolated cultures were used in this research (*Saccharomyces cerevisiae* (IPBCC.Y.05.544) and *Trichoderma reesei* were obtained from the Institut Pertanian Bogor Culture Collection (IPB CC) at Bogor Agricultural University. Isolates of *Trichoderma reesei* was refreshed on a Potato Dextrose Agar (PDA) medium (Bratachem, Indonesia). The culture was ncubated at 25°C, for 7 days before inoculation. Isolates of *Saccharomyces cerevisiae* were refreshed on a PDA medium and incubated for 3 days. Isolates were grown on 50 ml of Yeast Malt Pepton Glucose (YMPG) propagation medium consisting of 5 g/L yeast, 5 g/L malt,

glucose 10 g/L, and 5 g/L pepton in 200 ml erlenmeyer flask. Incubation was performed in a 125 rpm shaker at room temperature ($\pm 30^\circ\text{C}$) for 24 hours before inoculation. Isolates *Trichoderma reesei* were grown at Nutritional medium for producing cellulase enzymes. The medium contains 2% $(\text{NH}_4)_2\text{SO}_4$, 2% KH_2PO_4 , 3 ml Urea 10%, 3% CaCl_2 in 1 L distilled water. To produce cellulase enzyme was added 1% Pretreated Sweet Sorghum Bagasse and 1% Polypeptide. This culture was propagated in 8 days and CMC-ase and FP-ase was measured.

3.3 Cultivation of *Trichoderma reesei*

For determining the microbial growth curve, so it was cultivated the *Trichoderma reesei*. Biomass yield, residual cellulose, total sugar and also Total Plate Count (TPC) from the cultivation process were used to identify the curve of pattern growth and the requires time for highest sugar production reached.

Sweet sorghum bagasse with a concentration of 10% (w/v) was dissolved in 1 liters of distilled water and then 10% (v/v) inoculum was added to the substrate. The cultivation process was carried out at room temperature by using 160 rpm agitation and 2 vvm aeration. A sample was taken and analyzed every 12 hours for 84 hours.

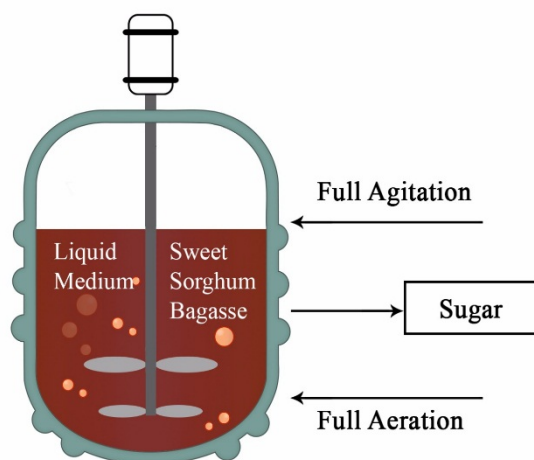


Figure 1. Cultivation of *Trichoderma reesei*
The cultivation of *Trichoderma reesei* is shown at figure 1. It shows that full

agitation and full aeration. Liquid medium is prepared for this cultivation. So, the sugar production is expected in this process using *Trichoderma reesei* in sweet sorghum bagasse medium.

3.4 Simultaneous Saccharification and Fermentation

Sweet sorghum bagasse with a concentration of 10% (w/v) was dissolved in 1.2 liters of liquid media. Then, 10% (v/v) inoculum was added to the substrate. *Trichoderma reesei* and *Saccharomyces cerevisiae* were inoculated at the beginning of cultivation. Aeration was set at 1 vvm, while agitation at a speed of 160 rpm at room temperature. SSF was carried out for 72 hours for bioethanol production.

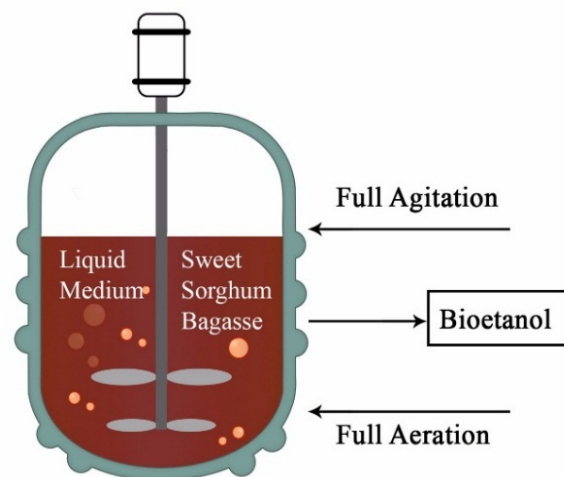


Figure 2. Simultaneous Saccharification and Fermentation of SSB using *Trichoderma reesei* and *Saccharomyces cerevisiae*

Simultaneous saccharification and fermentation process condition is shown at figure 2. It shows the process ocured at full agitation and aeration condition, cultivation at aerobic conditions. SSF was kept produce bioethanol as expected using *Trichoderma reesei* and *Saccharomyces cerevisiae*.

3.5 Measurement Parameters (Kinetic of cultivation)

Samples from bioreactor were taken and analyzed every 12 hours for 72 hours. And the parameters measured and calculated from the samples as performance indicators of the cultivation process such as:

- Total biomass produced (X)
- Level of bioethanol produced (P)
- Residual of cellulose substrate in the media (S)
- Maximum specific growth rate (μ_{max}): slope of curve was obtained by plotting $\ln X$ against cultivation time (h) [10].
- Mathematical Model:

$$\frac{dx}{dt} = \mu x$$

Yield of biomass and bioethanol per substrate used:

$$Y_{x/s} = \frac{X-X_0}{S_0-S} \quad Y_{p/s} = \frac{P-P_0}{S_0-S} \quad (1)$$

Yield of product formation of biomass:

$$Y_{p/x} = \frac{P_t - P_0}{X - X_0} \quad (2)$$

Substrate efficiency (Se):

$$\left(\frac{\Delta S}{S_0}\right) = \frac{S_0 - S}{S_0} \times 100\% \quad (3)$$

IV. Results and Discussion

4.1 Characterization of Sweet Sorghum Bagasse



Figure 3. Pretreated sweet sorghum bagasse using NaOH hydrothermal with H_2O_2

To figure 3 as shown that sweet sorghum bagasse has been pretreated using NaOH hydrothermal with H_2O_2 . Theoretically, high ethanol production depends on a high cellulose concentration. Increases in cellulose content are best influenced by removal of non-cellulose components by pretreatment. The chemical compositions of sweet sorghum bagasse (SSB) between untreated and treated were shown in Fig. 4. The percent hemicellulose content of native SSB is 31,80%, and decreased to 19,35%. Not only that, percent lignin

content decreased from 18,15% to 4,35% after NaOH Hydrothermal and H_2O_2 pretreatment. in contrast, after pretreatment the percent of cellulose content increased from 38,33% menjadi 56,93%.

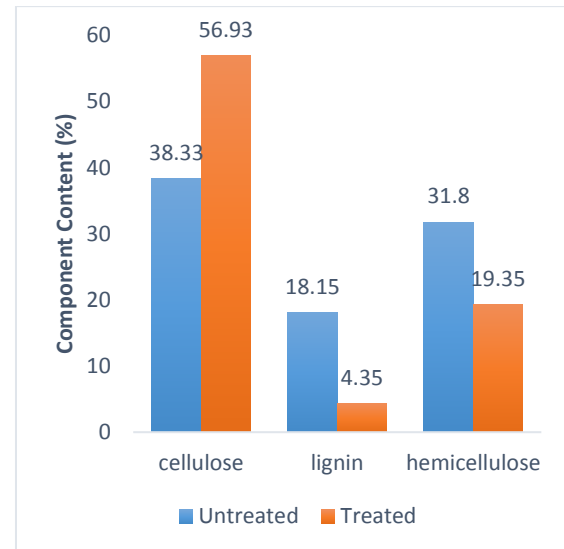


Figure 4. chemical components of untreated and treated of Sweet Sorghum Bagasse

Lignin has been implicated as a competitive cellulase adsorbent that can reduce the amount of cellulase available to catalyze cellulose hydrolysis. Therefore, excision of lignin has a significant effect on enzymatic hydrolysis. NaOH with hydrothermal process as an effective agent for lignocellulose pretreatment, and especially for increasing cellulose content.

In figure 4 shows that treated cellulose concentration has increased than untreated cellulose. Lignin content will be mostly degraded and cellulose with hemicellulose will be retained at perfect pretreatment. But for the best pretreatment method will occur usually depend mainly in the type of lignocelluloses. For enzymatic hydrolysis process has been facilitated the increase of cellulose and the decrease of lignin contents. Compared to Dahnum *et al.* (2015) which did pretreatment using NaOH 10% for EFB resulted only 38% lignin was removed, the results for this research clearly showed higher lignin removal.

4.2 Cultivation of *Trichoderma reesei*

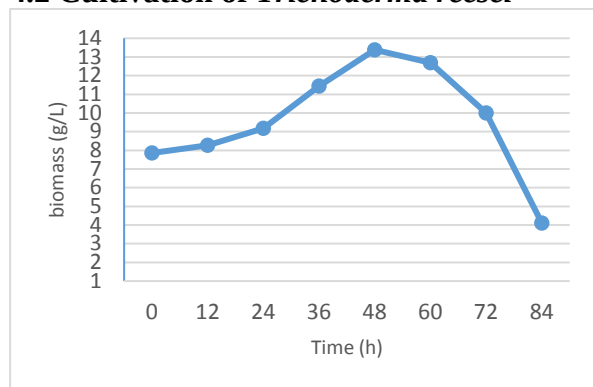


Figure 5. Growth pattern of *Trichoderma reesei* during cultivation

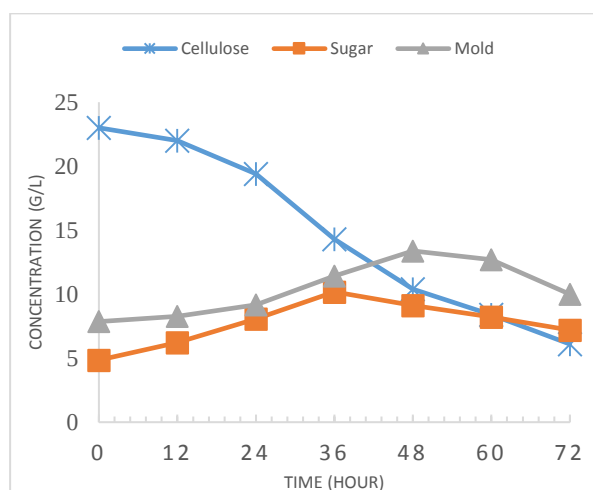


Figure 6. Cultivation results by the batch system of Sweet Sorghum Bagasse using *Trichoderma reesei*

Figure 6 shows the growth of *Trichoderma reesei* based on dry weight biomass. The early stage of *Trichoderma reesei* began at the 0 hour when the new culture was inoculated into the cultivation media on the process. *Trichoderma reesei* got into the adaptation phase after inoculation. The microbial growth performance was low because of the new media condition during the adaptation phase. Furthermore, after the adaptation phase there is lag phase of microbial growth curve the exponential phase come about 24th and 48th hours. During this exponential phase, the microbes grew at their maximum growth rate. During hours 0-12 for the adaptation phase, sugar production using *Trichoderma reesei* increased slowly. Throughout this adaptation phase, the endo- β -1,4-glucanase and exo- β -1,4-high glucanase enzymes

formed as biocatalyst for cellulose hydrolysis [11]. Sugar production rise up summarily along with the growth of *Trichoderma reesei* from the 12th hour until the 36th hour.

The endo- β -1,4-glucanase and exo- β -1,4-high glucanase enzymes were produced by *Trichoderma reesei* and break down the polymer chains of cellulose into simple monomer units. Cellulose concentration exssicate along with mold growth as sugar production increased. *Trichoderma reesei* growth reached the end of exponential phase at the 48th hour.

During the cultivation process, the content of residual cellulose decrease due to the *Trichoderma reesei* has metabolic activity that produces hydrolisis enzymes such as endo- β -1,4-glucanase and exo- β -1,4-high glucanase [12,13]. According to the performance of the process, cellulose of sweet sorghum bagasse an be used as a carbon source for the growth of *Trichoderma reesei* to produce sugar. Furthermore, *Trichoderma reesei* can also convert any other lignocellulosic material to produce sugar.

4.3 Simultaneous Saccharification and Fermentation (SSF)

SSF was conducted using NaOH hydrothermal and H₂O₂ Pretreated. To evaluate the ability to produce biethanol from these compounds by fermentation with *Trichoderma reesei* and *Saccharomyces cerevisiae*. Bioethanol was produced from sweet sorghum bagasse via a SSF process that used *Trichoderma reesei* and *Saccharomyces cerevisiae*. The *Trichoderma reesei* functioned as a saccharification agent to convert cellulose into sugar; then this sugar converted through fermentation into bioethanol by the *Saccharomyces cerevisiae*.

In accordance with [14] that simultaneous saccharification and fermentation is a method can be increased enzymes performance due to decrease of product's inhibition. Bioethanol production from affluent raw materials can be acquired

through the cultivation time, with lower cost and shorter processing times that increase productivity.

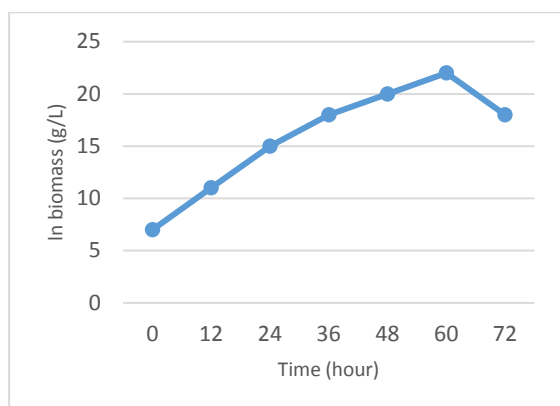


Figure 7. Growth of Microbial biomass during SSF

According to figure 7 which the dry cell weight of two microorganisms of *Trichoderma reesei* and *Saccharomyces cerevisiae*. For this SSF process, aeration is needed for a group of molds and yeasts to produce cells. The major factor which has a substantial impact on microorganism's survival is the presence of oxygen in aerobic cultivation condition. The aeration process cannot be detached from the agitation process. The air flow from the compressor entered the medium to sustain aeration and agitation.

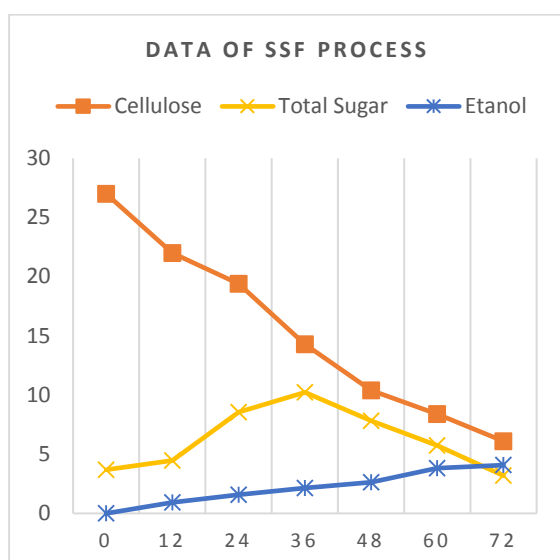


Figure 8. Trendline of analyzed component of Simultaneous Saccharification and Fermentation Process

The maximum bioethanol concentration, which was obtained during the 72nd hour, was 4,08 (g/L). *Saccharomyces cerevisiae* converted sugar into bioethanol by fermentation in addition to respiration. After the 36th hour, the sugar production met decline phase while the yeast growth started to increase. This condition shows that the sugar substrate has been consumed by the mold and yeast for cell production and by the yeast for bioethanol production.

Accordingly, sweet sorghum bagasse has been considered as a particularly important energy plant for the production of bioethanol fuel [15]. As a lignocellulosic biomass from agricultural residues, it is potentially available at \$60 ton for conversion into >20 billion gallons of cellulosic biofuels [16]. Lignocellulosic biomass is fundamentally composed of cellulose (35-50 wt%, dry basis), hemicellulose (15-30%), pectin (2-5%), and lignin (12-35%). Cellulose and hemicellulose which make more than 50% of total mass can be potentially converted to sugars for their conversion to bioethanol [17].



Figure 9. TPC SSF Process

Total plate count in SSF process at 60 h is shown in Figure 9. It explains the yeast grew dominantly for producing bioethanol.

4.5 The kinetics of cultivation in SSF

SSF process was duplicated and has been cultivation kinetics calculated, its used for measuring specific growth rate (μ). If maximum specific growth rates was relatively low, probably because of culturing microbes in a low concentration of medium.

The results was shown at table 1, yield of substrate used into biomass ($Y_{p/s}$) for SSF process was 0,30 g product/g substrate. While the efficiency of substrate by 89,8%. It shows that sweet sorghum bagasse used as a medium for bioethanol production by SSF technique using the two microbes since the effeciency is quite high. And the SSF technique as additional advantages because polysaccharides which have been converted into monosaccharides are not returned into polysaccharides again, but can directly fermented into ethanol.

Time	Y p/s (g/g)	Y x/s (g/g)	Se (%)
12	0,19 $\pm$ 0,02	0,01 $\pm$ 0,01	89
24	0,27 $\pm$ 0,01	0,03 $\pm$ 0,00	90
36	0,32 $\pm$ 0,00	0,04 $\pm$ 0,02	91
48	0,39 $\pm$ 0,02	0,03 $\pm$ 0,01	91
60	0,31 $\pm$ 0,01	0,03 $\pm$ 0,00	90
72	0,30 $\pm$ 0,01	0,02 $\pm$ 0,01	88
ave	0,30	0,27	89,8%

Table 1. Kinetic Parameters

V. Conclusion

Sweet sorghum bagasse (SSB) clearly show as the potential materials for bioethanol production. SSB has potential cellulose content of more than 56%. *Trichoderma reesei* is effective as saccharification agent and catalyst for producing sugar

A number conclusion can be made from this study, the combination of NaOH solution autoclaving and H₂O₂ immersing pretreatment was effective in preparing sweet sorghum bagasse for ethanol production. The processes of bioethanol production from sweet sorghum bagasse was previously carried out in Separate Hydrolysis and Fermentation (SHF). In response to SSF method was considered as

a better process than SHF due to fastly ethanol production and the highest concentration of produced ethanol. Beside that, the SSF process reduced the time process than SHF process. The implementation of SSF process using *Trichoderma reesei* as the saccharification catalyst and *Saccharomyces ceevisiae* as the fermentation catalyst simultaneously produced 4,08 g/L bioethanol.

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OBSTACLES OF APPLICATION OF GREEN PYRAMID RATING SYSTEM (GPRS) ON LOCAL PROJECTS IN EGYPT

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Abstract

Green architecture practices in Egypt are very limited and their progress does not go with constant steps as required for mitigating local environmental problems. This paper is a step towards determining the overall image of the Egyptian green architecture practices with a special focus on obstacle of its applications. This is met via evaluating some local environmentally oriented projects in terms of applying green architecture principles through reviewing fulfilling of Green Pyramid Rating System's (GPRS) credits for each case study. As the credits describe measures of applying green architecture principles, achieving these credits could be utilized as relative indicator of implementing these measures, and accordingly determining potentials and obstacles of applying these principles in the Egyptian context. It should be noted that the evaluation results exclusively describe the selected five case studies, yet they indicate and assert what can be described as obstacles and potentials for applying green architecture principles in the local context.

Keywords: Green Pyramid Rating System, Green Architecture, LEED, Obstacles, Potentials, Egyptian Context

1. Introduction

After the industrial revolution most of the world countries turned to use non-renewable energy resources until the start of energy crisis in 1970's. In 1980's world turned to take a responsible approach towards nature which helped in the emergence of a new green approach that represents a model shift in the way we understand, design and construction today. Green buildings aim to fundamentally change the built environment by creating energy efficient, healthy and productive buildings that mitigate the significant impacts of the built environment.

Several green building rating systems have been developed to promote green building practices such as Leadership in Energy and Environmental Design (LEED) in US, Building Research Establishment Environmental Assessment Method (BREEAM) in UK, and many others around the world.

On the local level, current green architecture practices in Egypt are still at an experimental phase and they need to be promoted to go with constant steps to mitigate environmental impacts.

In 2011, Egyptian Green Building Council (EGBC) has developed GPRS to evaluate local green building practices and encourage the building industry to adopt green architecture principles.

This research aims to determine obstacles of application of GPRS in Egypt, hence suggesting recommendations that can pave a better way to increase the potentials on account of obstacles towards applying green architecture principles in Egypt in the near future.

The research exclusively studies the obstacles of applying green architecture principle locally in Egypt, via examining the practices context.

2. Research Methods

This paper addresses the possibility of applying the principles of green architecture in Egypt through a review of selected of Egyptian environmental-oriented projects and applying GPRS on them to determine the obtained credits and the non-obtained credits and the reasons for not being achieved which could help in concluding obstacles which face the design teams seeking to develop green projects.

Additional data about the selected environmentally oriented projects is obtained through an open-ended interview with the designers of these projects. This interview mainly consists of two parts:

Part one is a set of questions about orienting the project towards green architecture, while part two is an application of GPRS checklist on the project and determining the reasons of failure to obtain some credits.

The interview is answered for every project case by case, and then a summary of interview answers and GPRS application results is presented.

The main criteria of selecting case studies projects is to choose projects that consider many of green architecture principles, or in other words projects that seek certification from any green building rating systems.

3. Selected Case Studies

As LEED certified and GPRS registered projects in Egypt fulfill these criteria, the selected projects for case studies are as follows:

3.1 Info Fort Warehouse Project



Figure 1: Info Fort Warehouse

- Project Type: Warehouse (Multiple building project)
- Location: 6th of October city, Giza, Egypt
- Date of Completion: 2013
- LEED Certification: LEED Silver
- Owner: Info Fort Company
- Designer: MA Consultants
- Total Area: 23,000 m².^[1]

3.2 L'Oreal Pyramids Cosmetics Factory

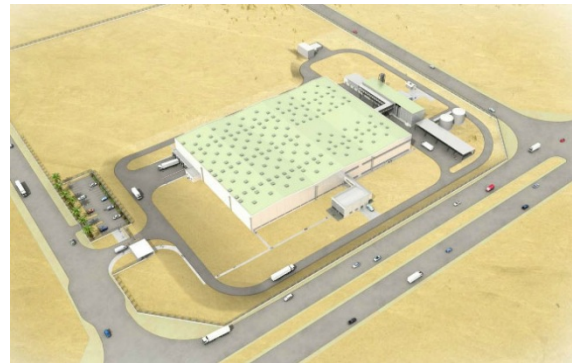


Figure 2: L'Oreal Pyramids Cosmetics Factory

- Project Type: Factory
- Location: Pyramids Industrial Parks, 10th of Ramadan City, Cairo
- LEED Certification: LEED Silver
- Date of Completion: 2013
- Owner: L'Oreal Cosmetics
- Designer: SNC Lavalin
- Total Area: 103,814 m², Footprint Area: 15,366 m².^[2]

3.3 Credit Agricole Egypt New Head Office



Figure 3: Credit Agricole Egypt New Head Office

- Project Type: Head Office Complex
- Location: New Cairo
- LEED Certification: LEED Platinum
- Date of Completion: Unknown
- Owner: Credit Agricole Egypt
- Designer: Engineering Consultants Group (ECG)
- Total Area: 51,334 m², Footprint Area: 26,667 m², Total Built Up Area: 42,000m².^[3]

3.4 Maadi Call Center MB4 Building



Figure 4: Maadi Call Center MB4 Building

- Project Type: Call Center Activities
- Location: Maadi, Autostrad Road
- LEED Certification: LEED Silver
- Date of Completion: Unknown
- Owner: Ministry of Communications
- Designer: Engineering Consultant Group (ECG)
- Total Area: Footprint: 4,200 m², Total Built Up Area: 25,200m²^[4]

3.5 Florenta Residential Compound



Figure 5: Florenta Residential Compound

- Project Type: Residential compound
- Location: El Maadi Ring Road, New Cairo, Cairo
- LEED Certification: N/A (GPRS Registered Project)
- Date of Completion: 2015
- Owner: Abraj Misr Company
- Designer: K&A Designs
- Total Area: 21,000 m²^[5]

4. Analysis & Results

GPRS was applied on the five case studies in the two parts:

In part one, designer 'opinion about LEED and GPRS application was defined through the following questions:

- Q1.What are the reasons of adopting green architecture principles in the project?
- Q2.What are the main obstacles that prevented from achieving some LEED credits?
- Q3.What are the main challenges in coordinating between different disciplines in the LEED registered/certified project?
- Q4.Did the designer know about developing an Egyptian green building rating system (GPRS) to be compatible with the Egyptian context?
- Q5.What are the reason for applying to obtain LEED certificate rather than GPRS certificate?
- Q6.Is the designer intending to apply for obtaining GPRS certificate in the future projects?

Answers of these questions in the five case studies are summarized in table 1.

Table 1: Answers of Interview Questions in the Five Case Studies

Qs	Case Studies				
	1	2	3	4	5
Q1	Owner	Owner	Owner	Owner	Owner
Q2	Lack of awareness	Lack of awareness & Initial cost	Initial cost	Initial cost	Initial cost
Q3	Lack of specialists	Lack of specialists & knowhow and qualified contractors	Lack of knowhow and qualified contractors	Lack of knowhow and qualified contractors	Lack of knowhow and qualified contractors
Q4	Yes	No	Only if involved in the academic career	Only if involved in the academic career	Yes
Q5	Marketability and owner requirements	Marketability and owner requirements	Marketability	Marketability	N/A
Q6	Only if owner requires	Only if owner requires	Only if owner requires	Only if owner requires	Only if owner requires

The table shows that:

- Designers orient their projects towards environmental architecture according to the owner requirements in all case studies.
- The main obstacle that prevented from achieving some credits is the initial cost in most of the cases.

The main challenges in coordinating between different disciplines in the LEED registered/certified project are lack of specialists, knowhow and qualified contractors.

- Knowledge about developing an Egyptian green building rating system

(GPRS) is not wide, especially when the designer is not involved in the academic career.

- Designers seek LEED certificate instead of GPRS certificate to increase the project marketability in most of the cases.
- Applying for GPRS certificate in the future projects depends on the owner requirements in all case studies.

While part two addresses the application of GPRS categories and credits on each case study with the help of data collected from the interviewees. Each project is then evaluated according to achieved and non-achieved credits.

A summary of case studies evaluation is presented in the following table.

Table 2: Summary of Case Studies Evaluation Using GPRS (based on data from^{[6], [7]})

GPRS Category	Case Studies				
	1	2	3	4	5
S.S	7.5	6	9	6	10.5
EA	8	11.5	10.5	6.5	9
WE	10.8	13.8	8.7	8.1	16.8
MR	4	4.5	2	2	3.5
IAQ	2.5	6	2.5	2.5	3.5
Man.	6.5	6.5	5.5	5.5	9
ID	2	3	0	0	0
Total	41	51.3	38.2	30.6	52.3
Rating	Certif ied	Silver	Unce- rtifie d	Unce- rtifie d	Silver

Credits applicability are then evaluated and divided into six applicability levels explained in table 3:

Table 3: Applicability Levels of GPRS Credits

Applicability Levels	No. of projects applied	Score
Fully obtained credits	5 of 5	4/4
Frequently obtained credits	4 of 5	3.2/4
Possibly obtained credits	3 of 5	2.4/4
Hardly obtained credits	2 of 5	1.6/4
Slightly obtained credits	1 of 5	0.8/4
Rarely obtained credits	0 of 4	0/4

The application of GPRS on the selected case studies indicates the credits that can be described as easy to be obtained and other the credits that designers may face some obstacles of fulfilling them.

Fully, frequently and possibly obtained credits indicate the easiness of their application and the availability of their application requirements.

On the other hand, obstacles of fulfilling other credits can be concluded from the credits that are hardly, slightly and rarely obtained in the examined case studies.

Table 4 represents evaluation of GPRS credits' fulfillment in the 5 case studies.

Hardly, slightly and rarely obtained credits are also highlighted in the schedule to conclude the obstacles that prevented from their application as follows:

Table 4: Fulfillment of GPRS credits in the five case studies

Categories/Credits	Credit Points	Case Study					Score/4	Evaluation					
		1	2	3	4	5		Fully	Freq.	Poss.	Hard	Sligh.	Rare.
Project Design and Implementation Plan	M	M	M	M	M	M	4	√					
Desert area development	1	1	1	1	0	1	3.2		√				
Informal area redevelopment	1	0	0	0	0	0	0						√
Brownfield site redevelopment	1	0	0	0	0	0	0						√
Compatibility with National Development Plan	1	0	0	1	0	1	1.6				√		

Transport infrastructure connection	1	1	1	1	1	1	4	√						
Catering for remote sites	1	0	0	0	0	1	0.8						√	
Alternative methods of transport	1	1	1	1	1	1	4	√						
Protection of habitat	1	1	0	1	1	1	3.2		√					
Respect sites of historic/cultural interest	1	0	0	0	0	0	0							√
Minimizing Pollution during construction	1	1	1	1	1	1	4	√						
Total	10	5	4	6	4	7	1.6	4	2	--	1	1	3	
Categories/Credits	Credit Points	Case Study					Score/4	Evaluation						
Energy Efficiency		1	2	3	4	5		Fully	Freq.	Poss.	Hard	Sligh.	Rare.	
Minimum Energy Performance	M	M	M	M	M	M	4	√						
Energy Monitoring & Reporting	M	M	M	M	M	M	4	√						
Ozone Depletion avoidance	M	M	M	M	M	M	4	√						
Energy Efficiency Improvement	10	6	1	9	2	0	1.4						√	
Passive external heat gain/loss reduction	7	0	5	0	0	2	0.8						√	
Energy Efficient Appliances	3	3	3	3	3	3	4	√						
Vertical Transportation Systems	3	0	0	0	0	0	0							√
Peak Load Reduction	6	3	3	3	3	0	1.6					√		
Renewable Energy Sources	10	0	4	1	0	10	1.2						√	
Environmental Impact	4	2	2	2	2	2	2					√		
Operation and Maintenance	1	1	1	1	1	1	4	√						
Optimized Energy and Performance	4	2	4	2	2	0	2					√		
Energy and Carbon Inventories	2	0	0	0	0	0	0							√
Total	50	17	23	22	14	18	2.2	5	--	--	3	3	2	
Categories/Credits	Credit Points	Case Study					Score/4	Evaluation						
Water Efficiency		1	2	3	4	5		Fully	Freq.	Poss.	Hard	Sligh.	Rare.	
Minimum Water Efficiency	M	M	M	M	M	M	4	√						
Water Use Monitoring	M	--	--	M	M	M	2.4			√				
Indoor Water Efficiency Improvement	8	6	8	3.5	3.5	5	2.6			√				

Outdoor Water Efficiency Improvement	8	5	3	5	4	6	2					√		
Efficiency of Water-based Cooling	4	0	0	0	0	0	0							√
Water Feature Efficiency	4	4	4	4	4	2	3.6		√					
Water Leakage Detection	6	0	0	0	0	0	0							√
Efficient Water Use During Construction	3	3	0	0	0	3	1.6					√		
Waste Water Management	12	0	8	2	2	8	1.33						√	
Sanitary Used Pipes	4	0	0	0	0	4	0.8						√	
Total	50	17	23	14.5	13.5	28	1.8	1	1	2	2	2	2	2
Categories/Credits	Credit Points	Case Study					Score/4	Evaluation						
Materials & Resources		1	2	3	4	5		Fully	Freq.	Poss.	Hard	Sligh.	Rare.	
Schedule of Principal Project Materials	M	M	M	M	M	M	4	√						
Elimination of exposure to toxic materials	M	M	M	M	M	M	4	√						
Regionally procured materials	3	3	3	1	1	2	2.7			√				
Materials fabricated on site	1	0	0	0	0	1	0.8						√	
Use of readily renewable materials	3	0	0	0	0	0	0							√
Use of salvaged materials	3	0	0	0	0	0	0							√
Use of recycled materials	4	0	1	2	2	2	1.4						√	
Use of lightweight materials	1	1	1	0	0	1	2.4			√				
Use of higher durability materials	1	1	1	1	1	1	4	√						
Use of prefabricated elements	3	3	3	0	0	0	1						√	
LCC analysis of materials in the project	1	0	0	0	0	0	0							√
Total	20	8	9	5	5	7	2.3	3	--	2	--	3	3	3
Categories/Credits	Credit Points	Case Study					Score/4	Evaluation						
Indoor Environmental Quality		1	2	3	4	5		Fully	Freq.	Poss.	Hard	Sligh	Rare.	
Minimum Ventilation and Indoor Air Quality	M	M	M	M	M	M	4	√						
Control of Smoking in and around the Building	M	M	M	M	M	M	4	√						
Control of Legionella and	M	--	--	--	--	M	0.8						√	

other health risks														
Optimized Ventilation	5	1	5	0	0	1	1.1							√
Controlling emissions from building materials	5	2	5	2	2	2	1.6						√	
Thermal Comfort	2	2	2	2	2	2	4	√						
Visual Comfort	2	0	0	1	1	2	1.6					√		
Acoustic Comfort	1	0	0	0	0	0	0							√
¹ Total	15	5	12	5	5	7	2.1	3	--	--	1	2	2	
Categories/Credits	Credit Points	Case Study					Score/4	Evaluation						
Management		1	2	3	4	5		Fully	Freq.	Poss.	Hard	Sligh.	Rare.	
Integrated Plan and Method Statement	M	M	M	M	M	M	4	√						
Health & Safety and Welfare regulations	M	M	M	M	M	M	4	√						
Demolition Method Statement	M	M	M	M	M	M	4	√						
Containers for site materials waste	2	2	2	2	2	2	4	√						
Employing waste recycling workers on site	1	1	1	1	1	1	4	√						
Access for lorries, plant and equipment	1	1	0	1	1	1	3.2		√					
Identified and separated storage areas	2	2	2	2	2	2	4	√						
Project Waste Management Plan	1	1	1	1	1	1	4	√						
Company specialized in recycling and disposal	2	2	2	2	2	2	4	√						
Protecting water sources from pollution	2	0	0	0	0	2	0.8						√	
Waste from mixing equipment	2	2	2	2	2	2	4	√						
Control of emissions and pollutants	2	2	2	0	0	0	1.6					√		
Providing a Building User Guide	3	0	3	0	0	3	1.6					√		
Providing a Periodic Maintenance Schedule	2	0	2	0	0	2	1.6					√		
Total	20	13	15	11	11	18	3.2	9	1	--	3	1	--	

5. Discussion & Conclusion

From the previous analysis, obstacles of fulfilling some credits of GPRS in the Egyptian context can be concluded as follows:

➤ Category 1: Sustainable Sites

- Absence of governmental incentives for redeveloping informal areas
- Absence of governmental incentives for following the national development plan
- High initial cost
- Sites of historic/cultural interest are exceptional cases

➤ Category 2: Energy & Atmosphere

- High initial cost required for some credits.
 - Lack of design team specialist who are aware of environmental control strategies and building simulation programs to choose the optimum choices for the building environmental performance
 - Unavailability of the required equipment for some credits
 - Lack of design team and other disciplines specialists who are aware with energy efficiency strategies and the use of simulation programs required for that purpose.
 - Lack of design team specialists
 - Unavailability of the required equipment and technology
 - Lack of design team specialist who are aware of environmental control strategies and building simulation programs to choose the optimum choices for the building environmental performance
 - Unavailability of the required technology for some credits
- ### ➤ Category 3: Water Efficiency
- Lack of design team awareness of the importance of irrigation operation and maintenance plan
 - Unavailability of the required equipment for some credits
 - High initial cost required for some credits.
 - Lack of contractors' awareness

- Lack of the required technology for some credits

- Lack of specialists

- Unavailability of certified sanitary pipes in the Egyptian market

➤ Category 4: Materials & Resources

- Lack of qualified contractors and builders

High initial cost required for some credits.

- Lack of contractors' awareness

- Unavailability of recycling companies for construction materials

to provide the required materials

- Unavailability of data about life cycle cost of the available materials.

➤ Category 5: Indoor Environmental Quality

- The mentioned code (ASHRAE) is not a local one, designers are not aware of its requirements and how to apply it

- Lack of the required technology for some credits

- Lack of specialists

- High initial cost required for some credits

- Unavailability of low emitting materials in the Egyptian market

- Lack of design team specialists who are aware about appropriate daylighting strategies and simulation programs required for this purpose

➤ Category 6: Management

- Lack of awareness of contractors and builders

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OPTIMAL CONFIGURATION OF POWER AND CONNECTION POINT OF PVP FOR LOCALIZED DIESEL POWER PLANT OPTIMIZATION

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Abstract

In this work, we analyze the effective model of PV plant (PVP) as a distributed generator to serve the load in a system where Diesel power plant (DPP) is used. The aim is to find the optimum configuration of PVP power and location, and load in a system to achieve the minimum DPP fuel consumption, as well as optimizing the working parameters of the feeder on which the PVP's are connected. An algorithm is proposed to provide the best practice solution for the problem. Based on power flow simulation in ETAP, we then compare the result from several logic configurations to find the best option of PVP power and location in a system with respect to the intended parameters mentioned. The result shows that DPP fuel consumption and grid parameters are improved. The results are presented as a recommendation to the studied DPP system as well as the similar system.

Keywords: Distributed Generation, Photovoltaic plant, Diesel power plant optimization, ETAP, Diesel Plant Optimization.

1. Introduction

Lengthy dependency of oil in most of developing countries has contributed to the irreplaceable use of diesel power plant (DPP). DPP has been used as main power producer to feed the load from cities to localized areas. For localized areas with hazardous terrain or even isolated small islands, this could turn to be the obstacle in keeping the continuity of load serving and fuel availability. From different stand point, the use of Photovoltaic power plant (PVP) has been so popular in past decade with variety of application and scale. The one that so popular is the integration of PVP using Distributed Generation (DG) approach to be working in a system with DPP as primary source.

The typical problem of DPP is that most of its generators has already close to their maximum service life, which related to the problem with its parts because of many workhours. Moreover, DPP also facing the problem with providing the continuity of fuel availability especially for isolated region/island. On the other hand, total replacement of DPP with different energy source also facing the problem of both

finance and efficiency, which is not consider as an option. The possible way is (1). to look for another power source as primary power plant and try to installed it gradually, and (2). to ease the workload of DPP generators and to lengthen its service life. In this work, the algorithm is proposed to the latter option.

Several works has been done to investigate the implementation of Distributed Generation technology in order to optimized network parameter where it is connected. In [1], the use of DG with different types of energy source by using objectives function of optimization was explained. Therefore, this paper will discuss the effect of PVP output power and load in order to make a rearrangement of generator working shifts, making sure its effective workload as possible.

2. Object of Study

The research object is 20 kV, 50Hz power grid of Ambon Island, located in Eastern Indonesia. The power grid contains 13 feeders, served by six Diesel Power Plant (DPP), with each three DPP working in parallel, (Figure 1). DPP 1 and 2 are the

main DPP, whereas DPP 3-6 are rented to support the main DPP because of engine failure of its several generator set. The grid is simulated in ETAP program with scheme provided in Appendix 1 & 2.

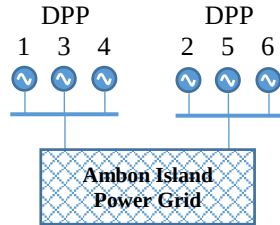


Figure 1. Ambon Island Power Grid

3. Research Methods

When additional power source injected its power through a particular point of interconnection (POI) in the network, it will reduce power flow along the power line because of power distribution from two different sources. Therefore, the level of additional power injected to the network determines how much power flow can be reduce along the power line. Hence, based on I^2R equation, power dissipated can be reduce. Moreover, the introduction of new power source able to reduce the workload of the generators. Thus, the relation between the PVP output power, the load and the generator optimum workload must be taken into consideration.

An algorithm that consist of set of criteria is to be create with the accordance with regulation and standard as a rule of thumb to solve the problem. But prior to that, several points needs to be taken into consideration such as:

- The generator load factor needs to be at a certain level where SFC level is at its maximum or 70-80% of nominal power when generator data is unavailable.
- The generators are consists of different type of nominal power and SFC level, therefore an operating shift for generators based on this factors need to be established.
- When using PVP to ease the workload of generators, an optimal PVP output power must be taken into consideration when determining PVP installed

capacity with respective to the local solar insolation potential.

- The economic factor of the results have to be improve after the implementation of the proposed algorithm.
- Since generator with higher capacity often have higher SFC thus it is best to use generator with low SFC to regulate with the uncertainty of solar insolation.
- Generator with lower SFC are to be

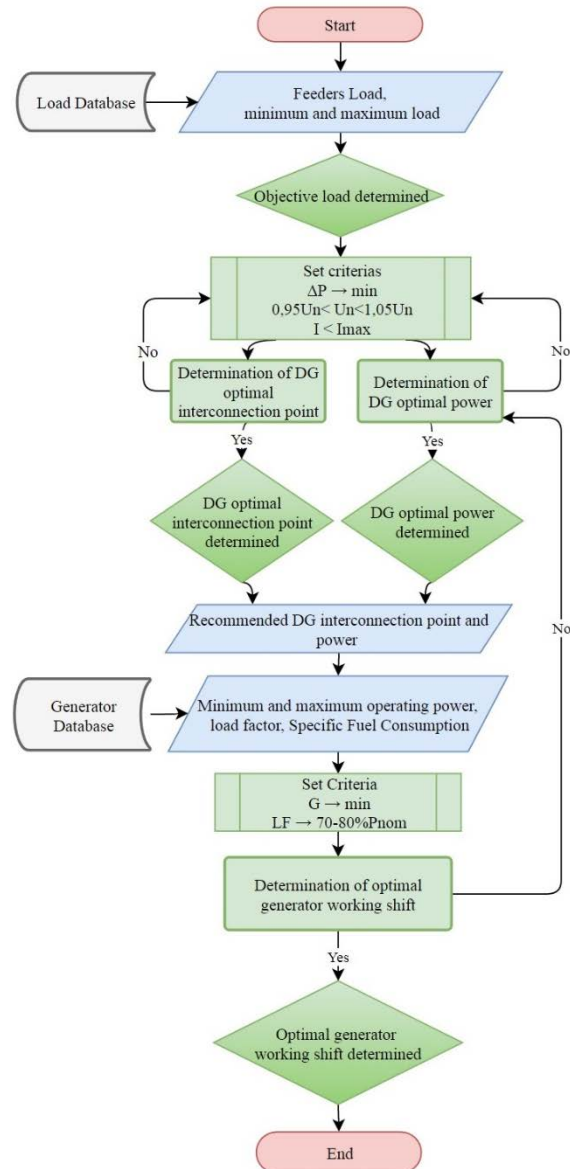


Figure 2. Optimization algorithm of DPP with PVP as DG

serving base load, while generator with higher SFC will be serving intermediate to peak load.

Based on these points, an optimization algorithm is made as shown in Figure 2.

3.1. Optimal DG POI and Power

Optimal POI and power of DG in a network system can be determine by a method in [2].

3.2. Generator Scheduling

The determination of generator working shift at time of, t are depends on several parameters such as load $P_L(t)$, the PVP power output $P_{PVPout}(t)$ and the generator power output $P_{Gout}(t)$. By formulating these parameters, it is possible to define the optimum working shift of generators on a real time fashion. Here the optimum working shift means that the workload of generators, LF can be put to optimum while fuel consumption, G can be put to minimum. Hence, these two parameters are taken as selection criteria. Prior to selection all generator set should be divided into Base Load Generator, G_{BL} and Load Following Generator, G_{LF} . G_{BL} are generators with low SFC that serve base load with constant $LF=0,75$. G_{LF} are higher SFC that serve both intermediate and peak load with more flexible $LF=0,7-0,8$. Moreover, low capacity generators G_{BL} will be turn off to compensate higher capacity generator in the case when last generator G_{LF} produces too much energy. This will ensure the flexibility of G_{LF} in serving the load while continuously minimizing fuel consumption as low as possible. The G_{LF} generators switching order are based on their SFC values (low to high).

In practice, G_{BL} and G_{LF} generators have to satisfy the following condition.

$$\frac{\sum_{i=1}^n (P_{G_{BL},i} \cdot LF) + \sum_{i=1}^n (P_{G_{LF},i} \cdot LF)}{P_{L1}} = 1 \quad (1)$$

Where, LF for $G_{BL} = 0,75$ and for $G_{LF} = 0,7-0,8$.

2.2. PVP Generator Optimization

The generator output power P_{Gout2} or the net load that has to be fed by generator after PVP integration, P_{L2} practically can be determine by the following expression.

$$P_{Gout2} = P_{L1} - P_{PVPout} = P_{L2} \quad (2)$$

Thus, generators condition in Eq. (1) after integration of PVP can be rewritten as.

$$\frac{\sum_{i=1}^n (P_{G_{BL},i} \cdot LF) + \sum_{i=1}^n (P_{G_{LF},i} \cdot LF)}{P_{L1} - P_{PVPout}} = 1 \quad (3)$$

The calculation of fuel consumption are taken from [3].

4. Analysis & Results

Through method in [2], the simulation is held in ETAP program and the results shows that the amount of PVP power needed by the power system in total is 10MW with configuration shown in Appendix 1. The result of PVP integration to the reduction of DPP power generation is shown in Figure 3. The scheme of simulated power system in ETAP can be seen in Appendix 1&2.

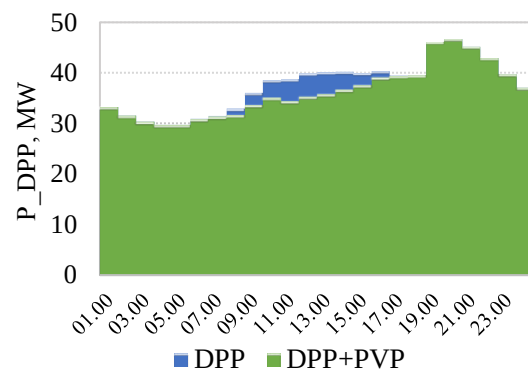


Figure 3. Yearly average total DPP generation. Using the method in [3], several results are taken as shown in a table below. The result shows are the state of yearly energy production, fuel consumption and cost on fuel before and after generator rescheduling, and integration of PVP after rescheduling.

Table 1. DPP characteristics at based scenario.

DPP	W, MWh/yr	G, ton/yr	3, mln. \$/yr
1. DPP Poka	43094	259590	\$194
3. DPP Rent 1	36719	197345	\$147
4. DPP Rent 2	55900	299491	\$224
2. DPP Hative	19648	105953	\$79
5. DPP Wika1	112557	669499	\$500
6. DPP Wika2	60842	317324	\$237
Σ	328760	1849203	\$1 381

Table 2. DPP characteristics after rescheduling.

DPP	W, MWh/ yr	G, ton/yr	3, mln. \$/yr
1. DPP Poka	9227	53509	\$40
3. DPP Rent 1	40537	214967	\$161
4. DPP Rent 2	71758	379532	\$283
2. DPP Hative	47961	253979	\$190
5. DPP Wika1	106717	613770	\$458
6. DPP Wika2	52560	259093	\$193
Σ	328760	1774852	\$1 325

Table 3. DPP characteristics after rescheduling with PVP.

DPP	W, MWh/ yr	G, ton/yr	3, mln. \$/yr
1. DPP Poka	9227	53509	\$40
3. DPP Rent 1	40537	214967	\$161
4. DPP Rent 2	66774	352945	\$264
2. DPP Hative	47961	253979	\$190
5. DPP Wika1	101483	583660	\$436
6. DPP Wika2	52560	259093	\$193
Σ	318542	1718155	\$1 283

After the implementation of working shift rescheduling, the number of working hours of total generator in a year are increased as a result of equal load distribution with lower load factor by 37,5% and reduced to 3,4% after the introduction of PVP. It also supposed to lengthen the service life of generators by imposing the right load at all time. Economically, all DPP are able to save \$56 million per year after rescheduling process, and further \$98 million per year after the addition of PVP to the grid.

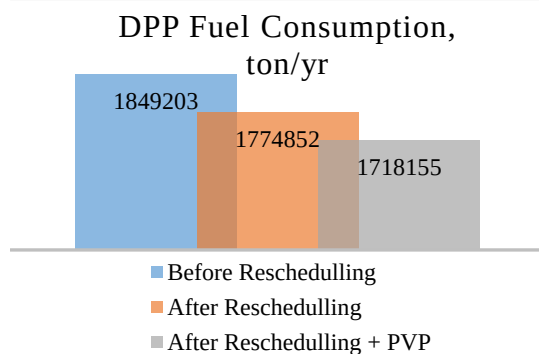


Figure 4. DPP Fuel consumption

5. Discussion & Conclusion

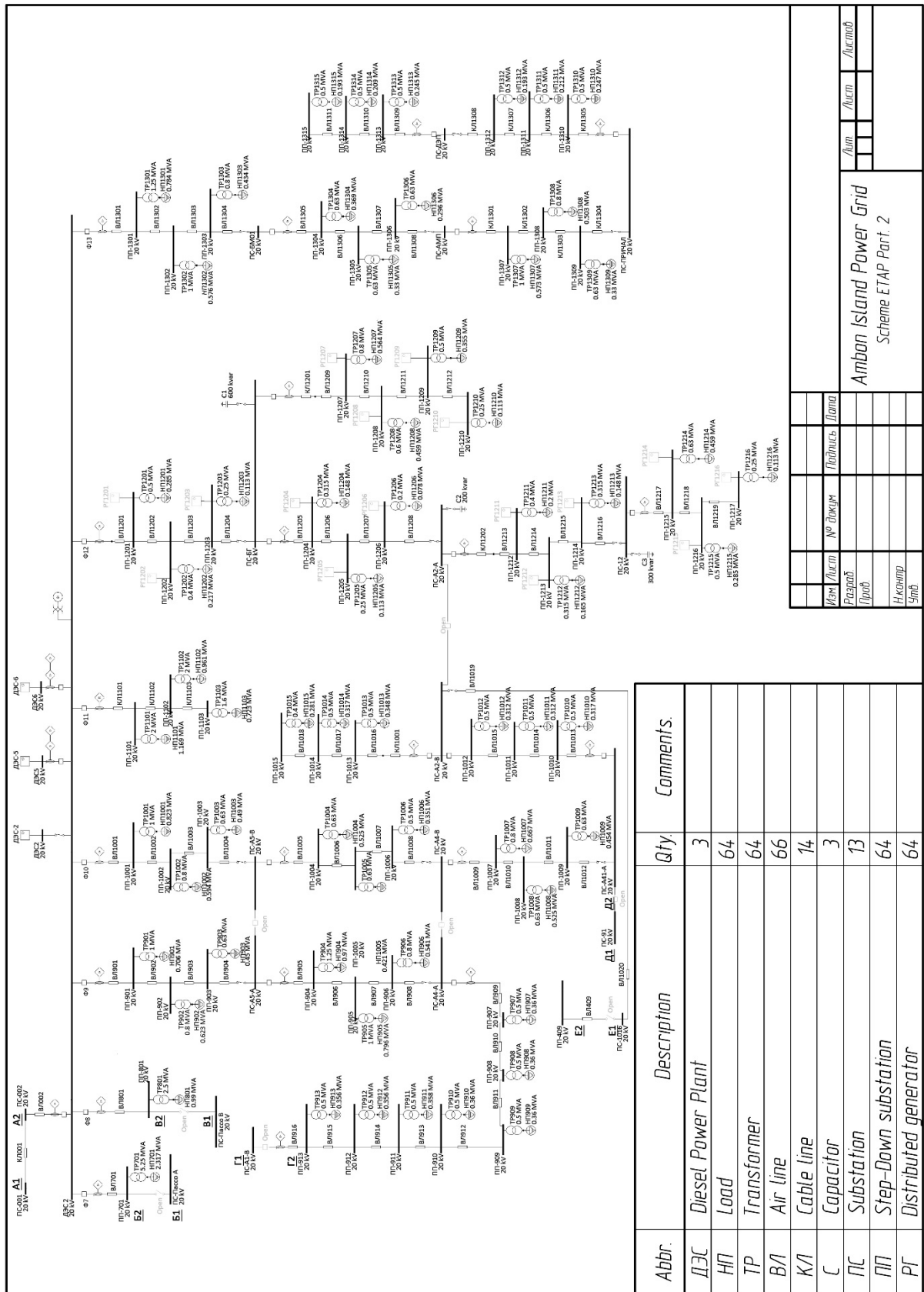
DPP optimization algorithm through DG connection to the grid and generator working shift rescheduling shows good result that can be implemented in many DPP station. Moreover, the algorithm can be used as recommendation for the studied power system as well as related electrical project with distributed generation based on renewable energy source.

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[illegible]

Appendix 2. Ambon Island Power Grid Scheme, Feeder 7 to Feeder 13



Appendix 3. Configuration of DG Power and Interconnection Point

Feeder	P_DG, MW	POI	Feeder	P_DG, MW	POI
F1	2	107	F7	No Vacant Land	-
F2	2	III*205	F8	No Vacant Land	-
F3	No Vacant Land	-	F9	No Vacant Land	-
F4	No Vacant Land	-	F10	No Vacant Land	-
F5	3	III506	F11	No Vacant Land	-
F6	1	III603	F12	2	III1214
*III = Step-Down Substation (at MV side)			F13	No Vacant Land	-

SOCIAL COHESION UNDER DIVERSE HOUSING ENVIRONMENTS IN SONGJIANG NEW TOWN, CHINA

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Abstract

Social cohesion is a pertinent issue especially in China where the restructuring of the urban landscape has influenced the social make-up of urban communities. This study investigated neighborly interaction as a form of social cohesion in Songjiang New Town, Shanghai, and used the negative binomial regression to analyze which factors influence neighborly interaction. The results confirmed previous literature regarding a number of individual determinants but more importantly revealed that while hukou was significant in establishing weak social ties, it was not influential in maintaining strong social relations. Nevertheless, the study argued that the institutional limitations arising from hukou status might be an imposed condition of low social contact among non-Shanghai hukou holders. Furthermore, the study revealed that relocation and commodity mixed developments were a factor of low social cohesion, contending for improved planning and design measures which mitigate for the dislocation experienced by relocates.

Keywords: urban diversity, social cohesion, social network, migrants, relocation housing

1. Introduction & Literature Review

Urban diversity is an inherent quality of neighborhoods today in China since the complete urban re-structuring of the post-economic reform era. As existing neighborhoods transformed and new neighborhoods formed overnight with intense changes in migration flows, especially in large receiving cities such as Shanghai, new social groups emerged and social cohesion of urban neighborhoods correspondingly changed. This has inspired a wave of research in regards to migrant settlements, urban villages, the problems of relocation, and the diversification of housing supply.

Insofar, there have been extensive studies on the social cohesion between the indigenous population and migrants in urban villages in China. However, more recent studies have revealed the diverse socioeconomic status of migrants [1, 10], the assimilated lifestyles of second and third generation migrants in their urban destinations [8, 10], and the wide-ranging

housing choices and aspirations of migrants [6] which are backdrops to the differing level of social cohesion in urban communities. Therefore, the understanding of social cohesion should not be limited to urban villages or a stereotyped socioeconomic profile of the migrant group, but rather extend to investigating wider geographical and socioeconomic contexts.

In this respect, New Town developments provide a useful test bed for broadening the understanding of social cohesion under dynamic urban changes, as New Town developments are known to be driven by internal migration and the provision of housing [11]. Against this background, this study empirically investigated social cohesion under various neighborhood contexts by focusing on four different areas in Songjiang New Town, Shanghai, China. More specifically, this study examined neighborly interaction as an important social cohesion indicator in three respects – the total number of neighbors,

regularly met neighbors, and neighbors within the housing estate – and inquired what individual and housing factors contributed to the differing levels of neighborly interaction.

2. Research Methods

Study Area

For this study, four neighborhoods were selected in three of the *jiedaos* in Songjiang: *Yueyang*, *Yongfeng*, and *Fangsong*. Area A is located in the old and established *Yueyang jiedao* which forms part of the original Songjiang district. Area B belongs to the *Yongfeng jiedao*, where residential development precipitated after the mid-2000s with a mix of high-end commodity housing and relocation housing estates. Area C and D both are part of the master-planned *Fangsong jiedao* which are the comprehensive large-scale developments constructed since the 2000s. Commodity housings are concentrated in these areas with wide-ranging building types such as high-rise, mixed-developments, and villa compounds. In total, 53 housing estates were surveyed.

Data collection

To collect data, a resident survey was conducted through the intercept survey method from December 24 until 31, 2015. With the assistance of undergraduate students from Tongji University, two sessions of three-hour long street surveys were conducted each day along two main street intersections for each site. The questionnaires were read out and filled in by the assistants themselves in order to minimize confusion and reduce mistakes. In total, 370 residents were surveyed.

Method

In order to analyze what factors may influence neighborly interaction, the research used the negative binomial regression, which is usually employed to model over-dispersed count data¹.

As mentioned earlier, the dependent variables were determined in three respects which investigated both the breadth and intensity of social relations: the total number of neighbors a resident knows (model 1); the number of neighbors that are in regular contact with the resident (model 2); and the number of neighbors a resident knows within their housing estate (model 3).

The independent variables were divided into two categories: individual determinants and housing environment determinants. The individual factors include both demographic and socioeconomic variables, as well as tenure years, as these are important determinants of social distance, which have been used in previous studies [2, 3, 5, 7, 10]. The housing environment determinants include building age, housing type in terms of economic classification, and physical building type. These variables test whether the differences in age of an area, building density or income disparities influence the formation of social relations.

3. Analysis & Results

The following table shows the negative binomial regression results using backward elimination (Table 1).

Table 1 Regression results using backward elimination

Dependent variable	Significant variables	Regression coefficients	P-value
Neighbors _Total	Gender	0.237	0.042
	Tenure years	0.075	0.000
	Hukou_Agriculture	-0.379	0.083
	BldType_high-rise	-0.263	0.055
	MS_widowed	-0.787	0.058
	MS_others	-2.033	0.000
	HousType_comm+relocatn	-0.468	0.005
	Inc_3-5	-0.400	0.012
	Inc_5-10	-0.436	0.001
Neighbors _Regular	Hukou_OtherUrban	-0.368	0.002
	MS_others	-1.033	0.000

¹ UCLA Institute for Digital Research and Education ([https://stats.idre.ucla.edu/stata/seminars/regression-models-](https://stats.idre.ucla.edu/stata/seminars/regression-models-with-count-data/)

[with-count-data/](https://stats.idre.ucla.edu/stata/dae/negative-binomial-regression/), <https://stats.idre.ucla.edu/stata/dae/negative-binomial-regression/>)

	Inc_5-10	-0.308	0.078
	Inc_3-5	-0.464	0.050
	Tenure years	0.066	0.000
Neighbors _Housing Estate	Gender	0.202	0.097
	BuiltYear_2000s	-0.378	0.018
	MS_married, living together	0.379	0.038
	BuiltYear_2010s	-0.420	0.026
	MS_widowed	-0.774	0.057
	MS_others	-1.055	0.000
	Employment	-0.210	0.071
	Inc_3-5	-0.366	0.018
	Inc_5-10	-0.377	0.007
	Tenure years	0.069	0.000
	HousType_comm+relocatn	-0.381	0.008
	Hukou_OtherUrban	-0.393	0.001
	Hukou_Agriculture	-0.446	0.026

Individual determinants

In general, female residents were more likely to have higher social contact (1.27 times more in terms of the total number of neighbors, and 1.22 times more within housing estate) and those who were not employed or retired were less likely to know neighbors within the housing estate by 19.0%. Widowed or those with marital status belonging to the “others” category had significantly low neighborly interaction. Also, middle-income households knew significantly fewer neighbors for all three models which corroborate previous literature on the middle-class wanting privacy and relying on social networks outside their neighborhood [6, 10].

Tenure year was highly significant for all three models ($p < 0.01$) and increased the likelihood of neighborly interaction by 1.07 times. As argued before, length of residence in relation to social network is a positive condition where familiarity develops over time and allows the building of interpersonal relations. While this may not necessarily further support a sense of belonging or social solidarity, which are other aspects of social cohesion [4, 10], tenure year is significant because it is influential in forming both weak and strong social ties [5].

Hukou status is significant in establishing social relations as expected, but not influential in maintaining relations, as it was not a significant variable in regularly met neighbors. Agriculture hukou and other urban hukou holders knew approximately 30% fewer neighbors in terms of total number, and both hukou statuses also knew fewer neighbors within their housing estate by 36.0% and 32.5% respectively. However, it was not found to be a significant variable in terms of the number of regularly met neighbors, indicating that while hukou is important in establishing weak social ties or acquaintances, it may not have such a clear bearing in forming strong social ties.

Housing determinants

The high-rise building type decreased the total number of neighbors by 23.1%, while those living in post-2000 developments knew fewer neighbors within their housing estate by approximately 30% (year of build 2000-2009 decreased by 31.5%; year of build 2010- decreased by 34.3%). Low social contact in post-2000 developments was corroborated by the descriptive statistics where higher neighborly interaction was found in older estates. Residents living in estates built before 2000 (27.6 people) and in parallel blocks (21.5 people) – a building type usually built in older areas – knew considerably more neighbors.

In regards to housing type, those living in commodity and relocation mixed development knew 37.4% less total neighbors and 31.7% fewer neighbors within their estate. This was a particularly important variable to consider as the p-value suggested its high significance. Furthermore, the fact that commodity and affordable housing was not a significant variable indicated that lack of neighborly interaction might not necessarily be a problem of income differences. In other words, the problem of dislocation or being an ‘outsider’ may be a more pressing issue which accentuates segregation rather than income levels. Hence, the commodity and

relocation mixed housing estates require closer examination.

Within the studied sample, there were nine commodity and relocation mixed housing, all located in areas A and B. Out of the 53 residents surveyed, 34 (64.2%) lived in area B, of which 22 people were known to have Shanghai urban hukou. If then, low social contact can be posited as a problem of Shanghai urban hukou holders who have been relocated to these estates, it may be that they choose to value their connections of former neighborhoods and do not actively seek new social networks in the new estate [6]. Also, if the relocated housing situation is not an improvement of their prior condition, this might lead to higher dissatisfaction compared to the new occupants of the development [9], which could adversely affect their decision to foster social relations.

This conjecture is plausible in area B where relocates needed to adjust not only in regards to a completely new environment but also into an area where there were many locational disadvantages such as inconvenient amenities and public transport, noise pollution and low vitality. In fact, those who moved due to relocation purposes had either average or low satisfaction of their living environment, with one resident evidently complaining of the noise levels within and outside the housing estate.

4. Discussion & Conclusion

In conclusion, the study called for a more nuanced understanding of hukou status while corroborating previous literature on the significance of individual determinants such as gender, marital status, income and length of residence. Although hukou is a significant variable in establishing initial social ties, it does not influence the formation of strong social ties, indicating that non-Shanghai urban hukou does not necessarily act as a disadvantage in social cohesion.

Nevertheless, because low social contact of non-Shanghai hukou holders is closely related to short tenure years, the institutional limitations of hukou should not be overlooked. Short tenure years itself may not be viewed as a serious problem since social relations can be expected to naturally form over the course of years. However, if the issue of short tenure year is related to the high residential mobility of agriculture and other city hukou holders due to institutional limitations or precarious living conditions, this would be considered problematic since, in this case, low social contact is an imposed condition rather than a condition out of choice. In other words, the institutional limitations of hukou can act as a barrier to forming sustainable and connected urban communities, which are often-cited objectives of urban projects in China.

The study also highlighted the problems of relocation, and how inconsiderate housing environments can deter social relations especially when relocates are accommodated alongside commodity housing residents with different housing expectations and experiences. Hence, acknowledging that the issue of relocation would maintain under the on-going urbanization of China, the mixing of relocates should be approached more carefully as they may be more prone to being reclusive. Planning and design measures that mitigate for the housing environment disadvantages – such as creating small hubs of urban amenities rather than placing endless rows of unoccupied shops, providing diverse community facilities within the housing estate, and introducing smaller urban blocks with better pedestrian and vehicle connections – may be necessary in creating spaces of interaction which may facilitate social cohesion or at least improved living satisfaction which may lead to fostering social cohesion.

Acknowledgements

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CHINA'S INITIATIVE OF ONE BELT ONE ROAD (OBOR) PROVIDES A PLATFORM FOR SUSTAINABLE ECONOMIC DEVELOPMENT: REDEEMING OLD SILK ROUTE FOR NEW ECONOMIC ERA

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Abstract

This paper gives an overview of The One Belt, One Road (OBOR) initiativeⁱ which is an action plan for reviving a historically significant New Silk Road concept offering considerable potential in several economic, environmental, political, cultural, and strategic realms; China's strategy proffers an inspiring vision of common development of up to 80 countries based on infrastructure development and common standards. Connecting China to Europe, the Middle East, Central Asia, and South Asia and will involve existing and new rail lines, highways, and pipelines. It is grandiose, potentially involving an area that covers 55 percent of world GNP, 70 percent of global population, and 75 percent of known energy reserves. China's financial commitments to the project are estimate to \$300 billion in infrastructure financing from China in the coming years.ⁱⁱ Main objective here is to envisage China as a global leader taking the lead from United States of America in terms of driving force for world economy towards sustainable development. Given recent economic crisis of 2008 and its catastrophic effects still haunting the global economy, world has envisioned a necessary revision of world economy along with other global catastrophes faced recently as consequences of global warming inherently being the reason behind whole global environmental scenario and restructuring the global economy towards sustainable development. First this paper analyzes the ideal global economic scenario as envisioned by economic utopians, then it provides the historical perspective and significance of traditional trade routes including silk route and finally provides an analysis of how China is intending to reinvent and restructure the whole global economy through reviving the old silk route with the help of OBOR and how much it can contribute towards sustainable economic development along with OBOR's capability to take global economy closer to the ideal scenario in future.

1. Introduction

The One Belt, One Road (OBOR) initiative is an action plan for a New Silk Road concept offering considerable potential in several economic, environmental, political, cultural, and strategic realms; China's strategy proffers an inspiring vision of common development of up to 80 countries based on infrastructure development and common standards. Connecting China to Europe, the Middle East, Central Asia, and South Asia and will involve existing and new rail lines, highways, and pipelines. It is grandiose, potentially involving an area that covers 55 percent of world GNP, 70

percent of global population, and 75 percent of known energy reserves. China's financial commitments to the project are estimate to \$300 billion in infrastructure financing from China in the coming years.

From the fall of 2013, Chinese President Xi Jinping put forward the strategic framework of building the "Silk Road Economic Belt" and a counterpart "21st Century Maritime Silk Road," an ambitious vision that has evoked enthusiasm among many stakeholders.ⁱⁱⁱ Consistently supported by Chinese observers, it has clearly become a major foreign and economic policy hallmark of the present government^{iv}. In September

2015, China's National Development and Reform Commission (NDRC), Foreign Ministry and Ministry of Commerce (MOFCOM) announced that the scheme's official English name is 'The Belt and Road' (一带一路).

Beijing's current effort to improve ties and stimulate growth and development along its geographic periphery, facilitating land-based trade across the Eurasian landmass, promoting infrastructural development and connectivity, and stimulating economic integration. These initiatives were seen as a leverage of China's growing economic power and influence in order to strengthen and expand cooperative interactions, create an integrated web of mutually beneficial economic, social and political ties, and ultimately lower distrust and enhance a sense of common security. "One Belt, One Road is a good international economic strategy, but for now it is certainly not an easy one."^v Europe is an integral part of China's transcontinental vision, and the European Union (EU) has its own vested interests in the Belt—as the EU–China Connectivity Platform demonstrates. This plan sets out a vision in which Chinese-led infrastructure construction, reduced tariffs, and simplified customs administration would allow trade to flow seamlessly between China and Europe by both rail and cargo ship^{vi}. China has committed a total of about \$100 billion to a trio of new infrastructure funds: \$40 billion to the Central Asia-focused Silk Road Fund, \$50 billion to a new Asian Infrastructure Investment Bank (AIIB), and \$10 billion to the BRICS-led New Development Bank.^{vii}

It is expected that project will demand a high 'Policy coordination' in order to develop and then operate the infrastructure planned as part of the OBOR initiative.^{viii} Chinese plans basically negotiate free trade agreements with many if not all of the OBOR countries, as well as agreements to streamline customs,

inspection, and approvals. By the end of 2014, 77 out of China's 118 bilateral or trilateral free trade agreements were with nations covered by the OBOR initiative. Enhancing connectivity will focus initially on removing bottlenecks and providing missing links in existing transportation routes, building port facilities, and improving inter-modal operation.^{ix} Eventually the goal is to have high quality rail, highway, air, telecommunications, oil and natural gas pipeline, and port networks throughout the OBOR regions, with a goal of fostering much closer economic integration across Asia and between Asia and Europe.

For infrastructure in Asia, it is estimated that the OBOR countries need USD 5 trillion in infrastructure from 2016 to 2020. The Asian Development Bank estimated that Asia would need USD 8 trillion in infrastructure investment from 2010 to 2020. China is seeking to take on a more prominent role globally; OBOR is one manifestation of a China's much more engaged and assertive intentions in international affairs. China has consolidated substantial economic and political relationships around the world. Most relevant are the relationships with Southeast Asia, Central Asia, South Asia, Africa, and Central and Eastern Europe. Chinese officials have promoted the OBOR initiative at several international forums involving these regions, including the Asia–Europe Meeting (ASEM), the Shanghai Cooperation Organization (SCO), ASEAN+1, the China–Arab States Cooperation Forum (22 members of the Arab League plus China), the Forum on China–African Cooperation (50 African countries plus China), and China–CEE 16+1 (the sixteen Central and Eastern European Countries plus China).

Historical Significance of the Silk Road

The Silk Road was never a single road, as the name might suggest. The term was

coined by the German geographer Ferdinand von Richthofen in the late 19th century to describe the interlocking mosaic of trade routes within and across Asia to Europe, which has developed over the last 2000 years.^x The name is evocative of images of exploration and adventure, of intrepid travellers such as Marco Polo and Ibn Batuta, and has been engraved in world memory through myth, legend, song and film. Samarkand, Bukhara, Yarkand, Kashgar and Khiva are only some of the resplendent names of some of the stations along the Silk Road. Courage, curiosity, stamina and imagination are the primary emotions associated with travel through these routes, which was indeed a brave enterprise in those times. It is indeed the case that one of the earliest goods to be transported through these roads was silk from China. At one point, not only the aristocratic ladies of Rome but also its gentlemen were so besotted with purchasing fine Chinese silk that the outflow of gold to China threatened to upset the financial stability of the Roman Empire. It required the Emperor Tiberius himself to intervene, banning the use of silk by men (Hopkirk 1984).^{xi} Of course, many other products apart from silk travelled along this vast network of roads—ivory, gold, silver, tea, fruits and nuts, paintings, sculptures, manuscripts and ideas and doctrines of many types—religious, scientific, illusionary, revolutionary or merely eccentric. At one end of the Road was China, while India, Persia, Arabia, the Levant and Europe were destinations as well as origins of different branches of this complex array of tracks, roads, waterways and caravanserais. Trade and transfer of goods, ideas and services across this vast terrain were mediated by many middlemen and bankers. For a long time, Parthians occupied such positions, but later on Indian bankers from Sind and Gujarat gained renown as dependable financiers whose hands were honored from Muscat to Mongolia. The most celebrated ‘product’ to travel the Silk

Road was of course Buddhism, taken from India over the north-western passes of the Hindu Kush and across what is now Xinjiang, to reach into the heart of China. There followed a great interflow of trade, cultural intercourse, exploration and scholarly interaction between India and China. There is a wealth of literature on these intrepid travellers, such as Xuan Zang and Kumarajiva, amongst many others. Both Professor Amartya Sen (2006)^{xii} and Professor Lokesh Chandra (1998)^{xiii} have documented the range of artistic and scientific exchanges with China. More recently, a remarkable publication co-created by a team of Indian and Chinese scholars—the ‘Encyclopedia of India-China Cultural Contact’ (Ministry of External Affairs, 2014)^{xiv} co-sponsored by India’s Ministry of External Affairs—has listed over 700 scholars, travellers and gurus who contributed to cultural interpretation and understanding between the two civilizations. India’s own remarkable role in the millennium before 1200 AD was as the lead provider of advanced education in Buddhism as well as the arts, sciences and medicine at its great Universities of Nalanda, Vikramashila and Taxila, among others. Students from across Asia journeyed here by land and across the seas, often stopping at Srivijaya (in present-day Indonesia) to learn Sanskrit. The sea-route to India was also well travelled by pilgrims and traders, who often arrived by the land route and exited by sea or vice versa. In the early 15th century came the celebrated seven voyages of exploration and trade by the Ming Emperor’s great fleet of huge ‘treasure-ships’ led by Admiral Zheng He. Zheng He assembled a multinational crew from all over Asia for his voyages, which reached right up to East and South Africa. The Admiral is known to have remarked particularly on the skills of Indian navigators and pilots whom he took on board in Calicut and Cochin (Ma, 1997).^{xv} The Silk Roads were in fact an early example of globalization at work, and this

was exemplified particularly during the Mongol Empire of the 13th century. The Mongols unified the vast mass of Eurasia, practically from Beijing to Belgrade, creating the largest free-trade zone ever known, ensuring wide and cheap distribution of goods. Genghis Khan, in particular, abolished torture and mutilation, and employed talented people of many nationalities in his army and civil administration. He established religious freedom across the Empire and instituted the practice of diplomatic immunity for ambassadors (Weatherford, 2004).^{xvi} The Mongol international postal service—fast horses with relief riders and horses at regular way-stations—remained the quickest way of getting news from Vienna to Vladivostok until the Trans-Siberian Railway came 600 years later. One Belt One Road is a key to opening old trade routes along the traditional Silk Road bringing prosperity and peace for future civilizations.

Prospective Future Effects of OBOR

1. Accelerating Industrial Development

Many countries in the OBOR region aim to develop their economies away from a dependence on agriculture and natural resources toward industrialization. Infrastructure building is an important part of that effort, but so, too, is support for economic development. Proven ways of providing that support are setting up industrial parks and special economic zones, and promoting free trade both at home and abroad. China has a wealth of experience in both that it could share with its OBOR partners. Examples include the Suzhou Industrial park established jointly with the government of Singapore.^{xvii} Since 2006, China has started establishing National Overseas Economic and Trade Zones. The Thai-Chinese Rayong Industrial Zone and the China-Africa Lekki Free Trade Zone are examples of such successes.^{xviii} China should now consider setting up joint industrial parks

and working with other governments to establish cross-border free-trade zones and special economic zones in the OBOR region. The experience of such initiatives suggests that China has a role to play not only in supporting infrastructure development but also in spreading best practice in industry selection, molding an effective software environment, and helping to develop industrial parks in other countries in the OBOR region by prioritizing certain industries and by promoting investment. Through OBOR Chinese needs and intend to;

- Help local government identify priority industries. Given the vastly different development needs among OBOR nations, Chinese government and private sectors can help regional government prioritize industries that McKinsey's experience in economic development suggests OBOR nations should choose on the basis of their intrinsic current economic conditions^{xix} for example for;
 - **Low-Income Countries^{xx}**: The top priority should be helping to move these economies from dominance by agriculture and mining toward a modern, industrialized model. OBOR governments should consider helping, in particular, to develop labor-intensive industries including food processing, mining-product processing, textiles, furniture, rubber, and toys.
 - **Middle-Income countries**: For these economies, the key development issue is completing their economic transformation. China should consider focusing its collaboration with other OBOR nations in technology and capital-intensive industries, advanced manufacturing such as automobiles and machinery, electronics, biotechnology, and renewable energy.

- **High-income countries:** The focus in these economies should be on boosting industry up the value chain, and service sectors. China can work with OBOR partners on developing information technology, smart manufacturing, finance (especially sovereign funds), tourism, and education.
- Support local government efforts to attract foreign companies and investment. China has an opportunity to help its OBOR partners to develop industrial parks by offering support in attracting investment from state-owned, private, and multinational companies. This investment is needed to help to develop local firms along the value chain, as well as their operation and management capability. Among the key ingredients of these parks' success are appropriate taxation, and efficient administrative and financial services for companies. In the Thai-Chinese Rayong Industrial Zone, for instance, companies are free from income tax for the first eight years and pay half the full rate over the next five, or alternatively don't pay income tax for the first four years and at a half rate over the next nine. The Zone also provides transport to and from airports, company registration, and help with applications for industrial-land licenses. In the China-Africa Lekki Free Trade Zone, all enterprises are exempt from tax and foreign-funded enterprises are allowed 100 percent holdings, and have the benefit of a one-stop-shop for services including customs, immigration, and the police. Based on a network of industrial parks, China can work with its OBOR partners to build cross border free-trade and economic zones that will help to

make full use of the comparative advantages of different economies and integrate local businesses into global markets. We see scope to build between 50 and 80 overseas economic and trade zones in the OBOR region over the next few years.^{xxi}

2. Improving Social Well-Being

Another priority for China and its OBOR partners is to ensure that citizens have a model of community building that will help their citizens to enjoy a decent quality of life. There is a substantial body of evidence suggesting a close link between decent living conditions and sustainable economic growth. China is at the forefront of today's urbanization as well as community building. China can now use its experience to help other governments make similar strides. We expect that China takes affordable housing as a starting point, since the provision of affordable housing is one effective way to improve living conditions, particularly in cities that are increasingly important growth engines of the world economy due to their scale economics.^{xxii} MGI has estimated that, by 2025, 200 million households in developing countries will live in crowded, inadequate, or unsafe housing.^{xxiii} In the Kenyan capital Nairobi, for instance, two thirds of the population is squeezed into less than 2 percent of the land, typically in shacks smaller than ten feet square. MGI estimates that replacing today's substandard housing and building additional units needed by 2025 will require investment of \$9 trillion to \$11 trillion for construction. To promote affordable housing also requires large amount of collateral, which is estimated to be around \$300-400 billion per year by 2025 (not including loans to real estate developers), accounting for about 7 percent of for global mortgage collateral. The provision of affordable housing is expanding at phenomenal speed in China—4.8 million in affordable-housing units were completed in 2014, and another

7 million units have begun construction in the same year.^{xxiv} There are at least three areas where China can share its experience:

- Encourage private-sector involvement in construction. Some Chinese cities have a rule requiring developers to dedicate a percentage of their commercial residential developments to affordable housing units backed by fast-track channels that expedite various administrative procedures.^{xxv} This inclusivity principle has helped to persuade private-sector developers to become more actively involved in constructing affordable housing. In practice, it is necessary to also build public-transport infrastructure alongside affordable-housing development. Many low-income households cannot afford private cars, and therefore, they rely on public transport.
- Promote integrated construction to reduce costs. Using integrated full industry-chain management can reduce costs and improve efficiency. Country Garden, one of the top ten real-estate companies in China, uses identical integrated design, construction, interior decoration, and even manufacturing of construction materials in all of its 20 developments in Guangdong. This approach, which others could emulate for large affordable-housing projects, means the company can complete a project in just three months, and rigorously control costs.
- Spread the use of provident funds. China's mandatory, state-run provident-fund model of financing for affordable housing appears to be a good fit for developing economies in the OBOR region that may have inadequate credit and financial systems. China's

fund, put in place in 1994 to provide people with low-interest loans and stimulate growth in the real-estate market, totaled \$6.47 trillion in 2014 and its utilization rate reached 50 percent.^{xxvi}

Experience from other developing countries can also be leveraged, Mexico's INFONAVIT, for instance, has an independent risk-management committee, and independent audit commissioners appointed to determine interest rates based on applicants' income level and to use idle funds for affordable-housing construction.

China as the New Global Leader

Donald Trump has become the 45th president of the United States. Among his promises are a 45 percent import tax on Chinese products, the cancellation of the Paris climate agreement and the end of the Trans-Pacific Partnership trade deal. If he does not go back on his plans for global trade and international affairs, Trump will give room to other nations to take the lead in shaping globalization. While the US might be taking a step back from the world – a world it helped to create, to a large extent – China in particular can be expected to take on a more prominent role. Something China understands very well is the importance of connectivity – and hence transport infrastructure – for economic growth and development. Its major development framework is the One Belt One Road initiative with its two pillars, the Silk Road Economic Belt and the 21st Century Maritime Silk Road. This development project involves a territory equal to 55 percent of global GDP, 70 percent of the global population and 75 percent of its known energy reserves. The investments will involve about 300 projects extending from Singapore to Turkmenistan. One building block of One Belt One Road – also known as OBOR – is the Regional Comprehensive Economic

Partnership (RCEP). This China-driven alliance will comprise Australia, New Zealand, China, India, Japan and South Korea – as well as the ASEAN region. In 2014, ASEAN was the seventh-largest economic power in the world. It was also the third-largest economy in Asia, with a combined GDP of US\$2.6 trillion – higher than all of India. With the New Development Bank (NDB), the Silk Road Fund and the Asia Infrastructure Investment Bank (AIIB), China has prepared itself for responses to major financing needs – within and beyond the Belt and Road area. This shows some similarity with the Marshall Plan, the US support plan that helped to rebuild Western Europe after the end of the Second World War. If wisdom and resolve prevail, three decades from now, the Belt and Road Initiative will exemplify the benefits that a rising China can bring to the world. It is now more important than ever that the next chapter of the China story be centered on a commitment to sustainable development. This emphasis is the only key to preserve China's legacy and to ensure global prosperity for decades to come.^{xxvii}

OBOR's Capability of Restructuring Global Economy towards Sustainable Development

The success of the initiative, which spans nearly 100 countries, will depend on whether long-term concerns are prioritized.^{xxviii} In the face of climate change, a transition away from fossil fuel consumption and towards environmental sustainability is imperative. The good news is, within and outside China, models of sustainable development appear promising. The launch of the belt and road follows three decades of rapid economic growth in China, which has been fuelled by infrastructure development and intensive energy consumption. As a result of this legacy, China's investments in the initiative have attracted skepticism.

Observers questioned whether the belt and road is merely a vessel for China to reproduce its old development model, which, despite ushering in unprecedented growth, has led to widespread environmental degradation. Such questions are valid, considering that, between 2005 and 2016, 40 per cent of China's outbound investment was directed towards energy projects and 18 per cent to infrastructure. Moreover, environmental negligence is one of the most frequently cited complaints about Chinese companies overseas. The belt and road countries are home to some of the world's most vulnerable ecosystems and most precious carbon sink. They also use much of the world's resources: a study conducted by the Chinese Academy of Social Sciences found that 38 key belt and road nations emit more than 55 per cent of the world's greenhouse gases and consume 66 per cent of global water resources.^{xxix}

Within and outside China, models of sustainable development appear promising. Domestically, China has begun to decouple its economic progress from fossil fuel consumption and is now home to the world's fastest-growing renewable energy industry. China's coal consumption has fallen for three years running, a key factor in the flattening of global greenhouse gas emissions. Internationally, the imperative for multilateral sustainability initiatives is indisputable, as exemplified by the Paris agreement on climate change. If wisdom and resolve prevail, the Belt and Road Initiative will exemplify the benefits that a rising China can bring to the world. Shaping belt and road projects with the environment in mind makes economic sense. A focus on sustainable development will help achieve economic and political stability for China and its belt and road partners.^{xxx} It will improve energy efficiency and limit regional conflicts over natural resources. The question now is how to ensure that long-term imperatives are not overlooked in favor of short-term

profit. Doing so requires rules and processes, backed by high-level political resolve. It also depends on the inclusion of diverse stakeholders to assess the environmental implications of belt and road initiatives. It is crucial that China make publicly available information about the overseas belt and road projects, subjecting them to scrutiny from local and international communities. The belt and road has the potential to shape sustainable development across three continents. The initiative is ambitious and complex. It calls for collaboration from key international actors, such as the UN, the EU and the multilateral development banks.^{xxxi}

OBOR Is Globalization

Introduced in 2013, OBOR intends to revive two famous ancient trading routines from China to Europe. Its aim is to extensively facilitate the cooperation among countries on the land-based "Silk Road Economic Belt" and oceangoing "Maritime Silk Road". If successful, OBOR will grant this region great economic benefits and competitive advantages. Regardless of the details, OBOR is essentially a plan towards globalization. By forming regional economic partnerships to countries within the 'belt' and the 'road', China will be able to integrate itself to the world's economy, while strengthening its influence in these regions. Some scholars have reached a consensus that "globalization has been naturalized as the inevitable pathway to economic prosperity and success". For governments that "act strategically in order to attract economic activity to their jurisdiction with the ultimate aim of boosting aggregate growth, globalization is undoubtedly the way to go". In fact, globalization is nothing new to China after the Chinese Economic Reform and Opening Up in the late 1970s. Besides China, over the past few decades, other governments are also more willing to open the national economy to global market

forces. In 1960, Ronald Coase proposed the transaction cost theory. Oliver Williamson enriched the theory by adding the relationship mechanism. Taken literally, transaction cost refers to the costs to complete a market transaction. Transactions can be completed through the market, relationships and inside the firm. In fact, we can apply the transactions cost theory into international setting. The simplest interpretation of globalization is to do transactions with other countries. There are also three ways to transact between countries. Taking China for example, the first way is the market, where all other countries are treated equally and there are straightforward and explicit contracts. The second way is the relationship mechanism. OBOR is the best example for this. Countries along the OBOR region can transact relatively easily with each other and negotiate when necessary. The third way is to form a firm-like organization. Countries inside the organization can transact and negotiate with each other whenever necessary. A close example to this is World Trade Organization (WTO).^{xxxii}

OBOR versus Market

The market mechanism provides most benefits because all profitable transactions will take place. However, not all transactions' benefits outweigh the corresponding costs, especially in an international setting.^{xxxiii} These costs take various forms, geographic, political, military, and so on. Therefore, free trade is not working for the majority of the world. In other words, the high transaction costs prohibit lots of cross-border transactions from happening. The OBOR, if successful, will significantly reduce transaction costs mentioned above and thus induce more cross-border transactions. These reductions can be reflected in the following ways: transportation costs will be lower due to investments in cross-border infrastructures; tariffs costs within

the OBOR region will be lower due to favorable policies; frequent co-operations improve OBOR members' knowledge of each other, thereby reducing the cost of information searching; the trust built within the region can guarantee a steady transaction environment, thereby reducing the policy enforcement costs. In short, for members within the OBOR plan, OBOR is more preferable to the free market since it offers lower transaction costs.

OBOR versus WTO

Although both WTO and OBOR aim to facilitate cross-border transactions by lowering transaction costs, there are a few very important differences. Firstly, OBOR treats its members differently, while WTO treats its members equally. Each OBOR member can make contract with another member in differently terms and conditions based on their relationships, while all members within WTO need to follow the same rules. Secondly, OBOR offers more flexibility than WTO. The contracts and rules can easily be re-negotiated when necessary, while it is unlikely for WTO to constantly change its rules. Lastly but most importantly, the two have different beneficiaries. Clearly, the equilibrium of OBOR requires that everyone inside OBOR is a winner. However, for WTO, there is only one winner - WTO as a whole. Worse more, WTO is highly biased towards the developed and rich nations and thus failing developing nations and therefore lowering their true incentives to participate. In a world where each country pursues its own interest, the OBOR initiative is clearly more feasible than the WTO. In fact, some experts have already pointed out the failures of WTO based on the above analysis in recent years. Therefore, OBOR is more likely to sustain in the long run than WTO.^{xxxiv}

OBOR versus Marshal Plan

New financial institutions have been set up

to further OBOR and co-related objectives, most notably the Asian Infrastructure Investment Bank (AIIB),^{xxxv} the New Development Bank (formerly "BRICS" Development Bank), and the Silk Road Fund. China's Foreign Minister Wang Yi said that the OBOR was a "tool of geopolitics". In a nod to Western critics' fears about China's real intentions,^{xxxvi} he said the project should not be viewed through an "out-dated Cold War mentality".^{xxxvii} Su Hao has a similar analysis that regional powers are concerned about China's rise because, historically, a country that grows more powerful tends to "bully" others.^{xxxviii} However, the world has entered a new period: China today is "a giver, not a taker" and it aims to help poorer countries in its neighborhood to develop.^{xxxix} In an editorial published in Huanqiu Shibao, China refuses "traditional geopolitical confrontation", China neither "strive for hegemony" and nor "cheat and threaten" its neighbors. China is working for peace, and the implementation of the OBOR is the evidence of this commitment. Indirectly criticizing the US as a traditional power, Chinese officials and academics repeatedly stress that OBOR differs from Marshall Plan. Wang Yi states that comparing the OBOR to the Marshall Plan is like comparing "apples and oranges". The OBOR is based on "open cooperation". During China Development Forum, Foreign Minister Wang Yi said that "economic imbalances" are the root causes of conflict and that China should provide more "public goods" to mitigate such instances.^{xl}

Conclusion

The OBOR initiative has a real potential to bring different parts of Asia closer through physical, psychological, economic, cultural, environmental and political connections. Infrastructure will improve at places which need it and promote economic development along the way. It

will also bring East Asia together with Europe making the World smaller. The major economic flows are likely to be between China and Western Europe simply because those are the biggest markets along the “Belt” and the “Road”, with the potential to heal the wounds 2008 economic crises with coordination and cooperation, bases for Crises management.^{xli} Improving international relations eventually reducing the risk of conflicts and bringing a possible future of peace and prosperity to the nations is the ultimate goal here. The world’s lack of trust in the Chinese initiative has the solution within Chinese foreigner students (Chinese foreigner alumni association), for the last few years many students from all over the world travelled to get their education in China, now they need to proceed assuming positions with internships or jobs in this OBOR, and help to make clear the Chinese Dream of a World peace building in a multicultural civilization, avoiding conflicts and fighting the environmental disaster, energy and food poverty (Expo 2017 – Astana).^{xlii}

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¹ The Thai-Chinese Rayong Industrial Zone, now home to 60 Chinese companies, was developed by China’s Holley Group and Thailand’s Amata Group. China-Africa Lekki Investment Limited,

registered in Beijing in March 2006, is a joint venture between China Railway Construction

Corporation Limited, China Civil Engineering Construction Corporation, China-Africa

Development Fund and Nanjing Jiangning Economic & Technological Development Corporation.

Thus far, 38 companies have signed contract to invest in the zone with a combined investment of \$100 million.

¹ The suggestions in this paper draw on interviews with scholars, business leaders, and McKinsey experts, but we acknowledge that further quantitative research is needed to build on our findings.

¹ The World Bank defines low-income countries as having a gross national income of less than \$1,045 per person; lower-middle-income with between \$1,045 and \$4,125, upper-middle-income between \$4,125 and \$12,746; and high-income of more than \$12,746. Middle-income includes lower-middle-income and upper-middle-income.

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¹ Speaking at a major international conference in Beijing, United Nations Secretary-General António Guterres today drew comparisons between China's 'One Belt, One Road' initiative and the Sustainable Development Goals, saying both are rooted in a shared vision for global development

¹ New Chinese-led institutions such as the Asian Infrastructure Investment Bank (AIIB), which has committed US\$100 billion to investment along the Silk Road, has promoted itself as "lean, clean and green" and in its Environment and Social Framework commits to helping countries pursue their national commitments under the Paris Agreement. The AIIB also pledged to only fund coal-fired power plants under exceptional circumstances in its 2017 Draft Energy Plan and has yet to approve any coal projects.

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ASIAN INFRASTRUCTURE INVESTMENT BANK: RESTRUCTURING GLOBAL ECONOMY TOWARDS SUSTAINABLE DEVELOPMENT

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Abstract

Beijing's current effort to improve ties and stimulate growth and development along its geographic periphery, facilitating land-based trade across the Eurasian landmass, promoting infrastructural development and connectivity, and stimulating economic integration. These initiatives were seen as a leverage of China's growing economic power and influence in order to strengthen and expand cooperative interactions, create an integrated web of mutually beneficial economic, social and political ties, and ultimately lower distrust and enhance a sense of common security. "One Belt, One Road is a good international economic strategy, but for now it is certainly not an easy one."ⁱ Europe is an integral part of China's transcontinental vision, and the European Union (EU) has its own vested interests in the Belt—as the EU–China Connectivity Platform demonstrates. This plan sets out a vision in which Chinese-led infrastructure construction, reduced tariffs, and simplified customs administration would allow trade to flow seamlessly between China and Europe by both rail and cargo ship.ⁱⁱ China has committed a total of about \$100 billion to a trio of new infrastructure funds: \$40 billion to the Central Asia-focused Silk Road Fund, \$50 billion to a new Asian Infrastructure Investment Bank (AIIB), and \$10 billion to the BRICS-led New Development Bank.ⁱⁱⁱ This paper analyzes the prospective contribution of AIIB in leading the way towards sustainable economic development as it has a renewed vision of financing major projects under the umbrella of renewable energy and has strict guidelines for approval of even other projects in terms of environmental protection. We will analyze different documents obtained from AIIB's official website and other academic literature to find out how AIIB has envisioned a global economy in terms of sustainable development.

Introduction

Recent news that the United Kingdom and other Western European countries will join the China-led Asian Infrastructure Investment Bank (AIIB) has prompted a flurry^{iv} of discussion^v about how the United States, which has been reserved about the new institution, should respond. The Chinese-led AIIB is a new international financial institution (IFI) that will finance infrastructure projects in Asia. Whatever Washington decides, it's clear that the AIIB and other new multilateral institutions are becoming an important part of the development finance landscape. These banks can support much-needed infrastructure improvements in the developing world, but they'll also need to ensure that their investments do not come

at the expense^{vi} of local communities or the environment.

In terms of economic power and population, emerging economies are underrepresented in existing IFIs like the World Bank and Asian Development Bank. Brazil, Russia, India, China and South Africa (BRICS countries) together comprise 21 percent^{vii} of the world economy and 43 percent of the world's population, yet their voting power at more traditional IFIs does not match their size. For example, they collectively hold 14 percent^{viii} and 11 percent^{ix} of voting shares in the International Bank for Reconstruction and Development and International Monetary Fund, respectively. At the same time, today's infrastructure investment needs far exceed the amount of finance currently available. In Asia alone,

the overall need for national infrastructure investment is estimated to be about US\$ 8.22 trillion^x for the period between 2010 and 2020. Existing available capital will not meet this financial need—new financial institutions like AIIB and the New Development Bank (NDB), a bank initiated by the BRICS countries, are stepping in to fill the gap. In October 2014, 21 countries signed an MOU to create the \$100 billion AIIB. As of April 2015, 35 countries had signed up to be prospective founding members—including a number of European countries such as the UK, Germany and Switzerland— and dozens more have applied. The bank is expected to be formally established by the end of 2015. Also in 2014, the BRICS signed an agreement to create a \$100 billion NDB. These banks usher in a new wave of increased development and financial cooperation between developing countries, emerging markets and developed economies. AIIB can be big and profound component of such an initiative of sustainable development for future global economy as its investments towards renewable energy show us.

Global Initiatives for Sustainable Development^{xi}

Major global initiatives for sustainable development are discussed below;

- The Sustainable Energy for All (SE4ALL) initiative, launched by the UN Secretary General Ban Ki-moon in September 2011, has three objectives for 2030: ensure universal access to modern energy services; double the share of renewable energy in the global energy mix; and double the global rate of improvement in energy efficiency. The initiative was launched to coincide with the UN General Assembly Resolution 65/151 of 20 December 2010 that declared 2012 the International Year of Sustainable Energy for All.
- The 2030 Agenda for Sustainable Development is a set of 17

aspirational "Sustainable Development Goals" (SDGs) with 169 targets developed under UN auspices, involving 193 UN Member States and global civil society. The goals are contained in paragraph 54 of the UN General Assembly Resolution A/RES/70/1 of 25 September 2015. One of those goals, SDG 7, calls for ensuring access to affordable, reliable, sustainable and modern energy for all by 2030.

- The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by "holding the increase in the global average temperature to well below 2 degrees Celsius above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5 degrees Celsius". The Agreement also aims to make "finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development". According to the Agreement, countries shall publicly outline nationally determined contributions (NDCs) that they intend to achieve for reductions in greenhouse gas emissions. The Paris Agreement was agreed by 197 Parties during the 21st Conference of the Parties (COP 21) of the UN Framework Convention on Climate Change (UNFCCC) in Paris in December 2015, and entered into force in November 2016.

AIIB's Efforts towards Sustainable Development through promoting Renewable Energy

1. Objective of the Energy Sector Strategy of AIIB^{xii}

- The objective of the Energy Sector Strategy is to provide the framework,

principles, and operational modalities to guide the Bank's future energy sector engagement, including the development of its project pipeline and future sub-sectorial lines of business.

- The Strategy embraces, and is informed by, the principles underpinning the Sustainable Energy for All (SE4ALL), the 2030 Agenda for Sustainable Development, and the Paris Agreement (see Box 1 above). It lays the framework for the Bank to support its client countries to: (i) develop and improve their energy infrastructure and facilitate their transition to a less carbon-intensive energy mix; and (ii) meet their goals and commitments under these global initiatives.
- The Strategy is consistent with the Bank's "Lean, Clean, and Green" core values and its institutional goals. The Strategy embodies the Bank's three thematic priorities: sustainable infrastructure, cross-country connectivity and private capital mobilization. Regular monitoring and reporting of portfolio composition will be an important discipline and help build a portfolio that reflects the Strategy and is aligned with the Bank's core values.

2. Guiding Principles of AIIB^{xiii}

The Energy Sector Strategy is developed around six principles, which will guide the build-up of the Bank's energy portfolio during the early years of operation.

Principle 1: Promote energy access and security. Lack of access or unreliable access to energy services deprives the most vulnerable people from availing of economic and other opportunities to improve their lives. Bank financing for improved energy access and security will support clients in achieving Sustainable Development Goal 7 (SDG 7). The Bank proposes to place emphasis on: (i) promoting, directly or indirectly, access to modern energy by those who currently have little or no access; (ii) improving the reliability of electricity supply; and (iii) reducing the negative health impacts caused by indoor combustion of solid fuels. According to the IEA^{xiv}, achieving universal electricity access for basic human needs by 2030 would increase global greenhouse gas emissions by just 1.3 percent.

Principle 2: Realize Energy Efficiency potential. International experience and primary energy forecasts by international institutions indicate that energy efficiency is one of the major means to achieve global environmental objectives. Prosperity and wellbeing can no longer be gauged by the consumption of energy but by the services derived from it. Given the high energy intensity in most non-OECD countries in Asia, the Bank proposes to cooperate with other MDBs operating in Asia to tap the existing large, but dispersed, potential for energy efficiency in industry, buildings and transport. Initially, the Bank proposes to focus on projects that make the most of existing energy infrastructure stocks through: (i) rehabilitation and upgrade of existing generation plants, and (ii) aggressive loss reduction and utility-driven energy efficiency programs in power and gas transmission and distribution networks. Over time, it will also develop financial instruments and engage with potential financial intermediaries in these areas.

Principle 3: Reduce the carbon intensity of energy supply. Energy is the dominant contributor to climate change, accounting

for around 60 per cent of total global greenhouse gas emissions. The Bank proposes to support clients to reduce the carbon intensity of energy to help them achieve their long-term climate goals provided in the Paris Agreement. According to the IEA 2015 World Energy Outlook, energy infrastructure investments need to be reshaped to meet the Paris Agreement goals:

- Investments in fuel supply during 2015-40 need to decrease from US\$33 trillion in the Current Policies Scenario (CPS) to US\$21 trillion in the 450 Scenario, mainly through a considerable reduction in oil investments, a sizable reduction in coal investments, and slightly lower investments in natural gas (although gas investments will remain significant in all three scenarios);
- Investments in power supply during 2015-40 need to increase from \$20 trillion in the Current Policies Scenario and the New Policies Scenario to US\$22 trillion in the 450 Scenario. The power sector overall would need to focus more on renewable energy (which will need to more than double to meet the goals of the Paris Agreement), and sustained investment in power transmission and distribution (T&D).

The Bank proposes to support energy investments that minimize adverse environmental impacts, and also reflect clients' individual energy situations (e.g., energy resource endowment, affordability of capital-intensive investments, security of supply, etc.). During the transition to a lower carbon intensity energy sector, fossil fuels will continue to play a significant role in the energy mix of most member countries. The Bank proposes to support and accelerate its members' respective transitions toward a low-carbon energy mix through investments in renewable

energy and reduction of carbon emissions from fossil fuels.

Principle 4: Local and regional pollution management. The Bank proposes to support its clients in reducing, limiting and mitigating the deleterious impact of pollution. Fossil fuel production, transport and consumption have severe negative impacts on the local environment, especially in Asia's densely populated cities. Historically, issues related to local and regional pollution have been addressed mainly by limiting emissions of fossil fuel-based power generation, especially coal-fired plants. New projects are now being developed by MDBs to address local pollution specifically and comprehensively, to counter the negative impacts on health and wellbeing. The Bank proposes to cooperate with other MDBs on these initiatives.

Principle 5: Catalyze private capital. The Bank is committed to promote private sector investments to help to close the momentous infrastructure investment gaps in developing Asia. For varying reasons, to date, private capital investments in energy and infrastructure have been marginal in non-OECD countries, although partial credits, investment and country guarantees by MDBs have been instrumental in promoting successful projects in several countries. Innovative approaches have also been initiated using grants and concessional financing by some countries to reduce the cost of electricity generated under public-private partnerships (PPP) and/or to improve risk sharing in PPP ventures. The largest concentrated solar power (CSP) generation project in Morocco supported by the World Bank and African Development Bank and the geothermal project supported by the World Bank in Indonesia are representative of the former approach, whereas the envisaged support of a geothermal PPP project in Nicaragua by the World Bank is illustrative of the latter. The Bank proposes to: (i) explore innovative models to catalyze private investments, and

significantly increase their contribution to meet the infrastructure needs of countries in Asia, especially those that are budget-constrained; (ii) build upon successful experiences and lessons learned of MDBs operating in Asia, especially in PPPs, ensuring that the costs and risks are appropriately shared and distributed; and (iii) explore with clients and private partners new cooperation modalities to meet country needs. In addition, the Bank proposes to avoid crowding out the private sector. When pursuing such opportunities, the Bank will evaluate risk carefully and ensure that appropriate measures are put in place to mitigate and manage such risks.

Principle 6: Promote regional cooperation and connectivity. Regional integration and cooperation are essential to take advantage of synergies, increase market size to improve competitiveness, and create a critical mass for cooperative R&D and manufacturing capabilities. Efforts deployed by MDBs and bilateral organizations in Asian countries and other regions have had moderate success. The Bank proposes to engage client countries and pursue regional connectivity of energy systems in Asia, especially power and gas, with a view to strengthening systems; improving the security and efficiency of energy supply; optimizing the use of resources; allowing for greater flexibility in their operation; reducing local, regional and global adverse environmental impacts; and fostering greater use of renewable energy resources.

Project Process for AIIB^{xv}

AIIB's project process is guided by its strategic goals and thematic priorities: sustainable infrastructure, cross country connectivity and private capital mobilization.

Strategic Programming

AIIB reviews project ideas and proposals from clients, partners and other stakeholders and seeks to achieve an appropriate balance among borrowers, sectors, sovereign and non-sovereign projects. Projects that meet the preliminary

screening criteria are included in the rolling investment program which will be discussed and approved by the Executive Committee on a regular basis.

Project Identification

As part of the Project Identification phase, the prospective borrower submits documentation pertaining to the proposed project. This documentation may include a brief project summary and/or a preliminary or final feasibility report. Following a review of the information received, AIIB may request that additional research be conducted to facilitate a more thorough assessment of the proposed project. This additional research could involve a site visit to further assess needs and potential impacts. It could also involve additional due diligence work related to technical, economic, financial, social, and environmental and governance factors. Based on the initial review, and any additional supportive research, AIIB will work with the borrower to prepare a project concept document to be used in internal deliberations.^{xvi}

Project Preparation

During this phase, AIIB's project team and the borrower's designated agency/agencies will work closely together on project design. In addition, AIIB's project team will make an assessment on the borrower's initial due diligence documents and will work with the borrower's designated agency/agencies to address any identified gaps. Following the project appraisal, the AIIB project team will prepare a Project Document that will include the project objective/impact, rationale, project components, estimated cost, financing plan, implementation arrangement and schedule, project risks and mitigation measures, and any project covenants that were agreed to. Subsequently, after an internal review, the Project Document will be finalized. Afterwards, draft loan agreements and project agreements will be submitted to the borrower for loan negotiations to be held on a mutually agreed to date.

Board Approval

After negotiations with the Borrower, the Project Document is submitted to the AIIB Board. Following the Board approval, the Project Document is posted on AIIB's website with the Borrower's consent. After Board approval, the Borrower's representative and AIIB's Vice President and Chief Investment Officer sign the loan and project agreements at a mutually agreed date. The loan becomes effective only after fulfilling the respective loan effectiveness conditions, if any and the legal requirements (legal opinion etc.).

Project Implementation

AIIB focuses on project readiness during the project preparation stage to avoid project start-up implementation delays. This preparation stage includes: (1) Procurement readiness (advance procurement actions for recruiting consultants and selecting contractors/suppliers);

(2) Implementation readiness (setting-up fully functional project implementation offices with qualified key staff). The designated project executing/implementation agency or agencies are responsible for implementing the project by executing each project activity as agreed in the detailed project description document, which provides overall project implementation guidance. The main purpose of achieving project readiness before the start of project implementation is to shorten the project implementation period and achieve the project impacts at the earliest.

The Borrower's Project Implementation Office is responsible to implement the project in a timely manner. If needed, the Borrower may recruit consultants to provide specialized professional services in areas such as detailed design, preparation of bidding documents and procurement of contractors for works, suppliers for the required goods, and capacity development through trainings in all the multidiscipline areas as needed. AIIB's project team remains fully engaged

during project implementation from the stage of inception to completion. Being a lean organization, AIIB's monitoring of project implementation and guidance for the Borrower's team are not limited to only periodic fielding of review missions that usually are twice a year. The AIIB team also offers its advisory services through video and teleconferences as and when required to review project implementation progress and resolve any issues in a timely manner. In addition, the Project Implementation Office of the Borrower prepares monthly progress reports, including an environmental and social management report, and shares them with AIIB. Such reports highlight the updated progress of each project component and loan covenant, contractual or project management issues (if any) and respective actions. AIIB also holds project launch workshops on procurement, disbursement and environmental and resettlement related implementation plan to support designated project implementation agency/agencies for smooth project implementation.^{xvii}

Project Completion and Evaluation

AIIB furnishes a project completion report within 6-12 months after project completion. The AIIB team prepares a Project Completion Report (PCR) on the Project's results, the performance by the Project Participants and AIIB, and the degree of achievement of the Project's development objectives. The PCR provides the comparison of project impacts, outcomes, components, and implementation arrangements as originally designed and as achieved at completion, as well as the main lessons learned for incorporation in future project designs. The PCR incorporates an evaluation by the Project participants, their performance and that of AIIB, if available. Upon approval by the Vice President and Chief Investment Officer of AIIB, the Project Completion Report is submitted to the Board of Directors for information.

Conclusion

Global warming and the various catastrophes associated with tend to increase the significance of restructuring the global economy based on renewable energy sources. Future international institutions have to realize this truth as soon as possible as their success lies with the success of economy based on renewable energy and sustainable development in future. China had proclaimed itself as the leader in economic development as envisioned through One Belt One Road (OBOR). AIIB is one the three financial institutions associated with OBOR. According to a vast exquisite plan of restructuring world economy on the basis of sustainable development as China has necessary resources and influence due to OBOR over world economies for redirecting funds towards renewable energy sources through Asian International Investment bank (AIIB). Evidently it is the right and necessary step that AIIB is overlooking promisingly.

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Infrastructure Investment Bank (AIIB), the BRICS’ New Development Bank, the Silk Road Fund, a CIC-backed fund (announced recently, during Li Keqiang’s visit to Brazil), and even, possibly, a SCO Development Bank.

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¹ The IDFC reports Green and Climate Finance Data through the Green Finance Mapping reports. www.idfc.org/Our-Program/green-finance-mapping.aspx

THE ACTUAL CONDITION OF VACANT HOUSES LOCATION IN CENTRAL URBAN AREA OF LOCAL CITIES

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Abstract

In Japan, decline of the central urban area has been a major problem for a long time. In addition, in recent years, an increase in vacant houses has become an issue all over Japan due to population decrease and the aging population. There is also concern that the number of vacant houses will increase in central urban areas. In this research, we grasped the actual conditions of vacant houses in central urban areas and analyzed location trends in the target 5 city. We investigated the vacant houses in each central urban area and after land use of disappeared vacant house, and analyzed the location trend of vacant houses about the following three points; "Distance to station", "Road contact condition", and "Building area". we can mention to the tendency of vacant houses location is the house which is located far from station, have contact with narrow road, and have relatively small building area.

Keywords: Vacant house, Central urban area, Local city

1. Introduction

Over a long time in Japan, in central urban areas, various urban functions such as residential function, commercial function, and public function were collected. However, many of its functions have been relocated to the suburbs with the progress of motorization, further suburban locations of large-scale commercial facilities and decreasing population of residents have led to the decline of central urban areas [1].

The problem with the decline in the central urban area did not start in recent years. In 1998, the three-town planning law (hereinafter referred to as "Three Laws") were enacted in order to revitalize the central urban area. However, the reduction of the population in the central urban area and the suburbanization of various functions were not stopped, and in 2006, new Three Laws were established to improve the problems of the conventional three laws. It became possible for each municipality to receive assistance such as a special example of taxation system from related ministries and government subsidies when the municipality created the central urban area activation basic plan (hereinafter

referred to as "Basic Plan") and certified by the prime minister.

And in recent years, due to population declines and aging population, the increase of vacant houses has become a big issue throughout Japan, and each local government actively takes a survey of empty houses and takes countermeasures.

Even in the central urban areas where population declines and aging population are contributing to the decline, there is concern that the number of vacant houses are increasing, and it is considered that it is a factor of the decline in the central urban area.

In this study, we first analyze the vacant house trends in 35 cities which has Basic Plan and a population size from 100,000 to 400,000 excluding the metropolitan area. Then we investigated the actual conditions of vacant houses in central urban areas in the 5 cities: Obihiro city, Hirosaki city, Ueda city, Kofu city and Isahaya city, which showed characteristic trends among 35 cities.

The purpose is to analyze the location trend of vacant houses while paying attention to the subsequent use of the lost vacant house,

“distance from the station”, “road contact condition” and “building area”.

2. Literature Review

There are many previous literatures about the central urban area.

Fuji et al (2008) mentioned the influence of condominium location on central urban area activation based on reading the surveys for both condominium residential and commercial staff [2].

Mituda et al (2009) mentioned the effect of a plane parking lot on central urban area activation for 53 cities accredited to the basic plan [3].

There are also many previous literatures about the vacant houses.

Yoshitake et al (2016) mentioned a future image review about the occurrence and extinction of vacant houses and vacant lots in Yokosuka cities Yato area [4].

Yamashita et al (2015) mentioned the occurrence factors of vacant houses in Utsunomiya city by focusing on the occurrence pattern for 31 years [5].

However, there are few literatures about vacant houses in central urban areas, and in addition, most of literatures mention only one city or one area, therefore there is an issue that characteristics of vacant houses are characterized by regions, and cannot find any similarities.

3. Vacant House Trends in 35 Cities

We first analyzed the vacant house trends of whole city in 35 cities which has certified Basic Plan and has a population size from 100,000 to 400,000. For the analysis, we used the “Land and Housing survey” by the Ministry of Internal Affairs and Communication, between 2008 and 2013. Figure-1 shows that the relation between vacant rate and increase/decrease of vacant rate in 35 cities. Vacant rate is expressed by percentage of vacant houses relative to the number of houses.

From the analysis, we got the changes in the vacant rate is roughly unchanged between 2008 (16.3%) and 2013 (16.5%). However, the vacant rate in 2013 in Japan

as a whole is 13.5%, therefore the vacant rate in local cities is in high flux. From figure-1, 21 cities are increasing in vacant rate. We decided to investigate the central urban area in 5 cities which showed characteristic trends regarding both increase and decrease: Obihiro city, Hirosaki city, Ueda city, Kofu city, and Isahaya city.

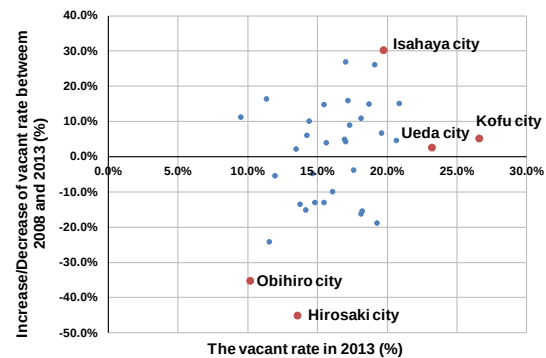


Figure-1: The relation between vacant rate and increase/decrease of vacant rate in 35 cities.

4. Research Methods of the Vacant House in Central Urban Area

In this study, we used the housing map to investigate the vacant houses in each central urban area because of there is no data about vacant house location that the municipal government have released.

We determined the vacant houses in central urban area in 5 cities between 2011 and 2016, then made charts of the distribution of vacant houses in each 5 central urban areas. We divided the vacant house distribution into three types: “a vacant house that occurred after 2012”, “a vacant house that kept standing since 2011”, and “a vacant house that disappeared after 2012”.

The area of central urban area is based on the basic plan in each city.

In this study, we focused only on detached houses, therefore we excluded the apartment and condominium.

5. Actual Condition of the Vacant House in 5 Central Urban Area.

5.1. Hokkaido Prefecture Obihiro City

The vacant rate in the whole of Obihiro city was 13.8% in 2008 and 10.2% in 2013. We can confirm that the trend of vacant houses is decreasing in the whole Obihiro city. Population and household in central urban area were 2,889 (population) and 1,762 (household) in 2011, 2,744 (population) and 1,760 (household) in 2016.

Figure-2 shows the distribution of vacant houses in the Obihiro central urban area. We confirmed the existence of 90 vacant houses in 2011 and 84 vacant houses in 2016. The vacant rate in central urban area was 16.1% in 2011 and 14.3% in 2016, it is a decreasing trend the same as the trend of the whole of Obihiro city.

In figure-2, there is a large distribution of vacant houses in the northeast area, along the national roads and major regional roads. In addition, we confirmed there are many vacant houses which occurred and disappeared in the northeast area.

Northeast area is the area where is expected the commercial function, from this, this area, it is feared that the decline of commercial function because of the influence of the vacant houses in bad affect to high-degree application.

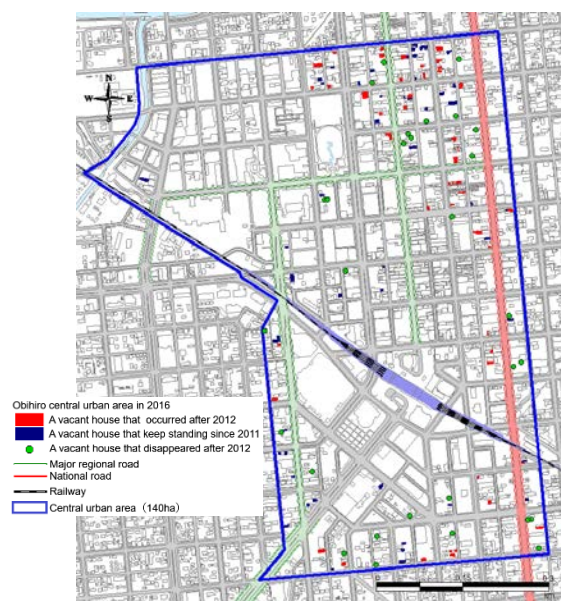


Figure-2: Distribution of vacant houses in Obihiro central urban area

5.2. Aomori Prefecture Hirosaki City

The vacant rate in the whole of Hirosaki city was 19.7% in 2008 and 13.6% in 2013. We can confirm that the trend of vacant houses is decreasing in a whole Hirosaki city. Population and household in central urban area were 7,498 (population) and 3,583 (household) in 2011, 7,520 (population) and 3,832 (household) in 2016.

Figure-3 shows the distribution of vacant houses in the Hirosaki central urban area. We confirmed the existence of 150 vacant houses in 2011 and 158 vacant houses in 2016. The vacant rate in central urban area was 10.6% in 2011 and 15.8% in 2016, it is an increasing trend in the central urban area against the trend of the whole of Hirosaki city.

In figure-3, there is a large distribution of vacant houses in the center area and along the major regional roads.

There are 14 large condominiums in the center area, from this, we need to ascertain about the relationship or influence of the condominiums location.

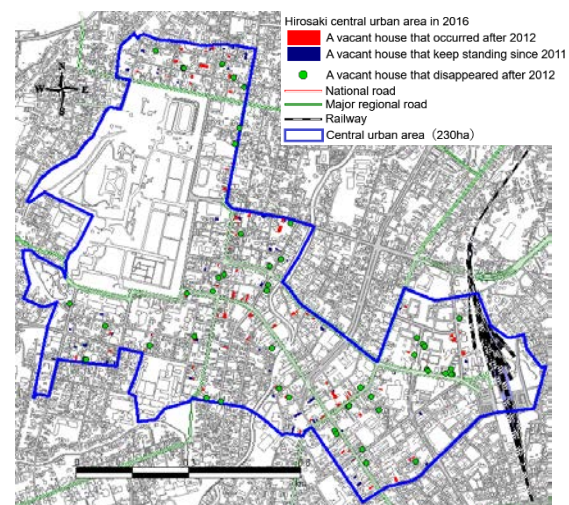


Figure-3: Distribution of vacant houses in Hirosaki central urban area

5.3. Nagano Prefecture Ueda City

The vacant rate in the whole of Ueda city was 22.7% in 2008 and 23.2% in 2013. We can confirm that the trend of vacant houses is increasing and the high vacant rate in a whole Hirosaki city. Population and household in central urban area were 9,996 (population) and 4,598 (household) in 2011,

10,382 (population) and 5,003 (household) in 2016.

Figure-4 shows the distribution of vacant houses in the Ueda central urban area. We confirmed the existence of 302 vacant houses in 2011 and 333 vacant houses in 2016. The vacant rate in the central urban area was 18.1% in 2011 and 22.3% in 2016, it is an increasing trend in the central urban area the same as the trend of the whole of Ueda city.

Ueda central urban area has the most vacant houses of the 5 cities, and from figure-4, vacant houses are distributed in the whole area and especially along national roads and major regional roads. There are also many occurrence and distribution of vacant houses, the corrective action is smooth but more than that new vacant houses have occurred, we can mention that this is a serious condition.

Saito (2014) mentioned, In Japan, it is difficult to circulate vacant houses again in housing market [6]. However, in the Ueda central urban area, many vacant houses are destroyed without being neglected. From this, we need to clear the process of smooth vacant house corrective action and circulate.

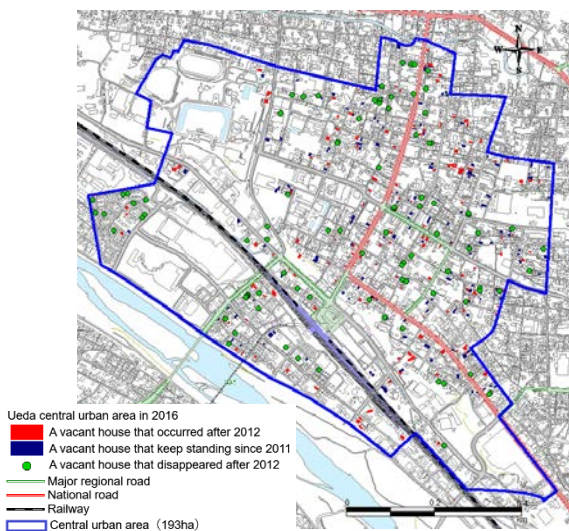


Figure-4: Distribution of vacant houses in Ueda central urban area

5.4. Yamanashi Prefecture Kofu City

The vacant rate in the whole of Kofu city was 25.2% in 2008 and 26.6% in 2013. We can confirm that the trend of vacant houses is increasing and the high vacant rate in the whole of Kofu city. Population and household in central urban area were 11,478 (population) and 5,820 (household) in 2011, 12,028 (population) and 6,362 (household) in 2016.

Figure-5 shows the distribution of vacant houses in Kofu central urban area. We confirmed the existence of 231 vacant houses in 2011 and 253 vacant houses in 2016. The vacant rate in the central urban area has 21.9% in 2011 and 27.2% in 2016, it is an increasing trend in central urban area same with the trend of the whole of Kofu city.

Kofu central urban area has many vacant houses, and highest vacant rates of 5 central urban areas. From Land and Housing survey in 2013, the vacant rate in Yamanashi prefecture has highest in Japan, and we can mention the vacant house condition in Kofu central urban area is also a serious condition.

From figure-5, there are few vacant houses distribution around the station and along national roads or major regional roads, on

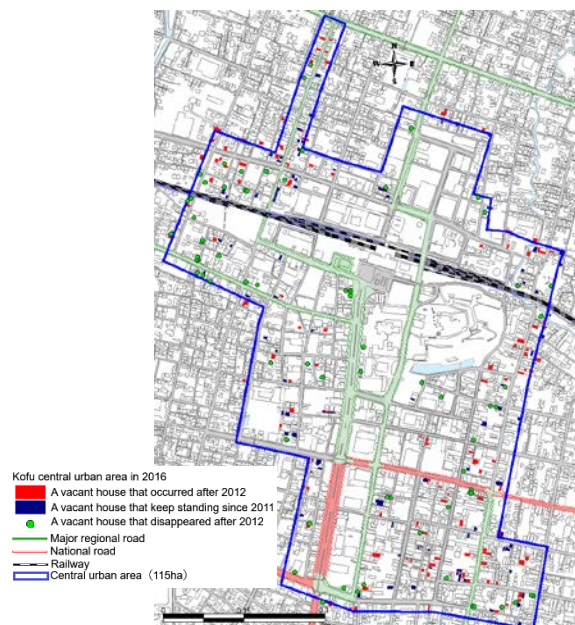


Figure-5: Distribution of vacant houses in Kofu central urban area

the other hand, there are many vacant houses distributed in the northwest area and the southeast area such as areas far from the station.

5.5. Nagasaki Prefecture Isahaya City

The vacant rate in the whole of Isahaya city was 13.8% in 2008 and 19.7% in 2013. We can confirm that the trend of vacant houses is rapidly increasing in the whole of Kofu city. Population and household in central urban area were 10,045 (population) and 4,420 (household) in 2011, 9,852 (population) and 4,417 (household) in 2016. Figure-6 shows the distribution of vacant houses in Isahaya central urban area. We confirmed the existence of 73 vacant houses in 2011 and 71 vacant houses in 2016. The vacant rate in the central urban area was 13.7% in 2011 and 17.0% in 2016. Although there are 2 declines in the number of vacant houses, there are also 15 declines in the number of houses, that's why the vacant rate has increased.

From figure-6, there are few vacant houses compared with other cities, but they are distributed along the railway and in the west area.

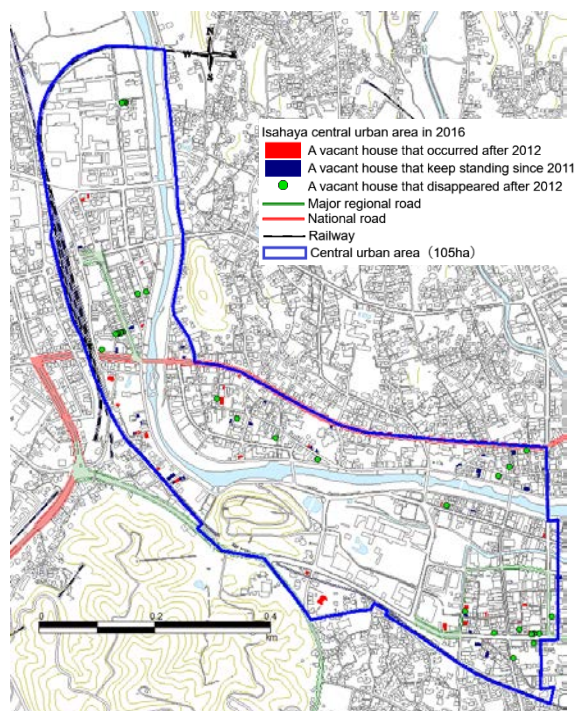


Figure-6: Distribution of vacant houses in Isahaya central urban area

In the west area, there is a shopping district and a plan to develop complex facilities which will have residential, office, and commercial function. By this deployment, this area is expected to have a resident population increase and activation of commercial function. We need to focus on the relationship with the urban redevelopment.

6. After Land Use of Disappeared Vacant Houses

In the previous chapter, we revealed the actual condition of vacant houses in each central urban area, and it might be concerned the effect of vacant house to various function decline in central urban area. On the other hand, effective utilization of vacant houses is an important factor to activation.

In this chapter, we investigated the after-land use of disappeared vacant house.

Table-1 shows, a number of vacant houses which were still vacant houses in 2011 but disappeared when we investigated in 2016, and the rate of disappeared vacant houses in 2011.

Figure-7 shows the breakdown of after land use of disappeared vacant houses in 2016. From table-1, the Ueda central urban area has the most disappeared vacant houses, however, about 30%-40% of the vacant houses disappeared in the 5 central urban areas. From figure-7, a large number of after land uses of disappeared vacant houses are “vacant lots”, “parking lots”, “new occupancy”, and “stores”. Especially, 39.7% vacant houses in sum of 5 cities have changed to vacant lots. Vacant lot is an

Table-1: Disappeared vacant houses and the rate of disappeared vacant houses in 2011

	a : a number of vacant houses in 2011	b : a number of disappeared vacant houses	b/a : the rate of disappeared vacant houses
Obihiro city	90	33	36.7%
Hirosaki city	150	54	36.0%
Ueda city	302	115	38.1%
Kofu city	231	74	32.0%
Isahaya city	73	31	42.5%

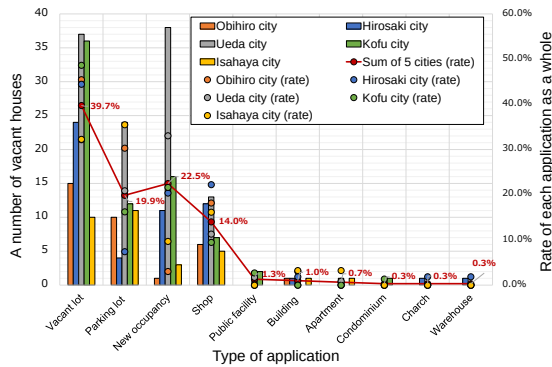


Figure-7: Breakdown of after land use

issue as the low unused land same with vacant house in Japan.

Parking lot is also an issue as the low unused land, however, according to an inhabitant's questionnaire in each cities' basic plan, "lack of parking lot" and "inconvenience of parking lot" is a reason why the people don't want to visit central urban areas. Therefore, parking lots are an important factor to activation in central urban areas.

Looking at each city, "new occupancy" is the most number and high rate compared with other cities. From this, as we mentioned in chapter5.3, smooth vacant houses circulate in Ueda central urban area is still interested.

7. Vacant House Location

By chapter5, we can mention to the characteristics of distribution of vacant houses are distributed along arterial roads and distributing far from stations. And we could see the variety of housing size.

From this, in this chapter, we investigated the trend of vacant house location against 887 vacant houses we could confirm in 2016, with focusing on 3 characteristics: "distance from station", "road contact condition", and "building area".

7.1. Distance from Station

We used the "distance calculation tool" on GIS to investigate the distance from station, dividing it into units of 100 meters.

Figure-8 shows the breakdown of distance from station in each central urban area.

From figure-8, we confirmed there are many distributions of vacant houses in "1000m or more" category, 43.8% of vacant houses distribute over 700m away. Ogawa (2013) mentioned the relationship between housing supply and population, households are stable in areas close to the station in local cities [7]. From this, also in central urban area, housing demand is high in areas close to the station.

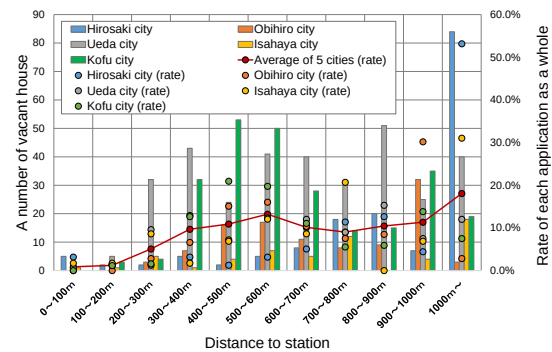


Figure-8: Breakdown of distance to station

7.2. Road Contact Condition

We used the "Nationwide Road Map Data for GIS" to investigate the road contact condition, dividing it into 4 types: "less than 3.0m", "3.0m or more and less than 5.5m", "5.5m or more and less than 13.0m", and "13.0m or more". "less than 3.0m" include a vacant house not in contact with the road. Figure-9 shows the breakdown of the road contact condition of vacant houses.

From figure-9, we confirmed the highest rate is the "less than 3.0m" category, it accounts for 38.5% of overall. In this, there

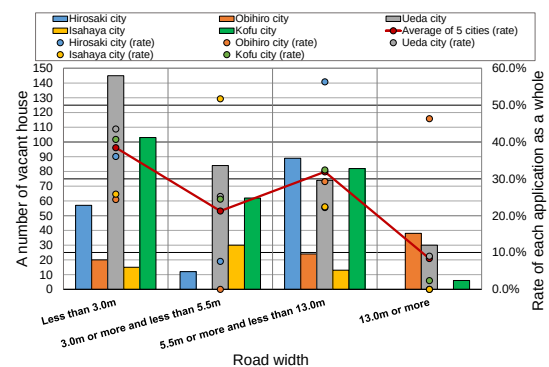


Figure-9: Breakdown of road contact condition

are many vacant houses which are not in contact with the road.

In Japan, the “Building Standards Law” has a “Contact Obligation” that the housing cannot be rebuilt unless more than 2.0m of the site is in contact with a road with a width of 4.0m or more. Therefore, there are many vacant houses which are difficult to update the land, and they might be concerned tends to be a vacant house.

7.3. Building Area

We used the “area calculation tool” on GIS to investigate the building area of vacant houses.

Figure-10 shows the building area by 5 cities. From figure-10, there are many distributions of vacant houses among building area 60-90m² (645sq ft - 968sq ft). According to the “Land and Housing survey” in 2013, the average building area of detached houses is 83.32m² (896sq ft) in Japan, therefore this result is the same as the building area distribution of entire houses in Japan and it is a general result.

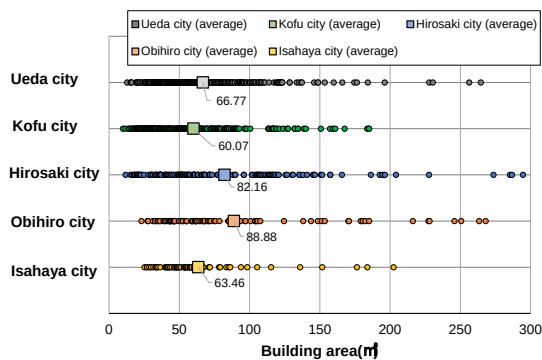


Figure-10: Building area of vacant house

8. Conclusion

The purpose of this study is to clarify the location trend of vacant houses in the central urban area of local cities.

We first clarified the actual condition of vacant houses in 5 central urban areas (Obihiro city, Hirosaki city, Ueda city, Kofu city, and Isahaya city), the number of vacant houses are increasing in 4 cities other than Obihiro city. From this, we can mention to tendency of the vacant house in

central urban area of local cities has get worse.

We can also mention to tendency of the vacant house distribution in the whole of the central urban area has 2 types: “dispersive location pattern” such as Hirosaki city and Ueda city, and “focus intensive location pattern” such as Obihiro city, Kofu city, and Isahaya city.

What we concluded about the vacant house location in central urban areas of local cities is the following 4 points.

- Many properties which had vacant houses became “Vacant lots”, “parking lots”, “new occupancy”, and “shops” after the vacant house disappeared.
- Many vacant houses are located over 700m away from the station.
- Many vacant houses have contact with a road of width less than 3.0m.
- Many vacant houses have building area with 60-90m² (645sq ft - 968sq ft).

Totally, we can mention to the tendency of vacant houses location in the central urban area of local cities is the house which is located far from station, have contact with narrow road, and have relatively small building area.

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TRANSFORMATION OF URBAN LIFE WITH URBAN WATER; NATURAL WATERSCAPE TO TECHNOLOGICAL WATER MANAGEMENT SYSTEM FOR THE CITY OF SÃO PAULO, BRAZIL.

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Abstract

São Paulo, Brazil is ranked in peak inventory for the aggressively urban growth and known as most populous city in the southern hemisphere. Urban water manner is usually indication of the heritage, culture, economy and political issues of a city. The formation of São Paulo can be identified by the presence of large rivers, it was called 'water city' once. But with the response of climatic issues, the rivers lost its natural flow due to rectification and canalization having hard and extensive infrastructural boundaries on both banks, isolating correlation between the river and the city. Almost, the whole water system runs under the ground surface at present. With the water system the social and cultural activities of city dwellers changed through time. Once the city of water is now facing its back towards the water and the rivers are nothing but lifeless infrastructural elements. This paper investigates the transformation of urban life with the transformation of rivers and possibilities of bringing back the life of water for the city dwellers enhancing the cultural heritage of the city.

Research question:

- *How urban life and urban water is co related for the city of São Paulo?*
- *How technologically improvised urban water system can be linked with the city and urban people by improving the environmental factors?*

Keywords: *Urban Water, Urban Life, Identity of city, Culture, Technology.*

1. Introduction

São Paulo is the largest city in the Americas by population and the place of culture, commerce, finance and arts. The location of the city is in the terrain of two main rivers, its floodplains and tributaries. Therefore, the relation of water with the city is proximate. The country uses its river as a vital source of producing hydropower and transportation as well. From the foundation of São Paulo, the regular activities of city dwellers were centralized by water, but currently, the scenario of urban life is opposite. The connection with water and people is lost due to rapid urbanization and road-based urbanism. The strong infrastructural system has created the barrier between river and city, thus the river has become the leftover part of the city which can hardly be seen and felt except during the flood time. This research paper concentrates on the new possibilities of integrating segregated rivers with the city again and revives the history and culture of the city inventing lost public

spaces for the city dwellers. The aggressive urbanization has grown without considering the urban water, where both can collectively perform for balanced urban life.

2. Research Methods

This research presented in the paper was possible by making a field trip to the city of São Paulo for two weeks. Having the opportunity to explore the site by public and private transportation system and taking pictures, interviewing city dwellers on site gave clear idea of the situation. This practical experience along with readers, articles, books, papers, searching in local libraries assisted to prepare the analysis and findings of this research.

The structure and analysis of the paper has been made in two parts. The first part of the research focuses on the shape of the city and conditions of the Tietê River basin. The water system of these rivers and urban areas are investigated. The historic evolution of urban expansion along with

water system is particularly focused in this part. In the second part of the paper, design strategies and proposals are defined. Solutions to connect segregated water with the city and city people are explored by adding ecological features by the river basins. Finally reviving the waterscape enhancing the culture and bringing back life to the lifeless rivers are concerned. Different mapping are used to interpret the design strategies.

3. Historical evolution and Urban growth of the city São Paulo

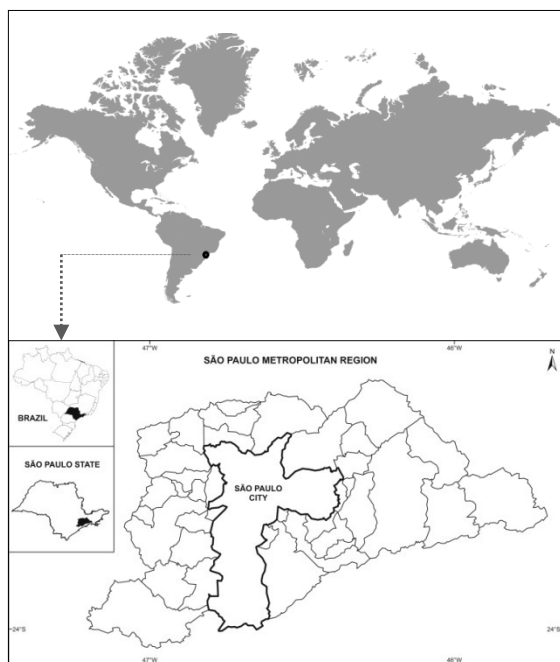


Figure1. Location of São Paulo

[Source: www.sciencedirect.com]

São Paulo, the city of southeastern Brazil has been ranked as the 12th largest city according to the population of the world. Being the nucleus of culture and economy, the metropolitan region of São Paulo is the grouping of 39 municipalities with 21.1 million of inhabitants (2014 National Census). The city of São Paulo is the largest among them. After the political independence in 1822, the city faced foremost changes. Before this the first 300 years were not so significant, it was just the administrative symbol of colonial government.

The coffee was launched to Brazil in 1727 and became a strong component of the Brazilian economy. São Paulo turned to the center for coffee commerce in the nineteenth century. This was a major attraction for foreign immigrants seeking work. The city became most multicultural due to various immigrants from Italians, Germans, Greeks, Japanese, Arabs, Chinese and Koreans. This enhanced the cultural value of the city. Water has been a part of the culture for these multidimensional cultural aspects. Activities centering water of the city was a very common phenomenon.

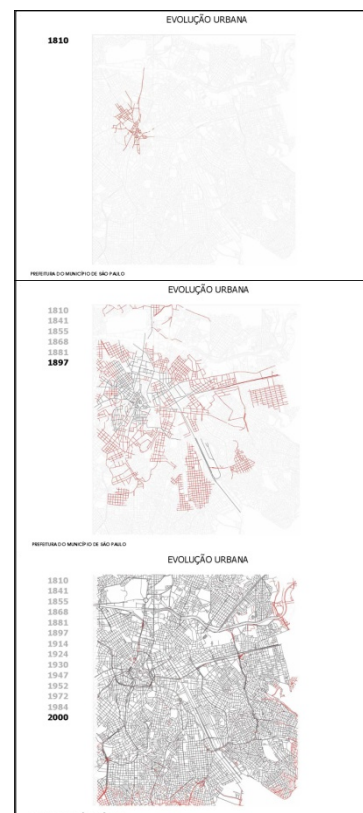


Figure2. Urban Growth of São Paulo during the year of 1810, 1897 and 2000.

[Source: The municipal of São Paulo]

For industrial and commercial purpose as well as for leisure activities, relation with water and city people was incredibly strong and habitual.

The climate of the region is always not favorable for the urban water management and usage. This monsoon-influenced humid subtropical climate go through

plenty rainfall every year (1,454 millimeters on average). The Metropolitan Region of São Paulo is having more precipitation and tremendous rainfall even in winter due to global climate change. Before the 1950s the crest of 50mm of precipitation was never seen but now it occurs two to five times every year. The magnificent locale of São Paulo consists of 7490 km² hills, deep valleys and slopes which floods with the heavy rainfall during summer.

The Brazilian architecture reached its radical moment at the end of the 1960s. After a decade of the inauguration of Brasília, the center of national architectural invention moved from Rio de Janeiro to São Paulo. São Paulo became rich in architecture as well. The buildings of São Paulo had to adapt with the growing chaotic urban flow. The urban design and pattern of the city also evolved with the rapid urbanization. With the urban growth, the infrastructural pattern developed and accommodated population (fig 2). With the construction of new railroads in 1930, the first industrial developments started to concentrate surrounding the railroads. The mobility increased and industrial expansion took place after this.

4. Urban life and Urban water for the city of São Paulo

The rivers and its tributaries, streams, creeks are now running under the city of São Paulo. These were cloaked underground and canalized to reduce the overflow of water during rainy season and hold the rapid urbanization. The relationships between São Paulo city and its water can be divided into three major periods. [1]

4.1. History of Water and city

1st period (16th century-19th century)

Key geographical feature in the São Paulo's urban core was the natural waterscape. The natural waterscape was incorporated into daily life as both ran simultaneously. Rivers were part of life

and integrated with daily activities. It played a fundamental task for transportation and communication scheme. Various athletic activities like 'rowing' clubs were very popular during early 20th century; it was part of the culture of the city.



Figure3. The Tietê River retraced from an old postcard showing the natural waterscape.

[Source: wikiwand.com]



Figure4. Daily activities along the Tietê River

[Source: sao-paulo.estadao.com.br]

Fishing and sports activities and nautical races on the river were very famous during the 1920s and 1930s. Boat race clubs were established in this period, few of them still exist now but lost its charm.



Figure5. The athletic activities along the Tietê River

[Source: sao-paulo.estadao.com.br]

2nd period (From 1850 and 1930)

The technological development influenced the relationships between city and people. To meet the need of water in everyday life and to supply the water to home changed the natural water flow of the city as well. The piping system occurred and sources were placed far away from the city. The natural fountains disappeared day by day and the rivers lost its charm and became a barrier for the city people. Activities centering the river lessened due to hard marginal. Large companies came to build these infrastructural barriers and introduced new technologies. Global capitalism and land acquiring tendencies were also a major factor in this change.

3rd period (1930 to now)

The aggressive urban growth was noticed during this time and still going on the city occupied its own floodplain areas. The marginal and avenues along the river were prominent and cityscape, landscape and waterscape changed after this. The main river was segregated from the city by the strong infrastructural barrier and the tributaries became the branches of traffic, the main water system run under the city. These technologies for infrastructure shaped the form of present São Paulo and spoiled the water resources and connectivity with water and the city. The electricity transmission poles and the railroad are established along the rivers as landscape elements making it more artificial.

4.2. Present condition of Water and city



Figure6. The Tietê River segregated by

strong infrastructural barrier having no physical connection with urban people.

[Photograph by author]

Most of the water bodies lost its life and was hidden permanently under concrete by 1960. The urban growth process and the technological intervention of the city destroyed the water resources and the Tietê River, the Pinheiros River and the Tamanduateí River became polluted by the sewers of the city. Even in 1960s, the Tietê had fishes but due to environmental degradation and construction of the reservoir, tramway, Power Company, hydroelectric power stations killed the river later. Swimming, water sports, rowing and other athletic activities and leisure time spend of urban people came to an end. The city has fully occupied the bank of the rivers where the village of São Paulo of Piratininga was founded once.



Figure7. Pollution of water bodies in São Paulo (present condition)

[Photograph by author]

5. The Alto-Tietê Basin

The Tietê is the main river of the city of and it was named on the map of 1748 indicating the meaning 'The truthful river'. This river runs throughout the metropolitan area of São Paulo and runs 1,136 kilometers in the São Paulo state marking as the north boundary of the city and a desired country destination for the Paulista culture. It runs beside the express highway named Marginal Tietê within the city. In 1907 and 1929 Guarapiranga and Billings Reservoirs were constructed for power generation. Traição and Pedreira pumping plants dominated the landscape along the

Tietê River basin and its tributaries which helped to make the river completely non-natural and extremely polluted. During the 1970s a State Environmental Agency CETESB was created and first wastewater

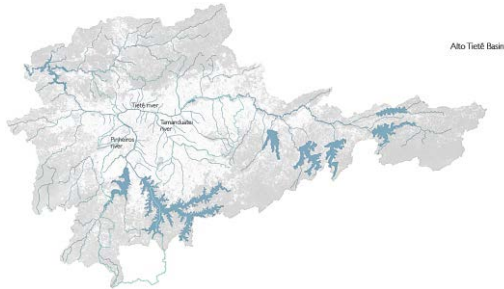


Figure8. The Alto-Tietê River Basin

collection and treatment were built to serve the city. The Alto-Tietê Basin Committee was formed in 1994 and numerous initiatives are taken to improve the water system for the city. The river is biologically dead. [ii]

6. Proposals to revitalize the rivers and the city

6.1. Physical connectivity with urban water and urban people

The segregation of the Tietê River is basically guided by the hard infrastructure including highway and railroads. For this reason the river is inaccessible for the people of the city. The banks (left and right) of the river are a solid concrete surface with no access to the pedestrian.



It would be difficult to change the infrastructural layout quickly but connecting the banks with bridge and promoting activities on the river banks can connect the people with water. The pedestrian walkway and bike path can be designed along the banks connecting with the other side by pedestrian-friendly over bridge will influence the mobility flow towards the water and people will be able to enjoy the nature.

6.2. Environmental contribution

To improve the water quality, a constructed wetland can play a vital role and treat water in a natural process. Wetland vegetation, soil and organisms purify the water by working as a biofilter. Subsurface or hybrid wetlands are an environmental friendly concept to improve water condition. These wetlands can be designed in consideration with contemporary waterscape and artificial ecologies will increase the environmental impact of the city without de-canalization of the river. These wetlands can be used as public spaces and bring people closer to the river. There are few tributaries of the Tietê River still uncovered, preserving those are essential at this time. This will also have a positive impact in solving the flood problem.

Figure9. Proposed wetland construction as public space and promoting activities

along the Tietê River and its tributaries.

[By author]

6.3. Reviving the culture

The history of São Paulo demonstrates how water was an integrated part of daily life. The culture, heritage and leisure activities of life were related which can be introduced in urban life too. Due to urbanization and water management up gradation, the water cultural co-relation has come to an end. Recreating water activities will revive the history of São Paulo's culture and heritage. The accessible water having activities will influence the city people to have their leisure and experience the earlier period again. The lack of cityscape can also be revived by providing public spaces like urban balconies in the interval of walkways, urban parks along the river bank, urban gardens which will give the city dwellers an opportunity to sense the presence of the river once again. Boat clubs can come to its role once again akin to the past.

7. Conclusions

The balanced restoration between urban water and urban life is a necessity for the city of São Paulo. The city having rapid urbanization and aggressive urban growth, a new paradigm in city and water must commence. By rearranging the urban tissue and infrastructure, integration of the water with the city can provide public spaces for urban people. The city of São Paulo will gain the lost tales and revive the cultural meaning and use of urban water with the growing urbanism. The research presented in the paper focuses strongly on the rivers standing as a marginal for the city. The land use pattern and urban tissue can be re-programmed considering the relation with urban life and urban water. This will certainly bring positivism in the culture of São Paulo, reviving the past. The city of water may not turn again as a water city, but definitely, it may turn to a city having proximity with water.

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GROWTH OF URBAN RETAILING IN PLANNED RESIDENTIAL AREAS OF DHAKA: A CASE STUDY OF BANANI

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Abstract

Spatial changes of entire Dhaka city have taken an evolutionary character due to its unpredicted alteration of land use and to some extent lack of planning farsightedness. Even planned areas are also experiencing a drastic functional change in the same urban space; and thus modifying the urban fabric. Some highly planned residential areas of Dhaka are of these categories- Banani R/A is one of this kinds. The sole spirit of residential character has masked here with mostly retail and commercial activities. The objective of this paper is thus two fold; Firstly, to reveal how a well planned, sophisticated residential area like Banani is blending with the commercial flavour, specially the retail-led generations and to which extent its present growth has flourished. Secondly, through the syntactic analysis, an attempt has taken to understand whether the retail development which is obviously spontaneous is following any hidden order within the existing road network of the area.

Keywords: *Planned Residential Areas, Urban Retailing, Retail Led-Generations, Spatial Transformation, Dhaka,*

1. Introduction

The history of evolution of cities throughout the world has brought out some undoubted and basic components which act as influencing factors behind generating and operating a city successfully. Trade and commerce is such an important one amongst them. Later on a specific term “Retail Activities” has been administered for specific retail building types in modern urban context. Thus a specialized built environment has come into being with its own functional characteristics and formal expression for physical identity. Though retail development and its related theories are mostly centered with urbanized context of developed countries, modernizing effect¹ has channeled the concept of retail-led built environment in developing countries too. Bangladesh, being a developing

country of South-Asia, has been experiencing urbanization as a late-20th century phenomenon. And Dhaka as a Capital is in the pivotal role of the process. This city has undergone and still going with the urbanization process so rapidly that spatial transformation and land use changes have been unpredictable to some extent. In most cases the transformation and changes are ending up with a physical interpretation of spontaneous² retail

¹ The influence of western retail environments has been considered to be an effect of modernization in studies of retail in developing countries [1]

² The retail environment in Dhaka is characterized by both the planned and unplanned retail developments, developed through private or government initiative. The government retail developments are physically planned but they do not have any control over tenant mix policy, location and clustering of different retail functions. The private developments do not follow any planning regulations in terms of their physical layout or any other aspects of retail planning theories. From these view points, the retail centres developed either through government or private initiative could not be defined as planned shopping developments. In fact, these so-called planned and unplanned retail developments have grown and chanced within a natural growth process with the growing needs of the various retailer and consumer groups. Therefore, this research defines these publicly or privately planned (so-called) and unplanned centres as 'Spontaneous' retail development.

activities [2]. Unlike some other planned residential areas of Dhaka, this phenomenon is unquestionably evident for Banani. Here retail-led generations in built environment are overriding its spatial identity as a residential zone. But the sustainability of retail development and the still flourishing trend of such building type surely denote some underlying equation of equilibrium among the juxtaposition of residential and retail type buildings. Hence objective of the paper is to focus on the present extent of spatial transformation of Banani residential area into a more retail activity oriented urban space and to find out how the transformation of small scale neighbouring built form into a volumetric commercial space is accommodating with its existing road network and road hierarchies.

A huge scope lies in there to go for an in-depth study about the retail clustering pattern and influence of such growth over the sustainability of the whole area as a new identity of urban regeneration.

However syntactic analysis is done for the specific area considering it as an independent system apart from the whole city. But comparisons with the whole context of urban retail development of Dhaka city may draw a new dimension of further investigation.

2. Literature Review

The changing land use pattern and morphological transformation of Banani has undergone with an extensive study, conducted by Khan, N. during 2007. The in depth research outcome showed that the changing land use pattern is not only the resultant factor of the absence of neighbouring support services and facilities in the initial planning, but also road higherarchy has dominated and enhanced the drastic changes. Thus the two fold aspect has made the transformation a sustainable one though the rapid growth

and development of these commercial activities in the Banani Residential Area are deteriorating the livability of the residence [3]. The major road higherarchy of Banani, classified by Khan, N. is as follows:

- Dhaka-Mymansingh road is one of the busiest two-way thoroughfares of the city and act as the **Primary Arterial road**³ for the Banani Residential area.

- It provides access through two secondary road KamalAttaturk and Road #11 in the east west direction to the residential area, which could be, said **Secondary Arterial road**⁴ for the local area.

- In this area, another type of roads, which serve the purpose of collecting traffic from arterial road and distribute the traffic to the local area, which are known as **Collector road**⁵. In Banani Road #1, Road #23, Road #27 act as a **Collector** from the Primary Arterial Road and Road #4, Road #6, Road #8, Road #10 act as a **Collector** from secondary arterial road.

- Some access roads, which are known as **Local road**⁶, provide access to the individual plots or buildings; collect traffic from the collector road.

³ **Arterial Road** are those road in an urban system which carry high proportion of total urban travel on minimum of mileage; interconnect and provide continuity for major rural corridors to accommodate trips entering and leaving urban area and movement through the urban area; serve demand for intra-area travel as between the central business district and outlying residential area [4].

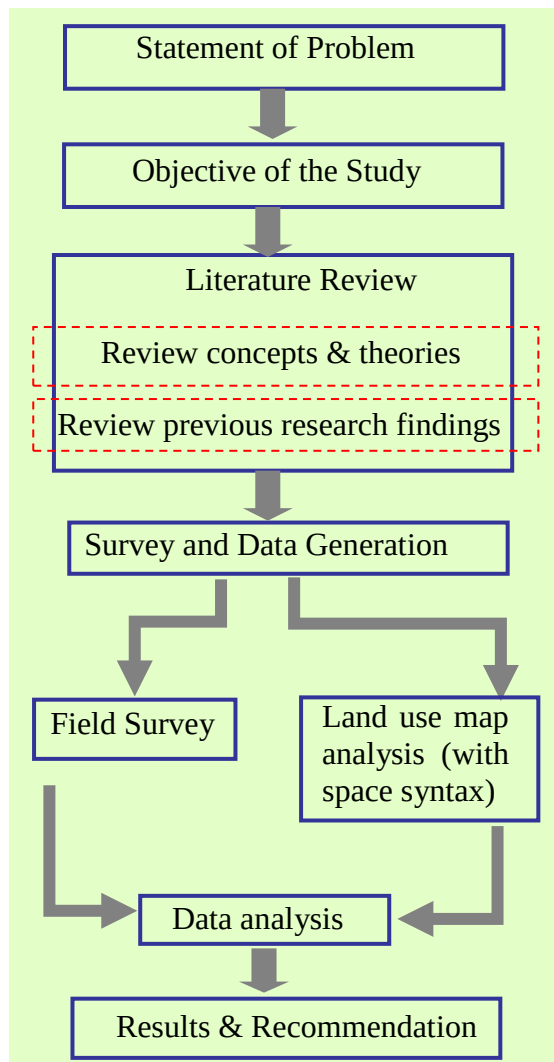
⁴ **Secondary Arterial Road** are those road which interconnect with the principal arterial ;serve trips of moderate length at a somewhat lower level of travel mobility than principal arterials; distribute traffic to smaller geographic areas than those serve by principal arterials; provide more land access than principal arterials without penetrating identifiable neighborhood [4].

⁵ **Collector Road** are those which serve both land access and traffic circulation in residential , commercial and industrial area; penetrate into residential neighborhood ; distribute and channel trips between local streets and arterials [4].

⁶ **Local streets** are those which provide direct access to adjacent land; provide access to higher systems; carry no through traffic movement [4].

3. Research Methods

For the overall study and analysis, Firstly, a field survey has conducted to identify the present trend of retail development in the specific residential area and there by some broad categories of retail types have been generated to classify the development trend ; Secondly, syntactic analysis is done for the Banani residential area as an independent system apart from the whole city of Dhaka using **space syntax** and its different measuring attributes which will be discussed in the data analysis section. All the maps and relevant figures are collected from authentic sources. The overall research framework is shown in the following diagram:



4. Background of the Study Area:

4.1. Location:

Urbanization process of Dhaka has led the city to adapt with continuous changes within its limited spatial organization, as well as expansion where it is necessary. Apart from the spontaneous settlement pattern of the southern region of Dhaka, the most planned residential areas are aligned with the natural growth pattern of the city towards north.

Banani residential area is located in Ward 19 of DCC & SPZ-9 of DMDP and lies in 23 0 47 | to 23 0 48 | N, Latitude and 90 0 24 | to 90 0 24 | 29 | | E, Longitude (Islam 2006).Geographically, Banani Residential areas are bounded by a major arterial road, Dhaka - Mymansingh Road in the west and Banani Lake in the east and south and Banani graveyard in the north [3].

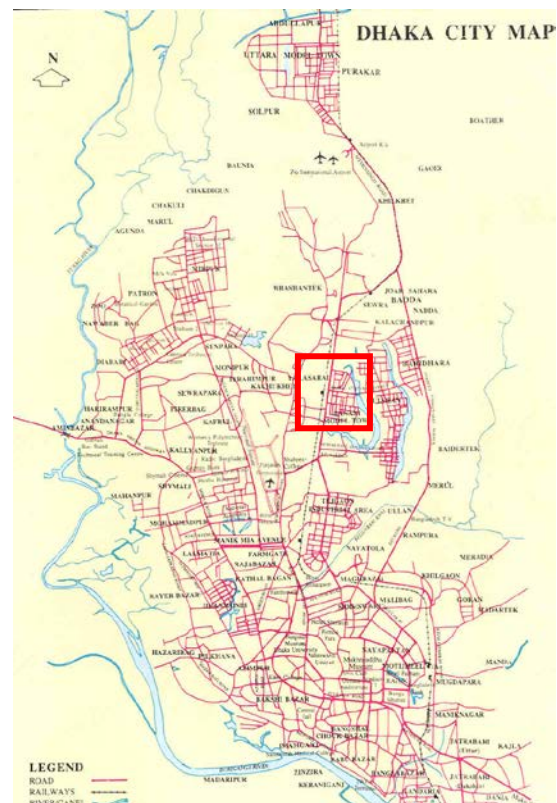


Fig: 1- Location of Banani residential area in Dhaka City Map (Source: Dhaka City Corporation)

4.2. Area Development history of BANANI:

The need for planned residential areas in pre-liberation period enhanced the residential development program of Banani by RAJUK. Banani was developed as a high-class residential area and planned in the style of a regular system of roads to provide residential accommodation for high-income groups after the independence in 1971 [3].

The simplified rectilinear plan in the southern part of Kamal Attaturk Avenue and curvilinear grid in the northern part has integrated the Banani Lake along the eastern side (Fig: 2). Though the physical planning lay out at its initial phase seem worked as it was targeted, the scope of neighbourhood facilities and support services were excluded. As a result, gradually out of necessity, small scale commercial endeavors were building up in a scattered manner within the residential area [3]. Later on the scattered development has taken in some part of the area a huge spatial transformation of clustered development and ribbon like development, among which the recent trend of retail led building type is the most dominating one.

The existing road network and its hierarchy (Fig: 2) has enhanced the adjacent urban mobility to penetrate through the neighbourhood. Consequently the ultimate character of the local roads almost became nearer to the global character of the city context. That's why Banani could not develop as a distinct residential neighbourhood which is important to retain the residential character [3].



Fig:2-Existing ward map of Banani residential area showing the latest development ;New bridge in the east and Peripheral road in the North-east (in red square)
(Source: Dhaka City Corporation, 2011)



Fig: 3- Road network of Banani residential area showing the existing road hierarchy (Source: DCC ward map modified by author, 2012)

5. Analysis & Results

5.1. Existing Retail Features in Banani:

The growth of retail development in last decade has changed Banani from its residential image to a more commercial one. Though all parts of the area are not experiencing the same pace of retail development, the overall image is certainly influenced by the changes in spatial character. Even retail development in this specific area is also governed by the specific socio-economic composition of the catchments area; thus specific categories of retail activities are generating and governing the overall retail character. Banani has now become a posh retail zone for the high-income group of Dhaka City.

To find out the present growth of retail activities in Banani, a field survey has been conducted. Identification process of retail structures has followed a precise division of retail typology under which the sub-categories are specified. The following are the 7 major retail types identified at present in Banani:

- **Shopping Centres-**
 - The multi-storied structures mostly used for shopping
- **Mixed use retail structures-**
 - More than one retail function in a single plot or building
 - Stores can be in ground level or in multi-levels
 - Whole plot used as multiple retail activities by different retailers
 - Building partially used for other purposes (residence/office space/industrial floor) with mixed use retailing on the other floors.
- **Specialized Store-**
 - Any kind of specific retail store in a single plot or building
 - Same type retail can be grouped in a single plot.
- **Service related retail activities-**
 - Tailor/ Parlour/ Saloon/ Dry-cleaning service

- **Restaurant/ Food and beverage related retailing-**
 - Fast food corner/Juice bar/Ice crème parlour/ Restaurant/ Snacks corner/ Coffee shop
- **Kancha Bazar-**
 - Permanent structure
 - Closed or semi open
- **Departmental store-**
 - Meena Bazar, Agora, Shwapno etc
 - Single store on a plot or in the ground floor of a multi-storied residential or commercial building.

The above mentioned retail structures have been identified and marked in the present land use map of Banani (Fig: 4) with a color coding. The map thus depicts a specific image layer of retail development throughout the residential areas.

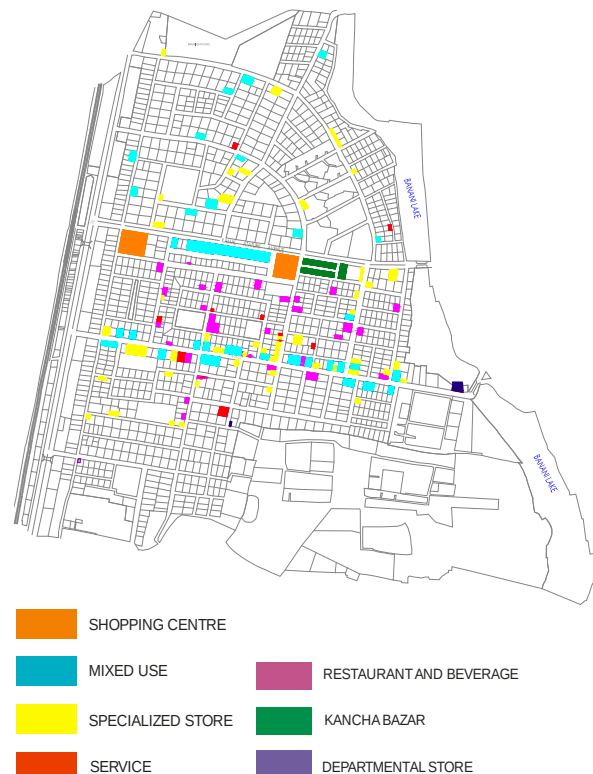


Fig: 4- The current growth of retail development in Banani (Source: DCC modified by Author, 2012)

The concentration of retail activities on both side of Rd No.# 11 shows a ribbon development. Amongst the total no of retail structures identified in the area, the highest are of restaurant and food and

beverage types. The significant no. of specialized stores is also flourished which are mostly the boutique shops. The sole character of independent Shopping mall is limited rather mixed use development is a rushing trend of the changing spatial type.



Fig: 6- Images show the street side linear pattern of specialized retail stores (Source: Author, 2012)

The overall trend of retail growth is following the existing road network hierarchy as most development is along the secondary arterial road and collector road. Local roads are still maintaining the neighboring flavor of the residential character. The major crowd generated by the central retail spine of Rd No.11 is carried away mostly within the northern collector roads and presently dispersing through the Banani Bridge to the eastern part. Thus the equilibrium settlement of residences and retail buildings are not confronting rather blending to accommodate a new urban fabric.

The traditional 4 and 6 storied buildings are now replacing by the mixed use high rise structures; thus a new sky line along the central part of east west direction of the residential area is defining the transformation of the previous neighboring character. The current trend of both mid rise and high rise retail structures in Banani is taking the advantages of the natural setting of enormous green which to some extent is pretending the negative impact of such a drastic commercial fenestration of residential façade.



Fig: 7- The recent trend of high-rise mixed use retail structures mostly along the Rd no.11 (Source: Author, 2012)

5.2. Spatial analysis with syntactic approach

The retail land use of Banani residential area has been examined through the use of space syntax. There are four first order measures in the system; these are- Integration(RA), Choice(CH), Connectivity(CN) and Control(CV). These four may in turn be correlated together to form second order measures.

Integration is the central concept of space syntax. The **integration value** of a line is a mathematical way of expressing the depth of that line from all other line in the system (Hillier & Hanson, 1984). Integration values are the ranked ordered from most integrated to the most segregated lines. In **integration**, the relative depth and shallowness of any spatial system are seen from any particular point within it. These values of well below 1 – of the order of 0.4 to 0.6 indicate more segregation and; while the value ending to and above 1 show strong integration. The analyzed map produced a color map showing the integration value ranging from red (most integrated roads) to blue (Least integrated roads). Integration has now been found empirically to correlate well with observed pattern of space occupancy, use and movement in towns and cities in different parts of the world [5].

Connectivity (CN) is literally the number of immediate neighbours that are connected to a space. It is a local syntactic measure. The **Control (CV)** represents the

amount of choice a space represents to its immediate neighbours as somewhere to go. Thus it acts as a local dynamic measure.

The second order measures even have sociological potential. The correlation between global integration and connectivity is considered as the index of **Intelligibility** of the system which means the degree to which what we can see from the spaces that make up the system. It also leads to a strong sense of readability of the system. In more intelligible system, the people occupancy along the axial line can be predictable from the measure of integration. That means the most integrated lines are the most intensely used by the people and in the non-intelligible system, people occupancy rate along axial line tend to be more random [3].

For the syntactic analysis, the axial map is produced with “Depth map” to reveal the spatial attribute of the specific area. The local integration ($R=4$) map can give us a more detailed illustration about the structure of locally integrated lines ($R=4$)⁷, by computing integration among the spaces up to four steps away from the root [3]. The segmented axial map of Banani is thus analyzed based on the syntactic measures to find out whether there lies any relationship between the Retail land use of the residential areas and its road network along with surrounding spatial structure.

5.3. Detail analysis of the data:

In this section, syntactic analysis of Banani residential area is done to understand the accessibility and connectivity issues about the changing retail land use in the residential area. The numerical measures are compiled in the following chart (Fig:9) to identify the most integrated roads (both

locally and globally) of the locality and their connectivity pattern within the system.

After analyzing the first 3 values of each four syntactic measures, it has been seen that in all four cases of value analysis, the following roads are found holding significant values in most cases:

- Road No# 11
- Road No# 4
- Kamal Attaturk Avenue (KAA)
- Road No# 8
- Road No# 10
- Road No# 18

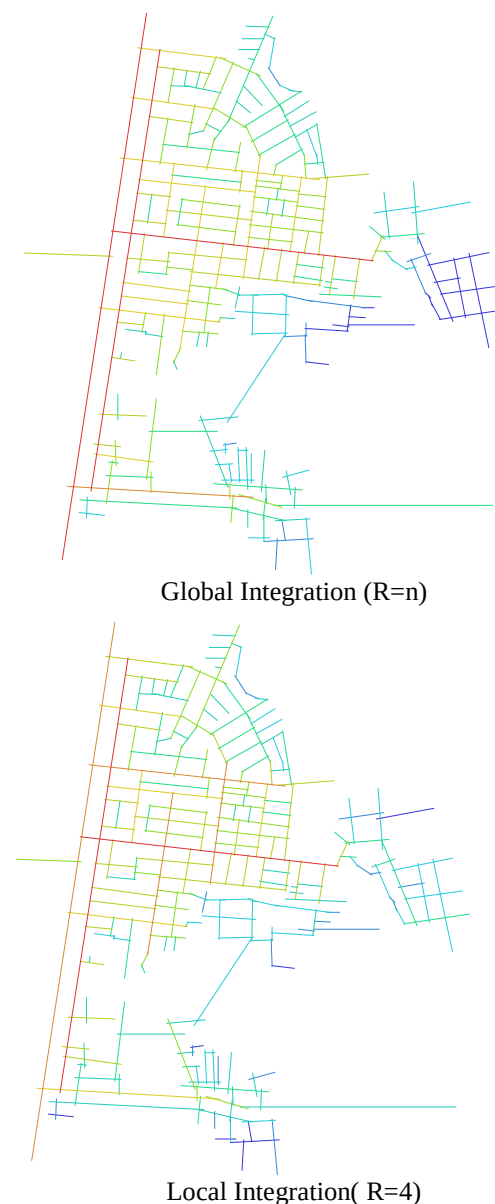
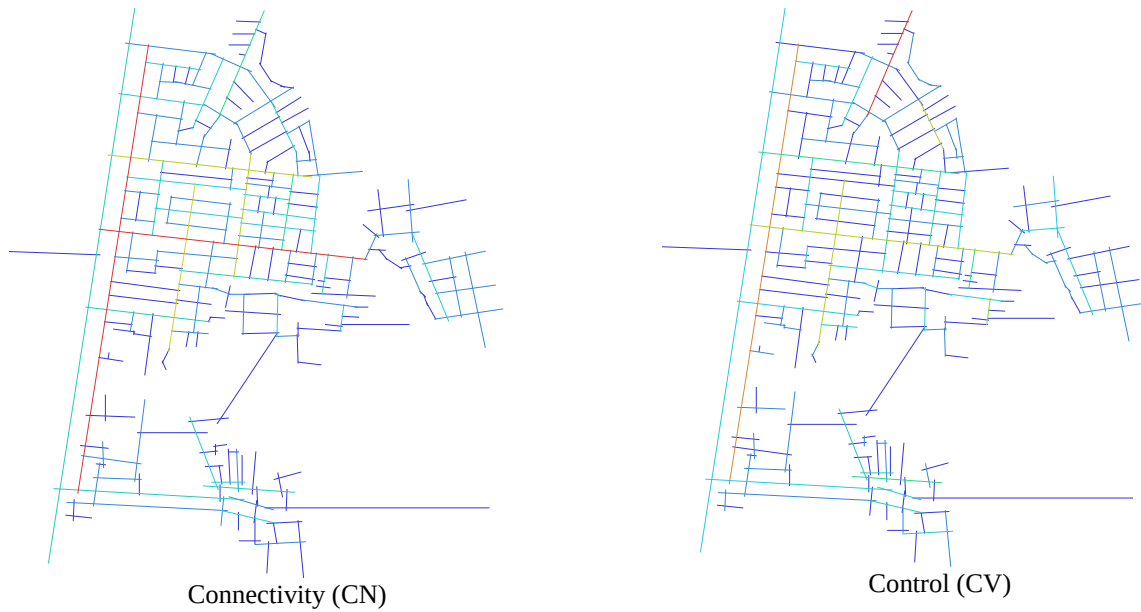


Fig: 8- The axial maps of Banani as an independent system show various values of syntactic measures ($R=n$, $R=4$, CN, CV), Source: [3].

⁷ It is important to note that local integration can be set/fixed according to the spatial character of a city. In this research radius 4 is used to calculate the local integration because in the previous research done by Dr. Farida Nilufar, it has already been proved that new Dhaka represents intensified local area effect at the radius-4, whereas the historic city characterized its localities at the radius-3 [5]



Syntactic measures	Values					
	Maximum value	Next 4 values (excluding the maximum one)				
		2 nd value	3 rd value	4 th value	5 th value	
Rn	1.79685	1.73632	1.68472	1.53011	1.5579	
Segment no.	119	122	120	1	70	
Road No.	Rd#4	Rd#11	Dhaka-Mymensingh Road	Mohakhali-Gulshan:1 Link road	Kamal Attaturk Avenue	
R=4	2.91272	2.86384	2.53107	2.48555	2.44106	
Segment no.	122	119	70	120	95	
Road No.	Rd#11	Rd#4	Kamal Attaturk Avenue	Dhaka-Mymensingh Road	Rd#10	
CN	19	15	13	10	9	
Segment no.	122	119	148	95	70	74
Road No.	Rd#11	Rd#4	Rd#8	Rd#10	KAA	Rd#18
CV	7.33333	5.8986	4.65501	4.62638	4.5	
Segment no.	74	119	148	122	73	
Road No.	Rd#18	Rd#4	Rd#8	Rd#11	Rd#27	

Fig: 9- Analysis of syntactic measures, Source: [3] modified by Author

Correlation of Syntactic measures:
 Again from the correlation scatter gram of the following figures (Fig: 10 and 11) it is found that the correlation value between global and local integration is very strong (**0.900388**). At the same time the intelligibility of the city is moderate (**0.501075**) comparing to the value of 2007 which was 0.7068 [3]

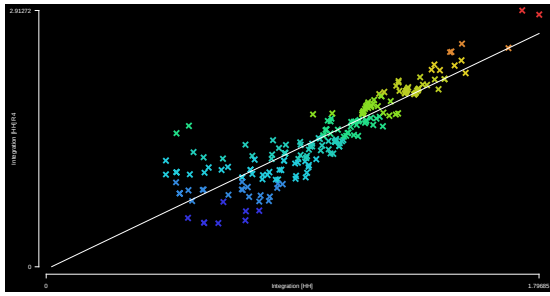


Fig: 10- R^2 of $Rn-R4=0.900388$
 $R^2=0.810699$, $Y=1.49036x-0.0302604$

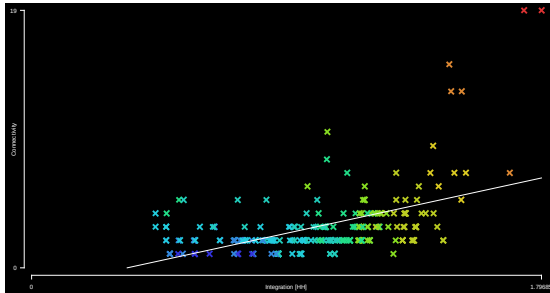


Fig: 11- R^2 of $Rn-CN=0.501075$
 $R^2=0.251077$, $Y=4.52799x-1.53067$

The retail land use findings from the field survey has been superimposed on the local integration ($R=4$) map (Fig: 12) of Banani to identify the relation of the retail development intensity of the area with the most locally integrated roads. And the image shows that the most locally integrated road of Banani (Rd No.11) acts as a retail spine for the continuous retail activities.



Fig: 12- Superimposed retail land use on the local integration map (Source: Author, 2012)

This road is globally also important and thus reveals the significance of having more movement generation. Because integrated spaces will, accordingly to the theory of natural movement [6], play a more central role in the urbanity. These spaces will not only be more frequently visited and used, they will also get better known because they are located in more legible places and at the same time within people's daily movement patterns [7].

Considering the values from the Fig: 6, for the specific roads, the following table (Fig: 13) reveals the relation of retail land use along the respective areas. Here the important findings show that being the most connected road (connectivity value is 19) both the Rd no.11 and Rd no. 4 shows a strong difference in retail generation preferences. The underlying reason behind the difference is the only movement and traffic pattern as Rd no 11 is perpendicular to the primary road of Dhaka-Mymensingh highway and the Rd No.4 is the parallel of the highway, thus bear no vibrant space choice for the retailers.

NAME OF ROADS	Retail Land Use development (%) Along The Road (Considering the usable access road)	Major retail types
Rd#11	31.76 %	Mixed use, Specialized Store, Restaurants
Rd#4	2.35%	Insignificant
Kamal Attaturk Avenue	15.88%	Mixed use, Shopping center, Specialized Store
Rd#8	8.23%	Services and Restaurants
Rd#10	9.42%	Specialized stores, Services and restaurants
Rd#12	5.88%	Specialized stores, Mixed use and restaurants
Rd#16, Rd#18 and Rd#27 and some local roads hold the remaining approx. 30% retail activities		

Fig: 13- Retail Growth analysis considering the road network (Source: Author, 2012)

6. Discussion & Conclusion

The spontaneous retail development in Banani seems sustainable though it's grabbing the residential plots apparently in an unordered manner for nearly the last two decades. The retail led activities and its flourishing character in Banani is an adaptive phenomenon now for the neighboring community. "Urban spaces are created by people, and they draw their character from the people that inhabit them" [8] the statement can be interpreted for planned residential area of Banani in such a manner that the livability of the area has now blended with the commercial activities; specially the variety of retail types. The intensity of such retail-led generations shows extensive variations of its types. The need based service retails grew in less integrated roads where most integrated roads attract the mixed use retail clusters as a strip development. The character thus has drawn for the area is the outcome of modification and alteration process of organic retail growth in an urban scale. Though the impact has so many aspects to analyze from socio-economic point of view, its sustainability to till date surely has a hidden morphology within the locality, consumer pattern and spatial higherarchy of existing road network.

7. Acknowledgments

The study had been conducted to produce a term end paper under the supervision of Dr. Nasreen Hossain, course tutor of 'Urban Retail Environment' (Course Code: Arch-6405). I gratefully thank her for the consistent support. I convey my heartfelt gratitude to Architect Sheikh Jawad Ali who assisted me in field survey while collecting the extensive data.

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REDESIGN OF STREET SPACE ACCORDING TO THE USER GROUPS' COGNITION CHARACTERISTICS IN THE DETACHED HOUSING AREA

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Abstract

The objective of this study is to identify the difference between the physical shapes of streets and building usage in Korea's new towns, depending on zone and sphere, thereby deriving characteristics related to perception of the street environment based on the assessment by user groups. This study investigates alternatives to mitigate such differences through a redesign of the street space. The targeted areas are both inside and outside of station influence areas within two new towns. This study conducted a questionnaire survey and an interview survey. To analyze the data, ANOVA analysis, IPA analysis, and AHP analysis were conducted. Through the data analysis, interviews, and redesign of street space applying implications from interview, in the future, a development shall be divided into a "shopping priority zone" and "residence priority zone". When urban design policies are directed toward planning smaller unit sectors, and setting design guidelines in detail, it will be more positive in the satisfaction level.

Keywords: Detached housing area, Street environment, Street space

1. Introduction

Recently, the type of housing in Korea has changed from high-rise apartments to low-rise detached houses, multiple houses, and detached housing which also function as shops. However, most of studies on urban environmental problems associated with the life quality of urban people are still focusing on large - scale apartment complexes and commercial areas. On the other hand, there are relatively few studies on urban street environment crowded with small - scale buildings in residential areas despite their harsh environment.

In particular, the residents who live in the detached housing area in new town have complained about the deterioration of the sunshine environment, traffic and parking problems, pedestrian safety problems, indiscriminate mix of residential and commercial functions, monolithic architectural forms, and monotonous street scenes.

Detached housing houses in type-1 general residential area have the same problems of buildings in commercial areas due to the combinational functions of shop and house.

In particular, due to the mix of commercial functions in the form of low - rise residential complexes, user groups that can be classified into residents, shop operators, and visitors will meet or conflict with interests according to the usage purpose of the detached housing area among the groups.

Understanding and applying the users' needs for street environment in urban design is the basis and goal of the design. In addition, since there is a difference in the street environment between the station influence areas and the non-station influence areas of existing city, it is necessary to grasp the current situation and to induce or suppress the change in accordance with the public interest.

Therefore, it is urgent to make the street environment assessment and to investigate the important factors of the street environment between user groups due to the mixture of residential and commercial functions in the detached housing area.

The purpose of this study is to identify the differences in the physical form of street space and architectural use in the detached

housing areas of new towns, and to identify the characteristics of street environment recognition among user groups. Also ways are sought to resolve the differences in evaluation.

2. Literature Review

Prior studies related to the Detached Housing Area of New Town include the use of low-level areas of Detached Housing Area, street environment, external space, parking environment, improvement of District Unit Plan, research on housing satisfaction, and can be divided into research related to housing satisfaction, shopping mall related research, and urban design related research.

Additionally, the area of the preceding research related to the street environment can be divided into the street environment of the residential area, the street environment of the commercial area, and the street environment evaluation system.

In the preceding studies of street environment in low-rise residential area, the study on walking environment, physical environment factor and walking satisfaction (Sohyeon Park, et al., 2009[1]; Kyuri Kim., 2014[2]), walking path distribution and walking behavior analysis distribution and gait behavior analysis (Hanlim Seo., 2013[3]) are included.

Regarding the commercial environment, there are preceding studies on the physical environment of the street and the street activation and satisfaction according to the commercial sector (Jooah Lee, 2014[4]; Yeonkyung et al., 2009[5]; Youho Won, 2015[6]), and A Study on the Effect of Physical Characteristics and Walking Amount of Landscape (Kihun Kim et al., 2014[7]; Jeongwoo Lee et al., 2015[8]).

There are also preceding studies on the system and problems of district unit plan in new town (Dongwook Sohn, et al., 2014[9]; Youngin Kim, et al., 2009[10]; Sunghak Jo, 2007[11]) and studies on the commercial business types of Detached Housing Area (Jaehyen Kim. et al., 2008[12]; Jina Park, et al., 2013[13]).

3. Research Methods

The survey sites were Ilsan New Town and Samsung New Town, and each city was classified again into station and non - station influence areas. The contents of this study are 'new town', 'urban design and district unit plan', 'detached housing house', 'street environment characteristics', 'street environment of detached housing area.' As research methods, a closed questionnaire on the street environment was used to conduct the case survey and interview survey with user groups. An interview survey with experts was also carried out. Amenity, convenience, safety, and territoriality were set as the street environment measurement factors for evaluating the street environment and 26 elements were derived as the measurement elements.

The survey data were analyzed by ANOVA, IPA grid analysis, and AHP analysis. The user groups' interview survey data was used to identify the cause of satisfaction through the frequency analysis of the referred factors. The expert group's F.G.I survey data was used to analyze the interpretation results and to draw out the implications and the improvement methods for the system through the qualitative analysis.

4. Analysis & Results

4.1 Survey Analysis

The differences between the overall satisfaction and satisfaction with the components were analyzed. The sphere differences in amenity and safety were significant, and the satisfaction in amenity and safety was higher in Samsung New Town. With regards to the differences among the user groups and between the spheres, the differences in amenity, safety, and territoriality were significant among the user groups in Ilsan New Town. The differences in convenience and safety were significant between the spheres. Also, the differences in convenience and territoriality were significant among the user groups and spheres in Samsung New Town.

The correlations among the overall satisfaction and satisfaction with each

component were analyzed, and amenity, convenience, safety, and territoriality were significantly correlated. As a result of the multiple regression analysis on the factors affecting the overall satisfaction, amenity, territoriality, and convenience were analyzed to have significant effect in a descending order.

An IPA grid analysis was performed on the relationship between the importance and satisfaction with each factor of the street environment, and the cognition characteristics of each group and sphere were distinct from each other. All AHP analyses for each user group, sphere and district identified safety as the highest ranked factor, and territoriality as the lowest ranked factor. Safety was highly ranked presumably as a characteristic of the areas for business and detached houses.

4.2 Interview Results

In the station influence areas in Ilsan New Town, all users were not satisfied with the mixture between residence and businesses and business types. But they felt safe on the revitalized streets with a rise in the pedestrian volume brought by the businesses in low-levels.

The building exteriors and number of levels were satisfactory in all areas in Samsong New Town. The house residents were satisfied with the parking facilities, but the shop operators and visitors were not.

The width and maintenance status of the sidewalks, safe speed of the automobiles, and landscaping facilities were not satisfactory in Ilsan New Town and Samsong New Town. In particular, the illegal parking status, street noise, and illumination of the street lights were highly unsatisfactory in both cities.

The findings of the interviews with the expert groups show similar opinions, regardless of the field. They suggested that “safety enhancement through building a closed environment is meaningless, and it is more effective to ensure safety in individual buildings, businesses and houses, than in the entire locality.”

Second, the experts commented that for street revitalization, they argued that “the design factors for the street environment (geometric line forms of the road, street lights, street trees, terraces, signboards, local history, etc.) shall be provided in detail to distinguish the street environment for each block.”

Third, for improvement, they suggested that “the spheres where commercialization is difficult needs an increase in the number of households more than businesses in the first floors, and for the spheres where more commerce is needed than residence, such demand needs to be applied in the district unit plan” while “the applications shall be more flexible than the current rigid system in order to enable the composition of use type based on the choice of the market and landlord.” Also, “building a buffer zone between the housing area and business concentrated area by differentiating the allowed use types” can be another way.

Fourth, the dissatisfaction with convenience and safety, particularly with the parking spaces and illegal parking, “it is the result of the mixture between the walking route and vehicle route due to narrow sidewalks, and causes problems in parking, noises, landscape, and pedestrian safety. The density of the vehicle transit shall be reduced through the installation of common parking lots.” “Efficient parking lot installations are needed, such as small-sized dispersed parking lots in the areas for businesses and detached houses, and overlapping parking lots for parks and green spaces, instead of a large off-street parking lots in the commercial area” For improvement, they suggested to “build more common parking lots at the stages of district unit planning and preparation of housing area, and initiate a compulsory land donation system as part of the current housing area development and urban development projects.”

Fifth, with regards to territoriality, they commented that “the height, external wall materials, and colors are important and satisfactory for all of the residents,

merchants, and visitors in Samsong. However, a different result was observed in Ilsan. In other words, the planning and architecture of Samsong seemed to have reflected the research findings and plans with which territoriality could be recognized.” On territoriality, “rather than the current district unit planning, detailed regulations on specific exterior and colors will encourage unique and thematic architecture for some districts for the satisfaction of consumers and residents.”

4.3 Redesign of Street Space

This study redesigned the street environment shown in <Table 1> with the applications of the implications from the interviews with the user groups and expert groups.

In accordance with the interview findings, a set of applicable components were selected for the redesign, and the revised working guidelines for lot development and provisions in the current legislations were reviewed. Subsequently, the street space redesign components were selected, and three building unit types were designated to form the spaces in the roads and lots for street space design. Next, these components and unit types were synthesized to redesign the street space.

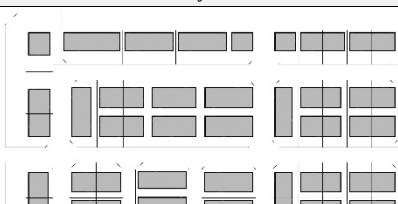
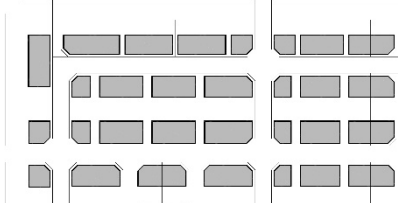
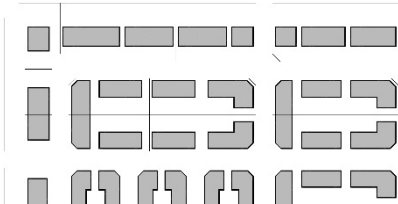
Of the three synthesized patterns, the first front space type was applied to the comparatively wider roadsides in the areas that are adjacent to train stations, that have more pedestrian traffic, and that in need of street revitalization. Consequently, the vehicular access from the road became more convenient, and the front space and sidewalk width were widened. Also, all outdoor activities were concentrated in the wide roadsides for better convenience and safety.

The rear space type was applied to the roadsides with low pedestrian volumes that need quietness. The commercial space and outdoor shops were located independently in the rear for a stronger definition territoriality and pedestrian safety from the road.

The courtyard type was applied to the lots within the blocks that need protection of residential environment. Amenity and convenience have been improved by the combined arrangement of parking lots and landscape, and the boundary was drawn against the commercial district. The sole arrangement of residence strengthened the definition of territoriality.

The number of discontinuing sidewalks was largely reduced by the building agreement and the double wall structure between the buildings, and the front length of the buildings were increased, resulting in better amenity and convenience for pedestrians. Also, the public parking lots were distributed in the commercial areas to fulfill the parking demands of visitors.

Table 1. Combination of Redesign Factors and Basic Unit Types

Div	Layout
Front space type	
Rear space type	
Courtyard type	

5. Discussion & Conclusion

In Ilsan new town, the satisfaction on all factors of street environment was higher in station influence area than in non-station influence area. In the station influence area with many shops, the activation of street due to shopping sections was surveyed to increase the pedestrian volume and help to

improve the safety which has the highest importance.

The reason why the satisfaction of shop operators was lower than that of residents or visitors seems to be because the physical street environment of shopping section such as parking spaces was poor in the station influence area and the supply of shops in the non-station influence area was too large when relative to its commercial volume. And, in the business type of shops, the importance level was very high but the satisfaction was low in all the user groups. It is necessary to regulate or induce the shop types according to the location of the station and non-station influence areas so as to secure the territoriality and the sphere characteristics.

In the element of 'the exterior design of building' of the amenity factor and in the elements of 'the height of building,' 'the exterior wall material of building', and 'color' of the territoriality, their importance and satisfaction levels turned out to be higher in Samsung New Town than in Ilsan. It may be because the age of buildings is not so long, but it can also be because the district unit plan of Samsung New Town is more specific and concrete than that of Ilsan, as shown in the survey.

Therefore, in the future urban design, it seems more positive for the street environment satisfaction level to subdivide the target district into smaller units and suggest specific design guidelines in regulating or inducing rather than to design it as a unit of district.

Finally, the lack of parking space and the illegal parking were the factors to increase the dissatisfaction on the street environment in detached house area, as mentioned in the precedent studies. As the current block supplying price system based on the composition cost and the appraisal price is generating too much profit to the block suppliers, it can be a good method to install the public parking lot in the areas with high installation demands such as station influence area and to include the expenses to the development cost.

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AN ANALYSIS ON THE EFFECT OF THE BUILDING USE TYPES AND PHYSICAL PROPERTIES OF STREETS ON STREET REVITALIZATION - FOCUSED ON THE BUILDING USES, LAND USE MIX, AND STREET PEDESTRIAN VOLUME IN THE STATION INFLUENCE AREAS IN SEOUL

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Abstract

This study aims to analyze the effect of the building use types and physical properties of the street on street revitalization. This study categorized the types of streets according to the characteristics of land use in the 273 station influence areas in Seoul. A regression analysis was carried out using pedestrian volume as a dependent variable, as a quantitative indicator for street revitalization. The building use and the physical features of the street were also used as independent variables. The result is that the streets need not only physical improvement but also active placement of commercial facilities in the bottom levels of the buildings and connections between public offices and public transit facilities for pedestrian-centered revitalization.

Keywords: *Street revitalization, pedestrian volume, street type, index of land use mix, land use type, physical properties of streets, station influence areas, cope of walking range*

1. Introduction

Recently, the pedestrian-centric paradigm shift in urban planning has become one of the main issues of urban regeneration and revitalization in Korea. As the site of various activities related to leisure, culture, commerce and business among other things, streets play a very important role for successful policymaking in this new paradigm.

In particular, the streets in the station influence areas connect other means of transportation and have concentrated land use around the area. As such, the revitalization of such streets through walking has very important urban space functions in order to stimulate local revitalization, including the commercial spheres in the surrounding alleys, and change in the surrounding land uses. However, building uses and the street design elements need to be differentiated according to the street type for pedestrian-friendly street revitalization, as the streets in the station influence areas vary in terms of their types and characteristics depending on the status of the surrounding land uses.

Therefore, this study categorized the types of streets according to the features of land use in the station influence areas, and analyzed the effects of the physical properties by the street types and the use types of the buildings for a street revitalization project. To accomplish this, the study set pedestrian volume as a quantitative indicator of street revitalization in 273 subway station influence areas in Seoul, Korea to specifically and positively analyze the relationship between the building uses and physical properties of streets as the factors affecting this indicator.

2. Literature Review

A number of preceding studies on pedestrians and street revitalization demonstrate “the dynamic relations with the physical environment, including pedestrian volume, frequency of purpose, satisfaction, height, diversity of land use, and activities and density of people such as floating populations in the subway”[1] as the factors affecting street revitalization.

The researchers who studies the relations

between pedestrian volume and the physical properties of streets include Jang Jin-young (2015)[2] who proposed the pedestrian volumes on major streets as the indicator of the level of commercial vitality in the region, and analyzed the population density, the number of employees in each industry, and the number of hospitals and facilities as the factors affecting pedestrian volumes. Jooah Lee (2014)[3] analyzed the effect of the physical environment factors of the streets on street revitalization on three commercial streets in the heart of Seoul and general commercial streets.

Table1. Previous findings on land use mix and pedestrian volumes

Author (Year)	Major findings
Jan Gehl (2010)[4]	Activities on streets in cities are created by the multiple purposes and complex functions, calling for the need for diversification of the street functions according to land use mix
Cervero & Radisch (1996)[5]	The pedestrian-friendly streets and combined uses in the residential areas in large cities increase accesses to public transit and pedestrian volume
Yan Song & Gerrit.J.K (2004)[6]	Land use mix has a positive effect on housing prices in the regions other than the detached housing concentrated areas
Ewing & Cervero (2010)[7]	Walking is closely related to the diversity of land use and the number of destinations within walking distance
Taehyoung Tommy Gim (2016)[8]	More variables should be considered for land use in large cities

Many preceding studies measured pedestrian volumes as the quantitative indicator of street revitalization, and analyzed the relationships among the pedestrian volumes, land use types and street design elements. However, the analytical findings on the relationships between land use mix and pedestrians differed depending on the research subject on the entire city of Seoul, hierarchy of urban spaces, and units of regional scopes, including regional living spheres and areas for a specific use type. According to the studies on the relationship between the diversity of land use and pedestrian volumes, the diversity of land use had the positive

effects on the pedestrian volumes in the scopes of the entire Seoul and regional living spheres, but these effects were either reverse or insignificant on the commercial or residential districts, depending on the researcher or study scope. This result was presumably caused by analyzing various factors on street revitalization, with the streets as one subject in most studies, despite the different factors affecting the pedestrian volumes depending on street type and characteristics.

Therefore, this study intends to analyze the relationships among the diversity of land uses, pedestrian volumes, and physical characteristics of the streets by classifying the streets according to the land use types on the streets in the station influence areas.

3. Research Methods

This study selected 1,316 streets within the scopes of 273 station influence areas in Seoul as its spatial scope. For its temporal scope, the pedestrian volumes according to the “Survey of the Floating Populations in Seoul.”[9] from 2014 to 2015 were used. The consistency of the data was maintained by sampling the number of subway passengers and building use statues from the buildings’ accounting books of taxation in the same period.

This study set the scopes of the station influence areas within 500m, and walking range in these areas within a radius of 50m and 100m through reviewing related legislations and preceding. To analyze the baseline data, this study identified the characteristics of the streets and floating populations in the station influence areas. A cluster analysis was performed on the characteristics of the buildings uses to classify the street types.

To analyze the relationships among the factors affecting street revitalization in the station influence areas, a regression analysis was carried out using pedestrian volume as a dependent variable, as a quantitative indicator for street revitalization. This study identified the variables through a relational analysis on

multicollinearity and a correlation analysis on the factors affecting street revitalization. For the independent variables, the index of land use mix (LUM) and commercial purpose of the first floor were used for the variables for building use, while the street type, fence, bus stops, sidewalk width, slope subway passengers, and distance to subway entrances, etc. were used for the variables of the physical features of the street.

To analyze the effect of these independent variables on the pedestrian volumes, a regression analysis was performed on all streets in the station influence areas, and then another analyses for each street type based on the land use types on the streets. The findings of these regression analyses were compared to verify the variance among the factors affecting the pedestrian volumes on all streets in the station influence area, and also each type of streets. A model for regression analysis was established through analyzing the effects of the building use type and physical properties of the street on the pedestrian volumes, depending on the land use type.

4. Analysis & Results

Based on this scope, the types of streets were categorized, through a cluster analysis on the gross area ratio for each building use, into the residence-centered type, commercial type, and business·public and other mixed types within 50m and 100m of walking range.

Among the variables on the building uses in the 50m and 100m scopes of the pedestrian spheres, increases in the gross area for commercial use on the first floor had the largest positive (+) effect on pedestrian volume. With regard to land use mix, the more singular the uses were, the more pedestrian volume increased, with the largest negative (-) effect.

Regarding the relationship with the physical properties of the streets, it was analyzed that the pedestrian volumes were high on wide streets, safe and flat streets with fences between the sidewalk and roads, streets that

are close to subway entrances, and streets offering convenient transfers to nearby bus stops with a large floating population and public transportation users, as pedestrian-only streets where the sidewalk and road are separated.

These physical characteristics of the streets were significant as the control variables for this study, for their similarity with the findings of the previous studies and general predictions for pedestrian volume increases. Therefore, the physical properties of the streets were excluded as a variable for verification for generalization on the relationship between the building use types and street pedestrian volumes. As a variable on building use type, the analysis on the relationship between the index of land use mix / commerce in first floors and the pedestrian volumes showed the negative influence of the index of land use mix (-) and positive influence of the gross area for commerce on first floors, as shown by the previous analysis.

The pedestrian volumes in the residence-focused streets and commercial streets increased when the index of land use mix was lower and the commercial area in the first floor was wider; i.e. all entire streets in the station influence areas within the 50m and 100m scopes of the pedestrian spheres. Therefore, stimulation of commercial uses in the bottom levels should be considered a more important design element for these types of streets than the diversity of building uses. With regard to the physical properties of the street, segregation between the sidewalk and roads and the width of the sidewalk are important to enhance the stability and convenience of walking.

However, the gross area for the commercial purposes and index of land use mix were not significant or did not have a major impact on the public • business and other mixed types of streets within the 50m and 100m scopes of the pedestrian spheres, unlike all streets in the station influence areas, residence-focused streets, and commercial streets, on which these factors had the largest effect. However, the subway-related factors such as the number of subway passengers and distance to a subway

entrance had the largest impact of the physical properties of the street, probably because purposeful transit is more prevalent among pedestrians on this type of streets. Therefore, public buildings and facilities should be arranged near subway entrances, as the connections to public transit are more important to revitalize the public • business and other mixed types of streets than stimulating a diversity of building uses and commercial uses in the bottom levels.

5. Discussion & Conclusion

Streets in the station influence areas should be studied, considering their segmented design elements by type and characteristic. It is not desirable to revitalize streets in the station influence areas through incentives and planning for mixed uses without considering the distinct characteristics of streets in Korea, which are generally more highly dense than in cities in other countries. Therefore, according to their characteristics, the streets need not only physical improvement but also active placement of commercial facilities in the bottom levels of the buildings and connections between public offices and public transit facilities for pedestrian-centered revitalization. In terms of the physical design of the streets, walking stability should be strengthened by separating the sidewalk and roads and installing fences, while wide and flat sidewalks and a convenient public transit transfer system should be installed for pedestrians to revitalize the street. Planning for the building uses and street design according to the characteristics of each street type will stimulate street revitalization, change the surrounding land uses, and revitalize the local economy by increasing pedestrian volumes for successful urban regeneration.

However, urban planning on the current station influence areas and streets only proposes simple mixed use such as business facilities, commercial facilities, and conference spaces for street revitalization. It is suggested to adopt commercial facilities in the bottom levels of the buildings depending on the characteristics of the street, and to propose a set of guidelines on physical improvements

and specific street design on the sidewalks. This study categorized the street types in the station influence areas in Seoul and positively analyzed the effect of the land use types and physical properties of the streets on street revitalization. It is expected that its findings can be used as baseline data for street revitalization for renewal planning and district unit planning in regions surrounding the station influence areas and existing urban districts.

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APPLYING OF THE HUMAN-CENTERED DESIGN THEORY TO CREATE A MOBILE APPLICATION: A CASE OF URBAN TRANSPORT SYSTEM

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Abstract

This research is the exploration and development of a mobile application and graphic mapping to support the public transport system within the Maha Sarakham downtown with an emphasis on the “Song Taew”, a type of passenger-transport service. Indeed, the public transport system has been provided around the province for over 20 years to serve more than 100,000 people a day. However, there is no a well-preparation of guiding information service to aid the travelers to understand and learn more about the transporting routes that that should lead them to their desired destination. Particularly in this research, a “Human Centre Design” theory (HCD) was applied to construct the conceptual framework in order to support the research methods and to form up the stakeholder’s knowledge-based community as the heart of a navigating application and graphic mapping development and design. Finally, the evaluation on efficiency and effectiveness of the transit map model with the expert groups’ satisfaction, the total score was high ($\bar{x} = 3.71$, $SD .841$) affirming that the application is practically effective and applicable for practical use and any associated further study.

Keywords: Transit Map, Mobile Application, Human-Centered Design (HCD), Way-Finding, Maha Sarakham

1. Introduction

Nowadays, the beginning of the ASEAN Free-Economic Area notably pushes forward the regional integrative and logistics development policy into the Northeast of Thailand to be known as the “East-West Economic Corridor (EWEC)” to connect 4 neighboring countries to one another including Myanmar, Thailand, Laos, and Vietnam so that the region automatically becomes one of the foremost strategic points and the main route for trading and logistics. Therefore, the upgraded transportation system is another critical issue requiring a rapid progress in order to effectively carry out the missions in an era of the ASEAN Economic Community (AEC) that is expected to happen in 2016 [1].

Geographically, Maha Sarakham is a province in the Northeast of Thailand and one of the foremost strategic points for the EWEC to transmit products and services to Laos and Vietnam. Maha Sarakham is also

a part of the government’s double-track railway plan so it is formally another key location in this part of the country.

In general, Maha Sarakham is well-known for being one of education center in the Northeast where all levels of education are provided. Besides, this province has a plenty of tourism resource, rich culture and tradition, and local life-style of the native Isan people. However, in term of the public transport (Song Taew), Maha Sarakham has no good guiding information service and different forms of media e.g. website, printed media, which are an important source of information for the people who want to either travel or do other activities. Indeed, while the province is stepping into the AEC, it soon would be a huge problem if this basic information providing service is still undeveloped.

Despite all of the above, the data from the site-visit with the people in the Maha Sarakham downtown indicates there are 5 routing systems of the Song Taew service

but the guiding information service is still lacking and not well-prepared to serve the local people and tourists but the fact is that this information should be a database for both local people and the visitors doing their business in the area.

Those problems previously mentioned encouraged the service user to informally do their data searching in which the researcher noted that they typically prefer “asking” rather than “reading” to get the directions by themselves. At this point, it has been affirmed that lacking the useful database for the public transport somehow casts the effect on the people’s behavior and their activities involved with their travelling around the downtown for different purposes such as trading, working, and taking a trip because doing an activity needs transportation. Consequently, it apparently suggests that developing an effective guiding information service can be a firm database for people to carry out their activities around the downtown [2], [3].

As a consequence, the researcher was encouraged to develop some kind of information system to support the public transport within the Maha Sarakham downtown and it was a mobile application with 2D barcode scan to provide the guiding information and printed map in order to connect the service user with the public transport. Particularly, the Human-Centered Design (HCD) theory was applied as the conceptual framework for the study and constructing a data set for the development of the graphic application on mobile with printed map in which the stakeholders were invited to participate and exchange their ideas during the data collection and also in the evaluation in order to prevent the possible errors and to create the effective mobile application with optimal communicative function.

By conducting this research, the researcher expected to create a specific participation pattern in designing and developing an application on the public purposes as well as to provide the useful information for the

public transport in order to prepare for the forthcoming AEC. Accordingly, the objectives of this research were to 1) explore and analyze general context of public transport service within Maha Sarakham downtown; 2) design and develop a mobile application with guiding information service using the HCD theory; and 3) evaluate the efficiency and effectiveness of the graphical transit map with the expert groups.

2. The Area of Study

According to general context of the public transport service in Maha Sarakham, there basically are 3 types of travelling including Type 1: personal transportation (car, motorbike), Type 2: Private transportation (taxi, tricycle, motorcycle taxi), and Type 3: Public transportation (Song Taew, See Figure 1). Specially, this research solely aimed to upgrade the guiding information service system for the Type 3 transportation or “Song Taew” because it is mostly popular amongst the local people and it is cheaper and simply accessible. Still, some key factors for this kind of service is absent and one of them is a routing service that requires the effective guiding information that has strong influence on the service user so that the service might become ineffective. On the contrary, this guiding information service will be helpful in catching up with the global changes and rapid-growing technology and more importantly to correspond to the Special Economic Zone Strategy in which Maha Sarakham province is one of the routes for the East-West Economic Corridor (EWEC) and also a part of the government’s double-track railway plan. For these reasons, the urban public transportation is undoubtedly necessary.



Figure 1. “Song Taew” Service in Maha Sarakham

2.1 HCD Approached in The Research

[4] stated that long before “Human-Centered Design (HCD) was invented, it used to the word “User-Centered Designed (UC)” that was rooted in “Usability Engineering”. Today, the HCD is being broadly mentioned as a guide to new product invention by engaging the stakeholder into the development process in order to create the best-quality product and service. Specifically, the Usability Concept of the HCD mainly looks at 3 variables including Efficiency, Effectiveness, and Satisfaction from the stakeholder within the system [5] and there are 4 main steps to follow as mentioned on an ISO 13407 and listed below [6].

- Define the context of use
- Specify the demands of service user and organization
- Find the solution for the production design problem
- Design the evaluation to suit the project

In fact, the HCD can be applied to solve various kinds of problematic designs by creating a model product to be tried out within an organization. Accordingly, the HCD is an important system that aids a designer to be more confident that the product has the best quality for the stakeholders, as the system users, within each section. Meanwhile, he can be assured that the project will smoothly achieve the goal. Besides, an ISO 13407 describes that the HCD is a repetition process perfectly designed for a model product test following the user’s demand.

As previously discussed, the HCD concept focuses on the stakeholder’s engagement into the system as the heart of the product development so the researcher purposively applied this concept for the development of the model application and graphic system and integrated additional ideas from all stakeholders, as the service provider and user in the public transport context, with the demand of the system developer in order to develop the authentically integrated product model. The final product was resulted as the application and graphic mapping system that are corresponding to the actual need of both service provider and users.

3. Participants

The sample group was classified into 3 groups as follows.

Group1: Government Officer: (1) Mayor of Maha Sarakham, (2) Director of Tourism Department, Maha Sarakham, and (3) Director of Maha Sarakham Provincial Land Transport Office. These participants were chosen by purposive sampling.

Group2: Expert Groups: (1) Graphic Design And Application (2) Urban Design (3) Transport Engineering

Group3: Local People: (1) Students (elementary, secondary, university), (2) Working age, (3) Elderly people, (4) Extras (Buddhist monks, handicapped), and (5) Son Taew owners. Each group consisted of 20 people so it was totally 100 participants. These were selected by accidental sampling

4. Methodology

This research was based on the Human-Centered Design (HCD) framework following an ISO 13407 and the methodology was classified into 3 main stages as below.

4.1 Stage 1 (Pre-Design) Data Collection

Literature review: the researcher did a document study on various issues e.g. the mass transportation concepts, Maha Sarakham context, the public transport within the target area, etc. The study was also conducted on the associated theories

that were applicable for the design process such as information system design, 2D barcode, mobile application design, human factors, and Human-Centered Design.

Observation: Later, the researcher did site-visit to observe the preparation on guiding information service and investigate the behaviors of the service provider and user. After that, more data was collected from the interview with the key informants.

In-depth interview: the interview was done with different groups of key informants including 1) Government Officer: Mayor of Maha Sarakham, Director of Tourism Department, Maha Sarakham, and Director of Maha Sarakham Provincial Land Transport Office; and 2) Specialist: Transportation engineer, Urban design specialist, and culture and art specialists.

Questionnaire: the questionnaire was provided to the local people as the service user of the public transport including 1) Students (elementary, secondary, university), 2) Working age, (3) Elderly people, 4) Extras (Buddhist monks, handicapped), and 5) Son Taew owners.

Data analysis: During Stage 1, each data collection methods provided different set of data including the variables from content analysis, documents, literature review, and observation, the variables from typological analysis, in-depth interview, and the variables from frequency analysis, and questionnaire. All data was processed to define the bond that was later triangulated to compare different data from different sources that made them more accurate and reliable [7].

4.2 Stage 2 (Post-Design) Data Collection

Based on the outcomes from document study and interview with the key informants, the researcher created a model application and had it verified by the specialists from different associated fields including 1) Graphic design And Application, 2) Urban design, and 3) Transport engineering in order to ensure if the model application was able to communicate meaningfully through the

graphic content. In this regard, the Usability Test (ISO: 9241) was used as a universal principle for the media efficiency (definition, proper functionality), effectiveness (comprehension, vision), and satisfaction (attractive display).

Data Analysis: the result from the Usability Test was later analyzed in 3 aspects including 1) Efficiency: an evaluation on physical appearance and correct ratio of graphic content; 2) Effectiveness: an evaluation on the participant's understanding toward the content, symbolic interpretation, direction reading, and tool use; and 3) Satisfaction: an evaluation on attractive display, color and font use matched with the service user's satisfaction. To be exact, the data was processed by frequency analysis with rating-scale selection [8].

4.3 Research Findings Stage 1

Finding 1: According to the in-depth interview with the Government Officers including 1) Government Officer: Mayor of Maha Sarakham, Director of Tourism Department, Maha Sarakham, and Director of Maha Sarakham Provincial Land Transport Office; and 2) Specialist: Transportation engineer, Urban design specialist, and culture and art specialists, it was found that the symbol of Maha Sarakham through the eyes of those key informants was "Phra That Na Doon".

Finding 2: According to the site-visit, it was affirmed that there are 4 routes of Song Taew service running around Maha Sarakham downtown including 1) Route 1: Crops market – Provincial Prison; 2) Route 3: Mahasarakhan Rahabhat University – New City Hall; 3) Route 4: Mahasarakham University (Khamriang Campus) – Mahasarakham University (Downtown Campus); and 4) Route 466: Bus Station - Mahasarakham University (Khamriang Campus). Total number of the main stop is 15.

Finding 3: In term of the Song Taew routing design, specific colors were used for each route and they were mixed with the local

uniqueness of Maha Sarakham that is “Soi Dok Mak Silk” following the in-depth data suggested by the famous icons in the province. (See Figure 2)



Figure 2. Dok Mak flower (right), Soi Dok Mak Pattern on Silk (left)

Finding 4: Based on the questionnaire data from the local people, different needs of the service provider and user could be discussed as follows: time schedule should be clearly displayed at the stop point telling the upcoming route number and arrival time; the map of each route with the highlights along the route should be presented at the bus station, more stop points should be provided; the time schedule needs to be clearly explained; the application should tell the history of each highlight; recommended restaurants, and how to reach the place especially for the tourists; parking area needs to be restrictedly defined; types of services along each route should be suggested with notable sign; and the route number should be clearly presented on the Song Taew.

4.4 Design Output Stage 1

According to the research outcome, the key concept of the design could be obviously defined. Generally, the symbol of “Maha Sarakham City” is “Phra That Na Doon” and Soi Dok Mak Silk. These unique products can be used to create the key concept for the design of the mobile application to support the public transport within Maha Sarakham downtown. The logo was a simply but modernly duplicated image of “Phra That Na Doon” and “Soi Dok Mak Silk” was redesigned into a graphic pattern mixed with the colors of the Song Taew. More importantly, this research not only creates a product but also promote

learning the lifestyle and identity of the local people. (See Figure 3 and 4)



Figure 3. The overall designs based culture studies



Figure 4. The final draft of map prototype before testing

4.5 Research Findings Stage 2

This stage was a conclusion of the statistical data analysis used for the Usability Test on the efficiency and effectiveness of the mobile application as well as the participant’s satisfaction toward the public transport mapping system on mobile. The test was conducted by the specialists in 3 associated fields including graphic design and application, urban design, transport engineering, and the result of descriptive statistics analysis was affirmed that the total score of the application’s efficiency, effectiveness, and the participant’s satisfaction toward the design was high ($\bar{x} = 3.71$, SD .841) (See Table 1).

Topic	N	Mean	SD.
Section 1 Sum evaluative score of "logo design"	3	3.54	1.193
Section 2 sum evaluative score of "map layout"	3	3.38	.872
Section 3 sum evaluative score of "route information"	3	3.83	.673
Section 4 sum evaluative score of "Key Legends"	3	3.98	.855
Section 5 sum evaluative score of "UI of application guidance"	3	3.82	.614

Table 1: Usability Test Result Analysis by Specialist

Table 1 concludes the specialist's suggestions on critical issues that need to be revised including the layout, the logo should be more communicative, more of the main route should be added and connected to the section map and route information, and the application user's guide need to be redesigned as a real time one. Consequently, the application was finally redesigned properly following those suggestions and the HCD concept was used to create an appropriate process to evaluate any impacts of this research on the stakeholder's demand and the result was expected to be useful for any further study (See Table 2).

Experts	Comments
1) Graphic Design And Application	The map layout need to add some name of places to make sure user can be able to locate themselves.
2) Urban Design	The logo need to a bit adjust to make it represent to the shape of "Phra That Na Doon pagoda".
3) Transport Engineering	Some of map symbols on the map layout need to design related with the showing symbol in the map legends in the bottom section. The designer could re-arrangement the using step of the application to make it better comprehension. The designer could add the direction in the layout.

Table 2: Suggestions by Specialists

4.6 Design Output Stage 2

As suggested by the specialists at Stage 1, several designing problems were pointed out and modified including fixing a disconnection between the map symbols within Section Map and the Route information, rearranging the layout organization, adding more landmarks,

matching the Song Taew routes with correct colors, as well as proper size and font, and redesigning the symbols to be more communicative. More details were discussed below.

Design Output; Problem 1: The Song Taew on each route was particularly painted with 2 colors including Route 1: blue- white; Rout 3: blue- yellow Rout 4660: blue – orange; and Route 4: only yellow. Thus, the design was created to match with the actual color on the car to offer correct guiding information.

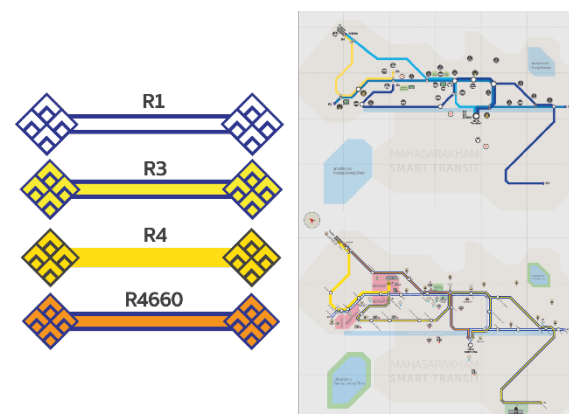


Figure 5. Design Output; Problem 1

Design Output; Problem 2: The symbols on the map were redesigned to clearly indicate the major locations e.g. shopping malls, universities, temples, hospitals, schools, police station, etc.



Figure 6. Design Output; Problem 2

Design Output; Problem 3: More of the landmark around the downtown were added including the new city hall, the clock tower, and Mahasarakham University Convention Hall.



Figure 7. Design Output; Problem 3

Design Output; Problem 4: The route information was redesigned with the font that was larger and more visible. Minor map was revised to match with the Section Map as well.

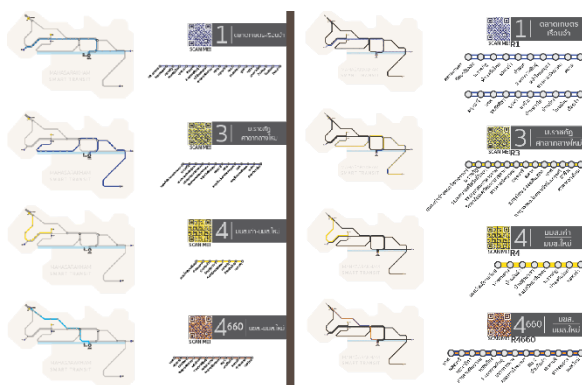


Figure 8. Design Output; Problem 4



Figure 9. Adaptation Map after experts' reviewed.

5. Discussion & Conclusion

After the redesigning at Stage 2, the final product became more complete so this revised graphic map would be used to create a software application. The application would be tried out with the sample group of 100 participants including students, working age, elderly, special participants, and service providers. These participants were the regular customer of

the Song Taew service so their attitude and suggestion would be helpful for a final design of the application.

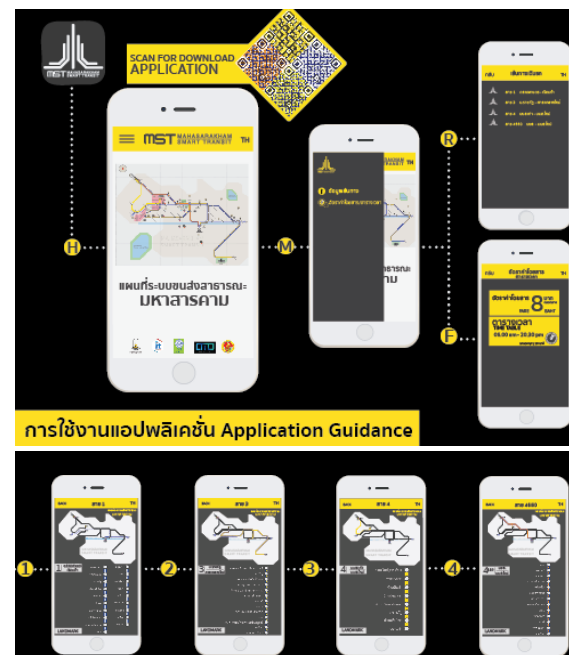


Figure 10. The Sample of User Interface Design.

This research clearly highlights notable knowledge body from the stakeholders that should be necessary for the development of the mobile application and public transport mapping to serve the travelers in Maha Sarakham province, in which the Human-Centered Design (HCD) theory was also applied to build up a data set on general context of the public transport service in Maha Sarakham. The model application was properly created and modified following the suggestions by the specialists in different associated fields in order to become a smart transit application that work applicably with any other applications.

6. Acknowledgment

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Mayor of Maha Sarakham province, Director of Tourism Department, Maha Sarakham, Director of Maha Sarakham Provincial Land Transport Office, the transportation engineering specialists, and the specialists in urban design and culture and art.

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A FUNDAMENTAL STUDY OF VACANT HOUSE IN LOCAL CITY IN JAPAN

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Abstract

We have been facing the problem concerning declining population and low birthrate in Japan. In these situation, the issue concerning vacant house is getting worse. Existence value of historic building is high because users who live or stay these houses find satisfaction from spending time in the environment around the historical Japanese landscape. On the other hand, utilization of vacant houses in urban region where are suburbanized with a certain level in local city is difficult. We grasped the actual state of vacant house in such city. In addition, we clarify the relationship between regional socio-economic condition and the status of vacant house quantitatively. There is a possibility that a vacant house use as tourism resource as well as dwelling.

Keywords: Vacant house, Urban policy, Regional revitalization, Tourism resource

1. Introduction

The problem concerning vacant house is getting worse in Japan. Living environment, public security and landscape have deteriorated with existence of such house. There are 820 vacant house out of a total of 6,063 houses in 2013 [1].

A convenience of every lifeday is high in a region where are suburbanized with a certain level in local city. This is an advantage from a view point of management of municipalities. On the other hand, they have disadvantage concerning utilization of vacant house. The reasons are follows. Many Japanese people want to live a new building except for the way of utilization which are mentioned previously. In addition, many Japanese firmly refuse other parson use their real estate. It is required that the way of a solution is suggested.

In this study, we focus on Ishii town in Tokushima prefecture where is one of a urban prefecture in Japan as a case study area.

The aims of this study is to clarify the actual state of vacant house around a central city in local municipality. In addition, we clarify a relationship between a status of vacant house and regional socio-economic condition, too.

2. Actual situation of Ishii town as a case study region

2.1 Summary of Ishii town

Ishii town which we focused upon as a case study region is located in Shikoku region (Western Japan). This town is adjacent to prefectural capital, so a convenience in residents live in this town is comparatively high. Location of Ishii town is shown in Figure 1.

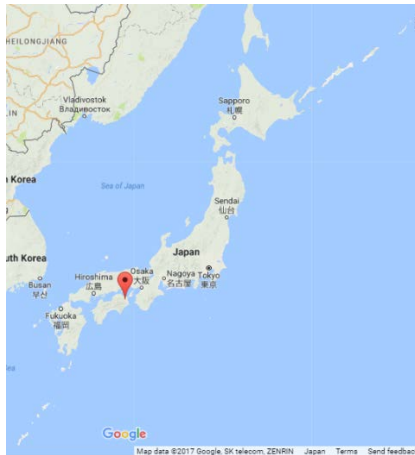


Figure 1. Map of Ishii town
Source: Google Maps

The number of population is 25,590 (The population of Japan is 127,094,745.) in 2015 [3]. Population in this town is slightly decreasing under the situation of rapid and long-term decreasing in Japan. The total number of dwellings are 9,780, the number of vacant houses is 920 in 2013 [3].

The smallest unit of analysis is sub-region which is specified by the Ministry of Land, Infrastructure, Transport and tourism. This classification is accorded at the following discussing. This classification is one of that which used when data is aggregated in the Census Bureau. Ishii town is divided into 30 areas and it is not enable the identification of the specific individual.

Figure 2 shows a proportion of the laboring population in the municipality. The mapping tool of the system of “jSTAT MAP” [4] provided by the the Statistics Bureau, Ministry of Internal Affairs and Communications is used in this study.

Data of socio-economic condition in is based on the data “the Census Bureau” in 2015 [5].

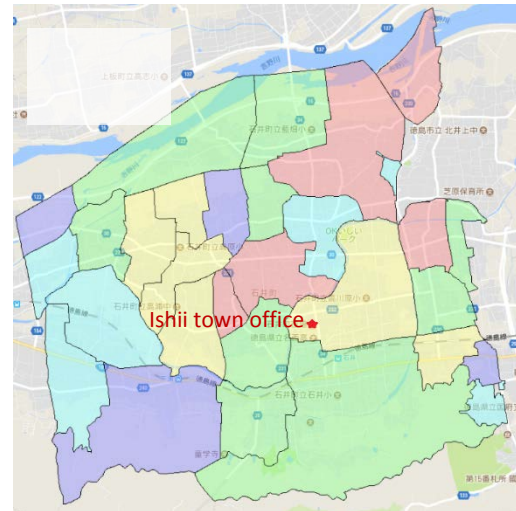
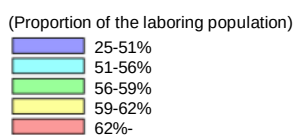


Figure 2. Proportion of the laboring population in Ishii town

Ratios of the labor population among the total population is high in center and the northeast areas. On the other hand, those values in the west area also show lower in comparison with in other areas.

2.2 Distribution of vacant house in Ishii town

Ishii town conduct a questionnaire survey concerning vacant house in 2017 [6].

The rank of the condition of vacant house is determines on based on each evaluation items shown in Table 2, comprehensively and quantitatively. These are related to the degree of decrepit and collapse. Details of the items mean that “condition of foundation and external wall of building”, “condition of the level of damage or decay”, “condition from the view point of emergency and evacuation” and “condition of rainwater drain”.

Table 2. Rank of determining

Rank (Score)	Degree of decrepit and collapse
1	Reusable with small-scale renovation
2	Low possible that the house is collapsed, although the house is not enough managed
3	A seriously damaged, because the house is not managed

- 4 Urgency of the need for renovation or demolishing is high, because high possible that the house is collapsed
- 5 Urgency of the need for demolishing is extremely high, because high possible that the house is collapsed

Figure 3 shows a distribution of population and vacant house. Each area is colored according to the color concerning population. The level of the number of vacant house is displayed as bar graphs.

The ministry of Ishii town conducted a questionnaire survey related to vacant house for owners of vacant houses [7]. They were collected and sent back. (A part of them is brought by survey respondents.)

Survey period: July, 2017

Scope of the survey: 602 owner

Percent of responses: 44.0%

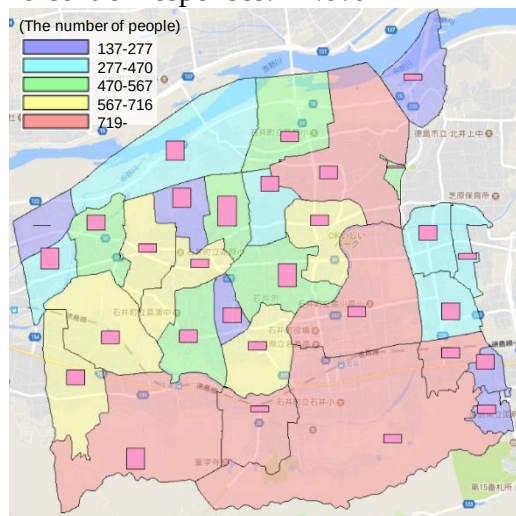
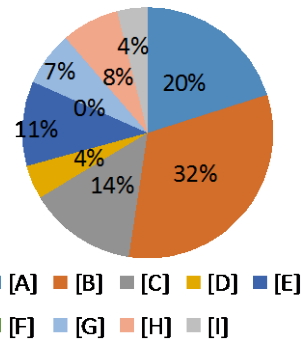


Figure 3. Distribution of vacant house in Ishii town

Figure 4 shows the reasons why vacant houses are. Figure 5 shows the intention how to use their vacant house in the future.

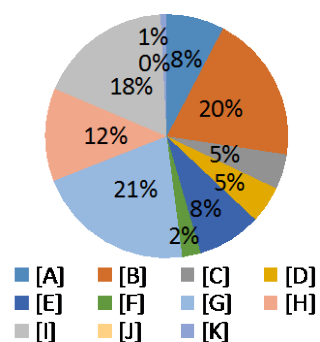


- [A] A house is redundant because a former resident transferred
- [B] A former resident died
- [C] A residence is not stay the house, because of admission into a retirement home or a hospital
- [D] A house cannot be used, because of dilapidation
- [E] There are no person after inheritance
- [F] A house cannot be sorting out, because no one is decided upon as heir
- [G] A house cannot be used, because there is no one as a buyer and a tenant
- [H] Others
- [I] Non-respondent

Figure 4. Reason of a house is vacant

From Figure 4, there are many vacant houses because former residents transferred, died and admitted into retirement home or hospital.

Rate of the owners of a vacant house who have a plan to use it in the future is 70%, although, 20% of the owners have no plan or idea to use it. They are needed a support by local municipality or nation.



[A]	An owner of a house want to use it either way of selling or renting
[B]	An owner of a house wants to sell it
[C]	An owner of a house wants to rent it
[D]	An owner of a house allow it access to public space for free or a low price
[E]	An owner of a house or relatives will use a house in the future
[F]	A owner of a house or relatives will use a house when a ceremony is held
[G]	A owner of a house want to manage it
[H]	A owner of a house want to demolish it
[I]	A owner of a house has no idea and plan how to use it
[J]	Others
[K]	Non-respondent

Figure 5. Intention how to use a vacant house in the future

3. Relationship between condition of vacant house and regional socio-economic condition

Relationship between condition and existence of vacant house and regional socio-economic condition are clarified. We define the condition of vacant house as equation (1). Score of them in each rank is shown in Table 2. It means that a score in an area where have a lot of vacant house is higher. In addition, the higher the score, the worse a condition of house in that area is. Table 3 show a correlation coefficient among variables related to a condition of vacant house and regional socio-economic condition.

$$S_i = \frac{\sum_{m=1}^5 (s_{mi} \times v h_{mi})}{\sum_{m=1}^5 s_{mi}} \quad (1)$$

S_i : Score rate of condition of vacant house in area i

s_{mi} : Score of condition of vacant house judged to rank m in area i

$v h_{mi}$: The number of vacant house judged to rank m in are i

Table 3. Correlation coefficient among variables

	[a]	[b]	[c]	[d]
[a] Score rate of condition of vacant house	1			
[b] The number of population	0.799	1		
[c] Ratio of the number of household which is composed only of 65 year old or older person	0.120	-0.156	1	
[d] Ratio of the labor population among the total population	0.072	0.274	0.022	1

From the result, the status of vacant house is affected by various socio-economic condition, quantitatively. The number of population is the higher, the score rate of condition of vacant house is. In addition, the the score rate of condition of vacant house is low in an area where the condition of an economic activities is brisk and lively.

4. Conclusion

The aims of this study are to grasp the actual stat of vacant house in local city and clarify the relationship between the status of such house and regional socio-economic condition. We focused upon Ishii town which is one of typical local city. From the analysis, it is clarified that the status of vacant house is affected by the regional condition of an economic activities and another social condition.

It is required that a promotion of settlement and tourism interaction in order to solute the problem of vacant house.

Migration between regions is influenced by interaction between regions as well as socio-economic condition. These are affected by regional attractiveness and convenience of transportation [8]. Concerning urban policies, we should consider those mechanism and residents' needs. Vacant house is one of an attractive tourism resources.

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A CONCEPTUAL PAPER: COLLABORATIVE PLANNING FOR COMMUNITY EMPOWERMENT IN URBAN PLANNING

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Abstract

The purpose of this conceptual paper is to develop a theoretical framework of collaborative planning for empowering community participation and influence in urban planning. Impact of neoliberalism in urban governance has contributed to the elitism in decision-making, thus benefited certain community segments. This underlined problem has implied the scarcity of conventional participatory planning in providing genuine participation to all community segments. Given that, scholars have advocated collaboration as the alternative to conventional participation to inclusively empower the community participation and influence in the urban planning. The framework is developed through literature survey as the method to collect and analyse the literature data. Substantively, this paper concluded that collaborative approach in urban planning enable all community segments to be educated and actively engaged throughout the process, thus enhance their influence in decision-making.

Keywords: Collaborative, Community Empowerment, Urban Planning, Urban Governance

1. Introduction

Community empowerment has been underlined as one of the fundamental principles for New Urban Agenda in addressing the impact of urbanization [1]. Conceptually, urban governance indicates a complex and dynamic pattern of decision-making made by multiple actors comprises of government, community and other stakeholders in addressing the multidimensional issues [2].

Urban governance is responsible for providing efficient planning decision-making concerning the development of urban land to promote equity in economic growth as well as essential services to its dwellers [3]. Thus, participatory planning ensures equal access for all community segments to both social and economic opportunities. Besides, it allows a decision made via democratic way [4]; [5].

1.2 Problem Statement

From the context of urban planning, the impact of neoliberalism to the government development strategy has to witness

constant changes of demand and usage of urban land by the private sector, hence led to elitism in planning decision-making and benefits particular community segments [6]; [7].

The lack of capacity among the low-income group to genuinely participate and influence the planning decision-making can be related to the scarcity of conventional participatory planning in educating and collaborating with the community. It is merely tokenism by the government [4]; [5]; [8].

1.3 Purpose of this Paper

This conceptual paper is anticipated to explore the implementation of collaborative planning for empowering the capacity of all community segments to participate, hence influence the planning decision through a theoretical framework. Therefore, the question addressed in this paper is:

How can the practices of collaborative planning can empower both the

participatory and influence of all community segments in urban planning?

2. Literature Review

2.1 Concept of Urban Governance

Urban governance is defined as a process of coordinating multiple interests of urban stakeholder where each stakeholder come from varied perspectives, values and systems which make the coordination to be complicated and required continuous discussions and negotiations [9]; [10]. Urban governance comprises of key urban actors where the relationship and communication between these actors form a complex and dynamic connection that determine the direction of the urban development of the city [2].

There are four key elements that have been highlighted by Avis that can enhance the effectiveness of the urban governance. These elements are; the institutional framework between national government and subnational government, the capacity of governance specifically urban local government that socially and economically responsible towards its community, private sector's role as contributor for economic growth for a city; and also the political elementary in the governance system which influence the capacity of the urban local government as well as the effectiveness of policy-making and decision-making [11].

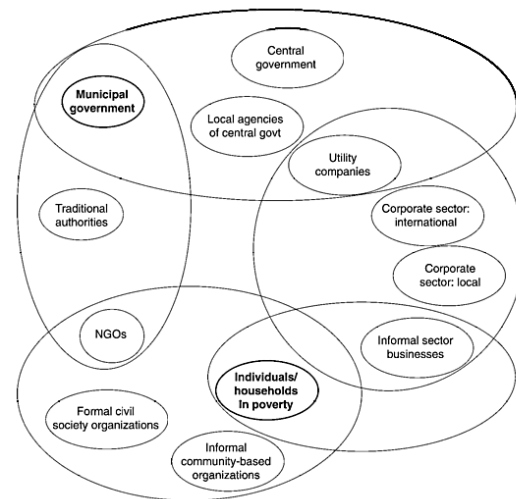


Fig. 1: Actors in Urban Governance Sphere

Source: [2]

In concern to the problem, three factors can influence the engagement of low-income group in the urban governance domain. These factors highlighted by [2] are; the inclusiveness of the political process in a city that let low-income segment to participate genuinely, the capacity of the urban governance to be more responsive towards the community interest, and also the provision of the avenue for low-income segment to access to their rights and be more influential.

2.2 Urban Planning and Urban Governance

Urban planning is concerning the planning and regulating the land use, distributing the spatial development, improving the well-being and quality of life of the people, generating economic growth and in the same time managing the resources and preserving the environment to achieve sustainability in development [12]. Urban planning is a medium in achieving sustainable development and environment [1]; [3].

According to Brown, there are three main approaches to urban planning; strategic planning which consists of metropolitan planning and local planning, development management or control that refers to the process of regulating and planning a development including preserving the

environment; as well as the action planning that address possible issue that need to be tackled through planning.

Theoretically, urban local government as the closest government entity to the urban community has enough understanding of the urban issues compare to their higher counterpart. This knowledge will then enhance urban local government as the urban planner in responding towards the community interest. Nonetheless, many local authorities in developing countries face challenges to effectively plan their urban areas due to weak planning control and outdated planning data [1].

Planning practices with top-down approach have resulted in the planning decision to focus more on national interest rather than the local [4]; [13]. As a result, it has left the local government in almost no-win situation, hence offer meaningless participation to the community [13]. This tokenism of traditional participatory planning in inclusively promote participation to all community segments has marginalized the low-income group from the planning process [5].

To enhance the effectiveness of urban governance, the capacity of urban local government in planning the spatial development, with urban local government been given sufficient autonomy to make a decision. Furthermore, the community including the low-income and other vulnerable groups should be encouraged to actively engage in the urban planning process in an effort to empower these segments in urban governance domain.

2.3 Community Empowerment in Urban Planning

Community empowerment has been underlined as one of the key principles for New Urban Agenda in addressing the impact of urbanization [1]. Scholars have constantly been described empowerment as an ideology that demand in fostering both the social policies and platforms to allow

the community to manage and gain control of their needs and way of life [14]; [15]; [16]. In other words, it refers to the enhancement of community capability, without excluding any segment from receiving the benefits of development [17].

Conceptually, community empowerment has been further defined as a catalyst for a smaller group of community, who is acting on behalf of their community hence slowly; develop into collective agenda [18]. Furthermore, Brinkerhoff and Azfar have operationally determined four main elements that contribute to the empowerment of community; community access to information, community participation in decision-making, community able to hold decision-maker accountable, and community have the capacity and resource to participate and voice their interests in the public process.

Pratchett et al. have defined successful community empowerment when the knowledge and capacity of the community to effectively engage in the public process including urban planning are improved. Moreover, successful empowerment is when the community believes that they can influence decision-maker, and the impact of participation has inclusively benefitted the community [17]; [19]. Also, Narayan indicates that community is successfully empowered when the urban local government has sufficient capacity to collaborate and build consensus in utilizing resources and solving their common problems [17].

2.4 Collaborative Planning for Community Empowerment

In addressing the complexity of decision-making in urban domain, and providing a genuine participation in the community, a new paradigm for community participation is needed. Therefore, collaborative planning has been promoted as an approach in addressing the need to empower the community to participate and

influence the process. This paradigm shift of participatory method is based on continuous discussion and collaboration has promoted greater trust and consensus; as well as improves the community knowledge and producing collective decision although it does not appeal to all [20]. Though the probability of achieving a resolution that appeals to all actors is ambiguous, nevertheless the approach made will ensure the objectives of the participatory process can be contented.

For that reason, collaborative planning has been promoted as an approach in addressing the need to empower the community to participate and influence the process.

Collaborative planning is an approach that offers the opportunity to various stakeholders to inclusively interact and participate in the planning process, thus addressing the complexity of interest of modern society [21]. Predominantly, collaborative planning is based on continuous communication between stakeholders, particularly community and planning authorities throughout the planning process to address disputes through consensus building [20].

Cooke et al. have elaborated the need for collaborative approach to go through multiple phases to establish a greater representation of community interest in the public process. Collaboration could be initiated by involving extensive stakeholders through numerous participatory means including forums and meetings [22]. Broad community participation will advocate genuine participatory, hence ensure the interest of marginalized segment to be considered.

There are ten keys to successful collaborative planning that have been identified by Gunton and Day which based

on their review of several works of literature (Table 1) [23].

Table 1. Successful Collaborative Planning
Key Success for Collaborative Planning

1.	Conditions that offer the opportunity for collaboration to be taken place.
2.	All interested stakeholders are well-represented.
3.	Ground rules to be clear and comprehensive throughout the process.
4.	All community segments to be educated and access to relevant information.
5.	Accountability element to be incorporated into the process including the stakeholder representative.
6.	The process should be adaptive to possible variation.
7.	The process is facilitating by skilled staffs and free from intervention.
8.	Timeframe and alternative decision-making process should be prepared.
9.	Well-defined implementation plan comprises of clear responsibilities, monitoring process together with mitigation measure.
10.	The implemented decision should be thoroughly evaluated.

Source: [23]

3 Theoretical Framework

The framework highlighted the relationship between collaborative planning and community empowerment in urban governance domain (Figure 2). Community empowerment in this framework is referred to inclusive participation in urban planning by all community segments. A genuine participatory process that merit ability to influence to a community can be justified through the incorporation of accountability and transparency in the process contribute to consensus building in making a planning decision.

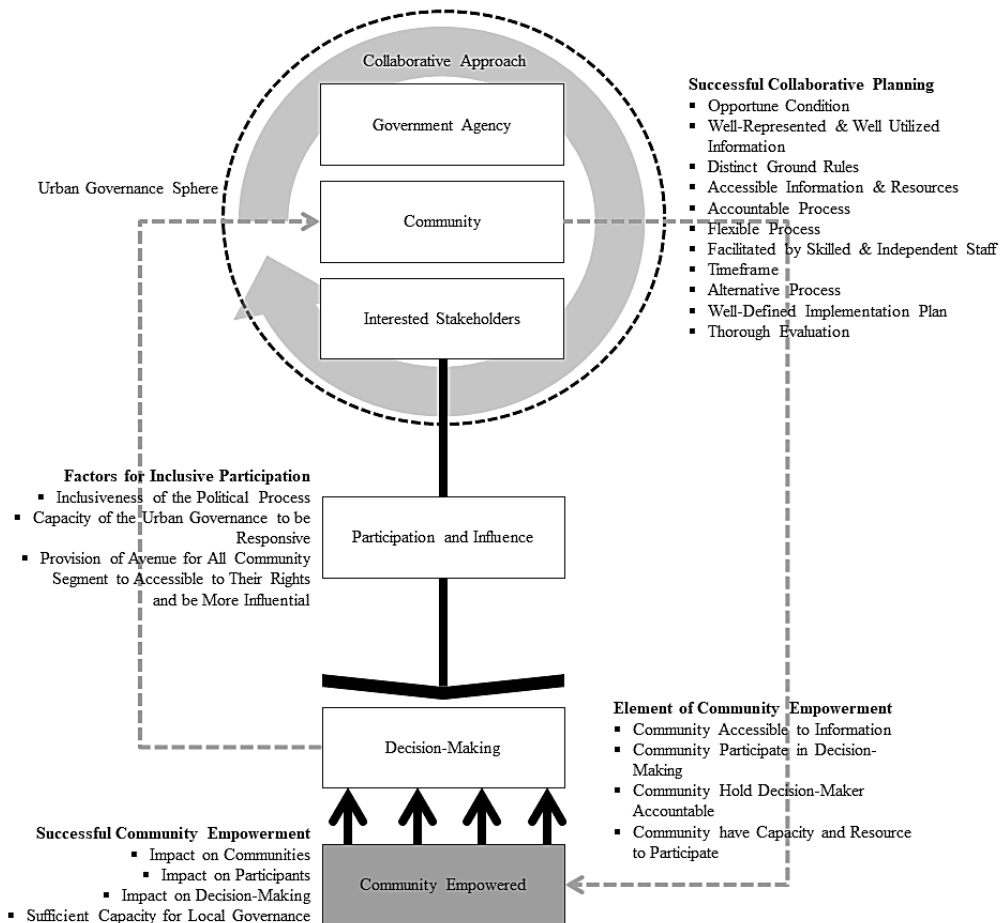


Figure 2: Theoretical Framework of Collaborative Planning for Community Empowerment in Urban Governance Domain

Sources: Interpreted from [2]; [17]; [18]; [19]; [23]

Therefore, it allows the community to exert their influence in decision-making. The successful elements of collaborative planning contribute to the empowerment of community where their experiential knowledge and capacity to engage effectively in the formal process has improved, hence benefitted the community as a whole. It also changes the perception of community in influencing their local matter; subsequently, improvise greater sense of community. Also, collective decision achieved through this collaborative approach which sees multiple actors continuously engage and communicates in deliberating alternatives to a common interest.

4 Method for Collecting and Analysing Literature

The conceptual paper has focused on the literature search and reviews as the method to collect and analyze the data. Initially, numbers of key literature have been identified using the “literature search” tool in Mendeley. Terms such as “collaborative planning” and “community empowerment” have been used to identify these literatures which later are reviewed to build a connection between both notions conceptually.

The relationship between the concepts of collaborative planning and community empowerment are grounded on the ideas of promoting a genuine participation to all community segments, hence enhance their influence in urban planning. It concerns the highlighted research question.

Therefore, to establish a complete picture of the relationship between both concepts, the identified literature [2]; [18]; [19]; [23] are reviewed and synthesized to establish a theoretical framework. These selected pieces of literature have highlighted common purpose; to promote meaningful and inclusive participation in the community.

The second section in this conceptual paper has linked the collaborative planning an alternative approach to conventional participatory planning in enhancing community participation and influence in urban planning, as well as considering the complexity of the relationship between multiple urban actors. The result of this literature review is the theoretical framework which is used to delineate the way collaborative planning can contribute to the empowerment of all community segments. It is supported by the underlined elements and factors that are derived from the literature.

5 Discussion

The literature reviewed in this conceptual paper is useful and constructive in accomplishing the purpose of this paper. Furthermore, it helps to address the question.

How can the practices of collaborative planning empower both the participatory and influence of all community segments in urban planning?

The community participatory and influence in the urban planning are empowered when all community segments are accessible to the planning process and its information. The accessibility to planning process and information allows the community to effectively participate and hold the decision-maker to be more accountable for his decision [18]. This is associated by the collaborative approach that enables all segments to be educated and well-informed of the process, hence well-

represented [23]. The facilitation of the urban planning process by skilled and independent staff or consultant has contributed to diverse engagement methods used throughout the process; indirectly acknowledge the importance for the process to be adaptive to the complicated relationship in urban governance domain [21]; [23].

Besides, a meaningful participatory process that merit ability to influence to the community can be justified through the incorporation of accountability and transparency in the process, hence contribute to consensus building in making a decision [19]; [23]. Constant evaluation of the implemented decision ensures community to hold the decision-maker accountable. As a result, it has changed the perception of community in influencing their local matter; subsequently, improvise greater sense of community [19].

6 Conclusion

This conceptual paper contributes to the continuous debate on how collaborative planning able to empower the community in urban planning. Conclusively, the paper has demonstrated through the literature reviewed of collaborative planning as a medium to enhancing the participation and influence of urban stakeholders including the community in the planning process. It is via knowledge enhancement, persuasion to collaborate and build consensus among the stakeholders.

The framework provides a guide for a meaningful participatory process which legitimates the ability of all community segments to be more influential, hence leading to better planning decision made.

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AN EVIDENT DISCONNECT BETWEEN CITY PLANNING AND EDUCATION POLICY MAKERS: A CASE OF BANGKOK'S TROUBLESOME PUBLIC SCHOOL INFRASTRUCTURE

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Abstract

Public schools are important elements of public, social and physical infrastructure. The quality of cities depends on the quality of schools. Likewise, the quality of schools depends on the quality of cities. This paper analyzes a profound and detrimental disconnect between city planning and education policy makers in terms of provision of public education facilities in Bangkok. This is evident in the deficiency of public school infrastructure to provide enough capacity for an oddly and robustly increasing population of a metropolitan city of Bangkok. This study incorporated primary and secondary school density in each district of Bangkok (in terms of area and population) through secondary data (Ministry of Interior) to show how oddly distributed are the education facilities. City planning scholars need to increase their engagement with public schools and school facilities and think more critically about how development and redevelopment decisions ultimately impact our public schools.

Keywords: public schools; public infrastructure; city planning; education policy; Bangkok

1. Introduction

Any nation's public schools are important elements of public infrastructure. The quality of cities depends, in part, on the quality of schools. Likewise, the quality of schools depends on the quality of cities. Yet there is a profound disconnect between cities and schools that is evident in local practice, research, professional degree programs, and most levels of policy making. Likewise, there is a troublesome disconnect between the education field and the field of city planning that needs to be overcome. For example, while planning for new and existing schools is rarely part of a university's city planning program

curriculum, so too are school facility issues altogether absent from most education program curriculum. As a result, the cross-pollination of these fields is missing at the professional development level in each core curriculum—a trend that works to support a “cities and schools disconnect” found in practice, policy, and researchⁱ.

To help dismantle the disconnect, this article is aimed at showcase the real deficiency in public school infrastructure incorporating city planning measures in Bangkok. Here we show the under capacity and over capacity of public school infrastructure prevalent in each district of Bangkok with respect to

primary and secondary school going population.

2. Literature Review

Almost 50 years ago, Michael Teitz (1968) argued that urban public facility locational decisions were fundamentally distinct from private locational decisions thereby it was fundamentally concerned with determining the optimal site for public facilities, given both efficiency and equity constraints.ⁱⁱ The evolution and legacy of these ideas in human geography, however, have not been systematically addressed. These governmental systems are functionally and hierarchically delimited by regions. Decisions concerning public facility systems are neither subject to competitive price structures nor necessarily quantifiable. Thus, ‘without monetarily quantifiable benefits, we are inevitably forced to consider in detail the distributional consequences of an outcome both over space and over population groups’ⁱⁱⁱ. There is widespread belief that the American public educational system is failing to meet the needs of all students, especially those in urban centers^{iv}. Facing poor-quality city schools, families with resources flee central cities for suburban schools or simply opt out to private schools. They leave urban schools with fewer resources, material or intellectual, to serve communities of increasing levels of concentrated poverty. These demographic shifts are causing an unprecedented rate of racial and economic segregation in our public schools^v.

City prospects are greatly impacted by these trends, with perceptions of low quality schools

quite often leading the list of concerns about urban life. Increasing student numbers place a strain on school facilities—in regards to both capacity and wear. The need for upgrading and expanding the nation’s public school infrastructure has been described as a “crisis.” It appears inevitable that there will be land use and planning conflicts at local levels as states and school districts move to build more schools. However, the planning field has largely ignored school planning; leaving it solely the responsibility of school districts, when, as Orfield (2002) shows, the location and quality of schools has a multitude of impacts on our urban areas. Schools impact neighborhoods, cities, and regions.^{vi} City officials realize that poor-performing schools hinder city revitalization efforts such as attracting and retaining businesses and middle-class families. Educators know that urban poverty concentration limits students’ academic performance. As public rhetoric continues to fault “failing urban schools,” the planning field must critically ask how planning decisions do and benefit or hurt local schools. We need to be concerned with the role of our public schools system—a social and physical infrastructure that is vital for the health of cities.

Breaking down the institutional and disciplinary barriers between city planning, education, and other related fields is necessary to improve both cities and schools. Governance work must develop the institutional frameworks to support joint planning. First, we need to create institutional linkages across fields and disciplines. Second, local “civic capacity”—the extent to

which different sectors of the community, from business to parents to local officials, educators, and others, mobilize around important issues—needs to be built to create a strong shared commitment and plan of action for improving public schools^{vii}. Third, the different disciplines must educate each other on their respective responsibilities and conceptions of what makes a quality school and what makes for quality cities^{viii}. In short, connecting cities and schools will require joint planning between planners and educators.

While many believe “we must fix the city schools before the city can make a comeback,” city schools need a great deal of help responding to the urban realities over which they have absolutely no control, especially poverty concentration in cities. Overall, two complimentary realities define the school infrastructure issue: (1) the quality of schools impact the prosperity of cities and (2) how cities change and develop impact the quality of schools. Therefore, the future quality of regions, cities, neighborhoods, and schools is intertwined^{ix}.

3. Research Methods

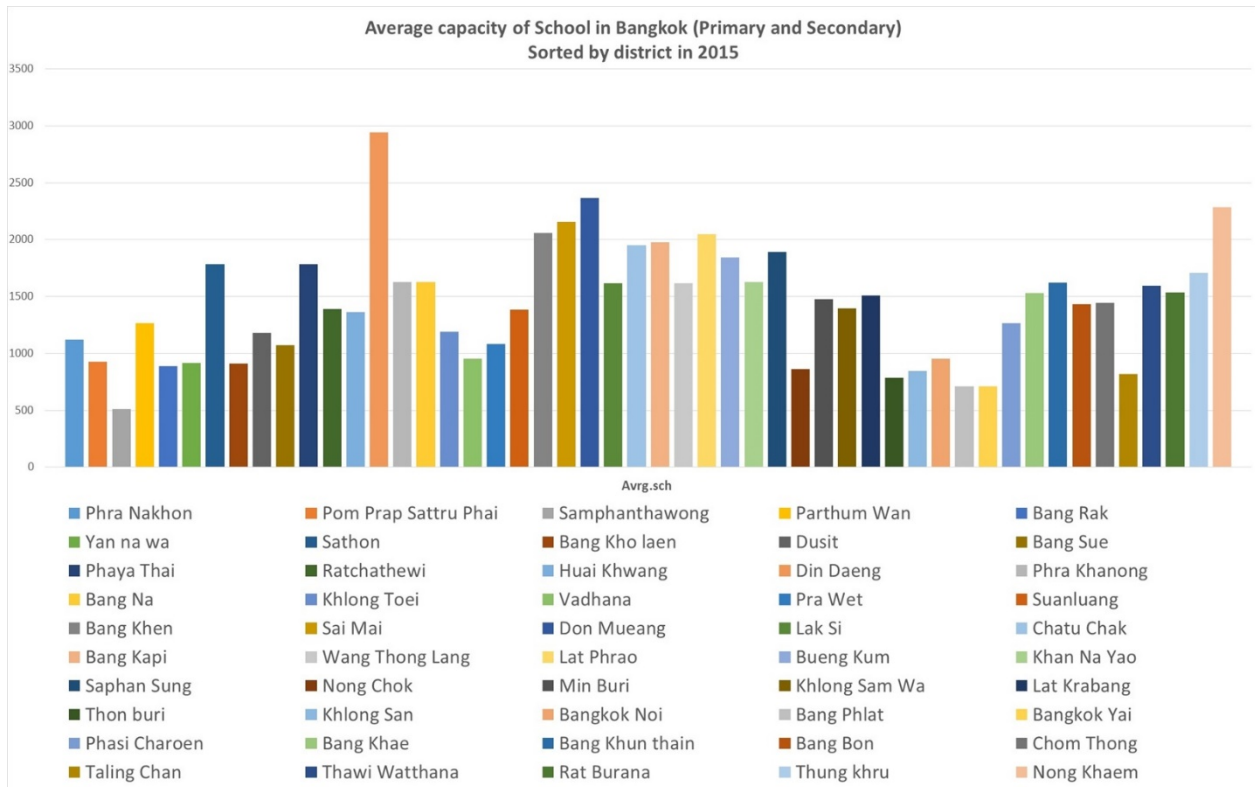
This study is surrounded on the primary and secondary public school facilities in each district of Bangkok. Secondary data obtained from various Thailand government agencies was used. Data used here included number of classrooms in each district as a whole through which total student capacity of the district was calculated as followed; Total number of classrooms* Total number of students in one class as allowed by the Office of the Basic

Education Commission, Ministry of Education, Thailand.^x Another data component is the total number of primary and secondary school going population (aged between 5-18 years) which was obtained from Ministry of Interior, Thailand.^{xi} This component was adjust through literacy rate as followed; Total primary and secondary school going population (1ged between 5-18 years) * Average literacy rate of Thailand as given UNESCO^{xii}. Total school going population was adjusted vie literacy rate as we did not want to account the population for public school facilities which does not want to or not even going to schools to avoid any discrepancies and get accurate illustrations of incapacity or overcapacity of public school facilities in each district.

Then Public School Infrastructure Deficiency (PSID) for each district was calculated by subtracting the total student capacity of a district from its total school going population. To avoid the criticism, Literacy rate adjusted public school infrastructure was also calculated as followed; Literacy rate adjusted total school going population – total student capacity of schools in a district.

4. Analysis & Results

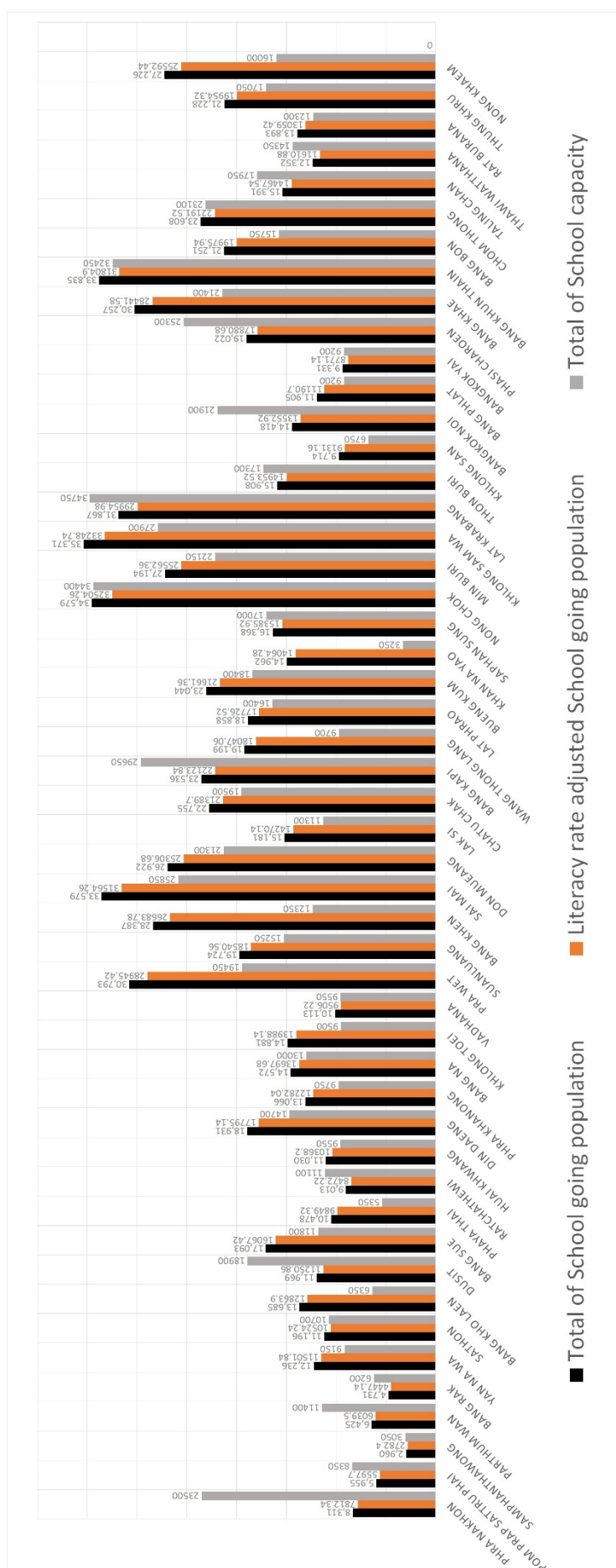
After using the formulas as discussed above, we obtained the results which elaborately show the current state of affairs in each district of Bangkok in terms of student capacity of public education facilities in each district of Bangkok. We also calculated the average capacity of a school in each district which is shown in the graph below.



Graph I: Average public school capacity in each district of Bangkok

To exhibit the overcapacity and under capacity of public school infrastructure in each district of Bangkok, we drew another illustrative graph which is more rich, compact and thorough in terms as given below. This graph has a separate bar section for each district having three bars thoroughly comparing the public school facilities and the total school going population. First bar among the three bar district section in the graph shows the total primary and secondary school going population (aged 5-18) in a district;

second bar in the separate district section represents the literacy rate adjusted school going population as some scholars may criticize the comparison of total school going population given some of the school going population do not intend to attend public schools or any schools. Third bar shows the total student capacity of primary and secondary public schools in a district. Each section allocated for a district compares the incapacity or overcapacity of public school facilities in every district of Bangkok giving a thorough information about city planning's disconnect with the education department or education policy makers.



Graph II: Comparison between Total school going population and total student capacity of each district in Bangkok

Public school infrastructure deficiency (PSID) and literacy adjusted public school infrastructure deficiency (LPSID) were also calculated for each district of Bangkok which show a positive or negative gaps; an illustration of positive for overcapacity and negative for under capacity of public school facilities with respect to targeted school going population. This is shown in Table 1 below.

DISTRICT	Public School Infrastructure Deficiency (PSDI)	Literacy rate adjusted Public School Infrastructure Deficiency (LPSDI)	DISTRICT	Public School Infrastructure Deficiency (PSDI)	Literacy rate adjusted Public School Infrastructure Deficiency (LPSDI)
Phra Nakhon	-15,189	-15687.66	Bang Kapi	-6,114	-7526.16
Pom Prap Sattru Phai	-2,395	-2752.3	Wang Thong Lang	9,499	8347.06
Samphanthawong	-90	-267.6	Lat Phrao	2,458	1326.52
Parthum Wan	-4,975	-5360.5	Bueng Kum	4,644	3261.36
Bang Rak	-1,469	-1752.86	Khan Na Yao	11,712	10814.28
Yan na wa	3,086	2351.84	Saphan Sung	-632	-1614.08
Sathon	496	-175.76	Nong Chok	179	-1895.74
Bang Kho laen	7,335	6513.9	Min Buri	5,044	3412.36
Dusit	-6,931	-7649.14	Khlong Sam Wa	7,471	5348.74
Bang Sue	5,293	4267.42	Lat Krabang	-2,883	-4795.02
Phaya Thai	5,128	4499.32	Thon buri	-1,392	-2346.48
Ratchathewi	-2,087	-2627.78	Khlong San	2,964	2381.16
Huai Khwang	1,480	818.2	Bangkok Noi	-7,482	-8347.08
Din Daeng	4,231	3095.14	Bang Phlat	2,705	1990.7
Phra Khanong	3,316	2532.04	Bangkok Yai	131	-428.86
Bang Na	1,572	697.68	Phasi Charoen	-6,278	-7419.32
Khlong Toei	5,381	4488.14	Bang Khae	8,857	7041.58
Vadhana	563	-43.78	Bang Khun thain	1,385	-645.1
Pra Wet	11,343	9495.42	Bang Bon	5,501	4225.94
Suanluang	4,474	3290.56	Chom Thong	508	-908.48
Bang Khen	16,037	14333.78	Taling Chan	-2,559	-3482.46
Sai Mai	7,729	5714.26	Thawi Watthana	-1,998	-2739.12
Don Mueang	5,622	4006.68	Rat Burana	1,593	759.42
Lak Si	3,881	2970.14	Thung khru	4,178	2904.32
Chatu Chak	3,255	1889.7	Nong Khaem	11,226	9592.44

Table 1: Public School Infrastructure Deficiency (PSDI) and Literacy rate adjusted PSDI

5. Discussion & Conclusion

As shown in the Table 1, PSDI and LPSDI have both negative and positive values whereas positive values account for overcapacity of public school facilities while negative values show under capacity of public schools for particular district in Bangkok. There dire need to reevaluate the public school location decisions as

it seems population trends in different districts are not taken into account while provision of such education facilities been decided. Some of the districts for instance Pra wet, Bang khen, Wang thong lang, Khan na yao and Nong Khaem with an over capacity of 11343, 16037, 9499, 11712 and 11226 respectively while others for instance Pra nakhon, Dusit, Bang

kapi, Bangkok noi and Phasi charoen face acute deficiency of 15189, 6931, 6114, 7482 and 6278 respectively. None of the districts have optimum number of public school facilities which shows a profound disconnect between city planning and education department. So there is dire need to reinvigorate the relationship and construct a way of cross-pollination between most important fields to have a vigorous identification and rejuvenation of policy metrics for the future development of Metropolis of Bangkok.

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- ^x Ministry of Education
Office of the Basic Education Commission
The criteria for determining the number of students per teacher per class are as follows.
Number of students per class
Ratio (Secondary) Teacher: Student = 1: 20
Number of students: Room = 40: 1
Number of Teachers = Number of Classrooms x (Number of Students: Room) / Number of Teachers: Students = Number of Classrooms x 2
Number of Administrative Teachers
- 121 - 359 students could have 1 Administrative Teacher.
- 360 - 719 students could have 1 Administrative Teacher with, 1 assistant
- 720 - 1,079 students could have 1 Administrative Teacher with 2 assistants
- 1,080 - 1,679 students could have 1 Administrative Teacher with 3 assistants
- 1,680 students or more could have 1 Administrative Teacher with 4 assistants
Condition
- To calculate Number of Classrooms (Number of students per classroom/number of students)
In each level of there are more than 10 students exceeded, have to open 1 more classroom
- To calculate number of teacher if after calculating if there is up to 0.5 should be

rounded half up to 1 round, if not should be rounded half down)

^{xi} Division of Registration Technology Development and Administration (RTDA)
The Bureau of Registration Administration (BORA) Ministry of Interior Thailand.

^{xii} UNESCO Institute for Statistics

PLACE IDENTITY IN THE AGE OF DISRUPTION: CURATING PLACE THROUGH THE CASE STUDY OF UAE MEMORIAL

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Abstract

As cities turn to their heritage and culture to conceptualize and market an authentic identity in a highly competitive global marketplace, the power of art to create new icons and shiny new attractions become economic priorities. Globalization of cities and unprecedented mass socio-cultural shifts provoke powerful discourse on how creative works transform urban space and impact on the unity of its inhabitants. Presented through the case study of a new memorial for United Arab Emirates, Wahat Al Karama, the Oasis of Dignity treads a fine balance between place destination and image making. Located in Abu Dhabi, where the traditional culture is firmly rooted in Arabia's Islamic traditions, and home to a massive population of expat workers now comprising nearly 85% of the inhabitants, discourse on the theories of brand marketing and place making to connect, catalyze and convey disparate global-local dialectical relationships are explored.

Keywords: City identity, rapid urbanization, Abu Dhabi, art, placemaking, brand marketing

1. Introduction

Creating a unique identity is equal to standing out from the crowd. In the super charged transformation of cities, having a distinct and marketable identity is paramount. The commissioning of public art in the late 20th and early 21st Centuries to contribute to place identity has seen a change in the role of art. Directed by creative city and culture led policies to “develop senses of identity, to develop sense of place, contribute to the civic identity, address community needs, tackle social exclusion, possess educational value, promote social change, and encourage economic developments” [19], public art is more than a shiny new ornament for decoration.

Presenting a practice based case study of the recently unveiled new memorial in Abu

Dhabi, Wahat Al Karama, *The Oasis of Dignity*, treads a delicate balance between traditional memorial, artist expression and place destination. Its role is far more complex than any monument may suggest. From nomadic Bedouin to modern metropolis, Abu Dhabi was a small fishing and pearling village until the influx of petrodollars. Its evolution from desert oasis to city of the future is fueled by visionary leadership as a nation building a place of contrasts, where Sheiks take selfies and Westerners smoke shisha. Abu Dhabi, where the traditional culture is firmly rooted in Arabia's Islamic traditions is also home to a massive population of expat workers now comprising nearly 85% of the inhabitants.

Curating place redolent with memories, traditions and religiosity juxtaposed with a

global dialogue of icon attraction and brand marketing offers complex, and at times conflicting messages. Conscious of a rising Islamophobia in the West, how can this memorial promise unity and connection, tolerance and respect, to a disparate viewer when it's very subject provokes binary reactions?

Acknowledging further limitations of time and place, socio-cultural and geo-economic politics, the pivotal role of collaborative placemaking posits the question of city identity within the global framework of disruption.

2. Literature Review

"Public art is the child of the postmodern condition" states Felix Duque in his article on *Public Art and making of urban space* [8] It is indeed often one of the more contentious and debated visual insertions into a public space. The history of public art meanders from art as monument celebrating the great and powerful, to art that tells the story of the place. Installed in the public realm, public art has moved from the object that could be situated anywhere, to art that is designed specifically for, and about, the site. Site specific art derives its meaning from the history, environment and people that live, work and visit there.[1,3] In this way, it extracts the vernacular and presents it back to the population.[4,15,10,18] Iconic artworks, bustling laneways and interactive installations feature heavily in tourism to market a place "where engagement "with space gives it meaning as a 'place', at least to the extent of being different from other places"[4]

The consumption of place as a commodity, through tourism or through the exchange of goods and services on a global scale, poses the vexing bind of conserving the local uniqueness whilst becoming part of a broader world agenda - without producing a

bland homogenized sameness [1,16]. In this aesthetic consideration, art must offer more than the object. It must be part of the experience and open up the critical discursive practices in the communicative relationship between people in the public realm [11, 9]

This research, interested in the relationship between public art and the identity of cities, is presented through two intertwined theoretical frameworks. The first is place making, defined as the multifaceted, interdisciplinary approach, to the planning, design and management of places within the public realm to bring the local vernacular into the play of the senses [3,14,22]. The second is city marketing through imagery, defined as the entrepreneurial marketing of a place for consumption to engender a place with an identity [2,12,13,20,22]

The memorial, historically a monumental singular structure, has metamorphosed and inserted itself into the urban fabric of key civic locations. [6]Integrated and empowering, the memorial is now a complex blend of personal artistic expression, design resolution, event commemoration and nationalistic statement packaged into an icon attraction for visiting tourists and dignitaries. "National remembrance often seeks to collectivise national memories into an 'imagined' community so that the portrayal of a 'national past' in monuments and memorials has become synonymous with the symbolic transmission of national identity"[7].

Memorials historically commemorate the cessation or ending of significant events in a time and place. However, the UAE Memorial, commemorating loss of life since Independence in 1971 includes the current conflict in Yemen. This evolving

open-ended dialogue, as additional names are added each year, resists becoming a relic of the past as its evolving future is reframed. The creation of new memorial in the UAE seeks to build a new place identity through constructed new experiences. Drawing together what is experienced physically and intellectually, the form and structure must speak to a broad collective, conceptually speaking to the diverse and broad audience of the rapid urbanization of the UAE.

Resplendent with a multiplicity of meanings and readings, sparking curiosity, sharing, participating and communing with others, new histories are overwritten with time.

3. Research Methods

Mixed method qualitative enquiry within forensic reflective practice in action posits the literate review, policy of place (Abu Dhabi) and select interviews with artist, curator and client as a multifaceted approach to analyzing empirical data. Situated within the context and culture of the inquiry, qualitative research is a “complex, interconnected family of terms, concepts, and assumptions” [5]. Research from different angles to stitch together the study weaves the various methods of into an understanding of the subject.

4. Analysis & Results

The strength of qualitative inquiry lies within “its inductive approach, its focus on specific situations or people, and its emphasis on words rather than numbers”[17]. This type of inquiry seeks to understand the cause, the why of the event, people and context, the process by which something occurs. The results of this inquiry purport to the success of collaborative placemaking within brand management. Winning the American Architecture Prize for Cultural Buildings in 2017, and a finalist in the World

Architecture Festival, is further validated with positive local and international media challenging the notion of global sameness and the production of the vernacular form.

5. Discussion & Conclusion

This practice-led, action-research discusses the complex urban context, the changing role of memorials and the collaboration of client, curator, artist, and architect to create a new urban identity in a highly contested urban fabric.

Within the current discourse on place making and the focus on experiences to attract people, public art is employed as a tool to activate a place, and inspire and mobilise a public to engage. Place making over time requires urban anchors such as public art to build these experiences. Brand marketing looks at how it can create experience as something that can be extracted and presented back to the public as a message. Research on brand marketing highlights the tactic of signature structures to building a marketable city brand through both physical and virtual experience. Here the power of the image and the use of technology to share, search and connect to a broader audience is a pragmatic tool for brand identity.

As a tapestry of interwoven meanings, symbols, emotions, memories and narratives, Wahat Al Karama, The Oasis of Dignity, is ultimately the creation of a new urban place with an authentic, distinct place identity. As a civic landmark, it successfully positions unity as a key principle through the confluence of the grand monument, the intimate experience and the complex context it draws from.

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