# International Conference

**Green Concept in Architecture and Environment**

## Writer Index

<table>
<thead>
<tr>
<th>No</th>
<th>Keynote Speaker</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Peter Kellett, Elias Yitbarek Alemayehu</td>
<td>Sustainable Rural Housing and the Challenge of Climate Change: Experiences from Ethiopia</td>
<td>i</td>
</tr>
<tr>
<td>2</td>
<td>George Ofori</td>
<td>Green Concept in Building Construction</td>
<td>xvii</td>
</tr>
<tr>
<td>3</td>
<td>Regan Potangaroa</td>
<td>The Gabion House Revisited</td>
<td>xxxix</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No</th>
<th>Author</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ni Putu Aryani</td>
<td>Sustainable Architectural Design in a Traditional Balinese Housing in Accordance to the Concept of Tri Mandala</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Ni Ketut Ayu Siwalatri</td>
<td>Sustainable Concept of Bali <em>Aga</em> Architecture</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Titien Saraswati</td>
<td>Managing Green Architecture Through Life Style</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Aprilia Fitriani</td>
<td>The Degradasi (Angle Degree, Gradien, Distance, Stem Diameter) Study of Mangrove <em>Rhizophora Apiculata</em> for Ecotourism Development Based on Mangrove <em>Rhizophora</em> Architecture (MRAC)</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>Satya Wahyuputra Santosa</td>
<td>Rectorate Building Expansion Design in Support of ITS Eco Campus Principles with Solar Envelope Concept</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>Mohamad Muqoffa</td>
<td>Designing with Veranda in Javanese Architecture</td>
<td>59</td>
</tr>
</tbody>
</table>

## Sub Theme: Green Concept in Architectural Design

<table>
<thead>
<tr>
<th>No</th>
<th>Author</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Ima Defiana</td>
<td>The Role of Housing’s Rear Wall as Generating wind Velocity in Nighttime on Humid Tropic</td>
<td>69</td>
</tr>
<tr>
<td>8</td>
<td>Nurrahmi Kartikawati</td>
<td>Spatial Control to Reduce Urban Heat Island Effect in Urban Housing</td>
<td>79</td>
</tr>
<tr>
<td>9</td>
<td>Meivirina Hanum</td>
<td>Green Architecture and Energy Efficiency as a Trigger to Design Creativity: A Case Study to Palembang City Library</td>
<td>97</td>
</tr>
<tr>
<td>10</td>
<td>Yuswinda Febrita</td>
<td>Effectivity Wind Catcher at Housing in Limited Areas in Hot-humid Tropical Climate</td>
<td>115</td>
</tr>
</tbody>
</table>

## Sub Theme: Architectural Science

<table>
<thead>
<tr>
<th>No</th>
<th>Author</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
</table>

## Sub Theme: Urban and Landscape Design

<table>
<thead>
<tr>
<th>No</th>
<th>Author</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Astri Anindya Sari</td>
<td>Optimizing Urban Open Space as Students Favorite Places for Restoration</td>
<td>127</td>
</tr>
<tr>
<td>No</td>
<td>Author</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>----</td>
<td>-------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>12</td>
<td>Himasari Hanan</td>
<td>Do Public parks create a Green Environment? Case Study: Taman Flora Surabaya</td>
<td>137</td>
</tr>
<tr>
<td>13</td>
<td>Bambang Soemardiono</td>
<td>Urban Sustainability Performance as the Framework in Evaluating Sustainable City</td>
<td>151</td>
</tr>
<tr>
<td>14</td>
<td>Nur Izzah Abu Bakar</td>
<td>Approaching Vertical Greenery as Public Art: A Review on Potentials in Urban Malaysia</td>
<td>173</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Sub Theme : Management and Urban Planning</strong></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Arif Kusumawanto</td>
<td>Green Urban Waterfront Management Case of Solo, Indonesia</td>
<td>195</td>
</tr>
<tr>
<td>16</td>
<td>Johannes Adiyanto</td>
<td>Understanding of Local Knowledge in Sustainable Development Toward Global Perspective (Exploration Studies of Javanese Culture)</td>
<td>215</td>
</tr>
<tr>
<td>17</td>
<td>Septiana Hariyani</td>
<td>The Assessment of Connectivity Indexes as Road Network’s Parameter of Sustainability in Malang City</td>
<td>227</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Sub Theme : Human Settlement and Environment</strong></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Mirza Fuady</td>
<td>Green Structure Concept in Coastal Settlement of Banda Aceh</td>
<td>239</td>
</tr>
<tr>
<td>19</td>
<td>Winny Astuti</td>
<td>Community-based Sanitation Program (Sanimas) as an Effort for Improving Environment Quality in Urban Slums Settlement</td>
<td>251</td>
</tr>
<tr>
<td>20</td>
<td>Amalia Nur Indah Sari</td>
<td>Eco-housing Concept in Coastal Settlement jatirejo Village, Pasuruan regency, East Java</td>
<td>263</td>
</tr>
<tr>
<td>21</td>
<td>Shirleyana</td>
<td>The Possibility for Public Green Open space Provision in Informal Settlement Case Study of kampung Kejawan Lor, Surabaya</td>
<td>275</td>
</tr>
<tr>
<td>22</td>
<td>Nurul L. Hasanuddin</td>
<td>How Green is the Condition of Low Income Informal Settlement? Case Study: Fishing Village in Keputih, Surabaya</td>
<td>289</td>
</tr>
<tr>
<td>23</td>
<td>Anizah Mohd Salleh</td>
<td>The Environmental Benefits of Agroforestry Systems in Relation to Social Sustainability</td>
<td>301</td>
</tr>
<tr>
<td>24</td>
<td>Edward Syarif</td>
<td>The Settlement Pattern of Mariso Waterfront to the Environmental Condition</td>
<td>319</td>
</tr>
<tr>
<td>25</td>
<td>Rusli</td>
<td>Green Concept Settlement that supports Ecosystem Based on Coastal Ecotourism in Donggala</td>
<td>333</td>
</tr>
<tr>
<td>26</td>
<td>Palupi Sri Narisywari</td>
<td>Green Concept of kampung Mangrove Gunung Anyar Tambak in Supporting Sustainable Settlement</td>
<td>345</td>
</tr>
<tr>
<td>27</td>
<td>Rita Ernawati</td>
<td>Sustainable Settlement through Green Kampung Approach</td>
<td>359</td>
</tr>
<tr>
<td>28</td>
<td>CE. Mediastika</td>
<td>Trend on the Lack of Private Open Space in</td>
<td>369</td>
</tr>
<tr>
<td>No</td>
<td>Author</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>----</td>
<td>-------------------------</td>
<td>-----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>29</td>
<td>Luluk Mawardah</td>
<td>Several Contiguous Housing in Sidoarjo</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Wiwik Setyaningsih</td>
<td>Residential Comfort Living on Flat for Urban Community/Families Low Income</td>
<td>381</td>
</tr>
<tr>
<td>31</td>
<td>Sherly de Yong</td>
<td>The Application of the Concept of Eco Green-tourism in Developing the Tourist Village through the Low Impact Development</td>
<td>393</td>
</tr>
<tr>
<td>32</td>
<td>Ricca Agnesia Alamsyah</td>
<td>The Uniqueness of Mayangkara House Roof Construction as Part of the Tropical Climate Response in Indonesia</td>
<td>425</td>
</tr>
<tr>
<td>33</td>
<td>V. Totok Noerwasito</td>
<td>Effect of Ceiling Height in the Compressed Earth Block Walled Building on Embodied Energy and Heat Energy Case Study Simple House in Surabaya</td>
<td>437</td>
</tr>
</tbody>
</table>

**Sub Theme : Theory and History of Architecture**

<table>
<thead>
<tr>
<th>No</th>
<th>Author</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>Sherly de Yong</td>
<td>Panopticism Exploration in Sustainable Development</td>
<td>409</td>
</tr>
</tbody>
</table>

**Sub Theme : Real Estate Design and Management**

<table>
<thead>
<tr>
<th>No</th>
<th>Author</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>Ricca Agnesia Alamsyah</td>
<td>Market Awareness in Sustainable Housing: Past, Present and Future Research</td>
<td>419</td>
</tr>
</tbody>
</table>

**Sub Theme : Building Construction**

<table>
<thead>
<tr>
<th>No</th>
<th>Author</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>Rabbani Kharismawan</td>
<td>The Uniqueness of Mayangkara House Roof Construction as Part of the Tropical Climate Response in Indonesia</td>
<td>425</td>
</tr>
<tr>
<td>34</td>
<td>V. Totok Noerwasito</td>
<td>Effect of Ceiling Height in the Compressed Earth Block Walled Building on Embodied Energy and Heat Energy Case Study Simple House in Surabaya</td>
<td>437</td>
</tr>
</tbody>
</table>
International Conference
Green Concept in Architecture and Environment

Keynote Speakers
Green Concept in Architecture and Environment

Department of Architecture ITS Surabaya, September 2013
SUSTAINABLE RURAL HOUSING AND THE CHALLENGE OF CLIMATE CHANGE: EXPERIENCES FROM ETHIOPIA

Peter Kellett*, Elias Yitbarek Alemayehu**
*) Visiting Professor in the Housing Chair
EiABC: Ethiopian Institute for Architecture, Building Construction and City Development, Addis Ababa University, Ethiopia. /
GURU: Global Urban Research Unit, School of Architecture Planning and Landscape, University of Newcastle, UK
e-mail: peter.kellett@ncl.ac.uk
**) Assistant Professor, Chair-holder of Housing
EiABC: Ethiopian Institute for Architecture, Building Construction and City Development, Addis Ababa University, Ethiopia
e-mail: eliasyt@yahoo.com

ABSTRACT

There is now overwhelming evidence that global warming is taking place, but the impacts on the built environment are less effectively documented. Similarly, climate instability is an additional factor in increasing movement of rural populations to urban centres. Inadequate living conditions in rural areas are also recognised as key components in encouraging such migration – hence efforts to create improved rural housing which is sustainable, affordable and desirable is a fundamental challenge.

The Ethiopian Institute of Architecture, Building Construction and City Development (EiABC) at Addis Ababa University is committed to developing research and practice into ways of planning and designing housing and settlements to make them more responsive to both climatic instability and the challenging socio-economic circumstances of Ethiopia. This paper reports on an on-going experimental sustainable rural housing project which is working with local communities to improve traditional vernacular housing through a range of innovative technologies and practices. Following detailed research into local construction technologies and lifestyles, full size prototypes were constructed to explore the positive elements of vernacular architecture within the framework of sustainability, and to test both the technologies and response of residents. This project is one of several live construction projects in the university which is also developing proposals for urban communities. These innovative projects are analysed in the context of climate change responses and sustainable development paradigms.

Keywords: rural housing, climate change, research project, Ethiopia
INTRODUCTION: CLIMATE CHANGE AND DEVELOPMENT

By the end of the century the world is expected to be on average between 1.8°C and 4°C hotter: large areas will be drier and regions in constant drought will increase from 2 to 10% by 2050 and by the end of the century the proportion of land suffering extreme drought will increase from 1% at present to 30% per cent. Rainfall patterns will become more intense with rain more likely to fall in deluges - washing away top-soil and causing flooding (Brown, 2008). Climate change and development are closely interrelated (Keller, 2009) and global warming could jeopardise decades of positive development efforts, particularly amongst the poorest people. This is certainly true of Ethiopia which is one of the very poorest in the world - listed 171 out of 182 countries in the Human Development Index ranking (UNDP, 2009). Poor people are especially threatened by climatic risks because of their high economic, social and environmental vulnerabilities.

CLIMATE CHANGE IN ETHIOPIA

Meteorological data show that since the 1960s, the temperature in Ethiopia has increased at about 0.2° C per decade and minimum temperatures have increased by approximately 0.4° C per decade (Keller, 2009:4; Regassa et al, 2010). Precipitation averages appear to have remained fairly stable, but both seasonal and annual rainfall has exhibited high spatial and temporal variability. Some studies indicate that in some regions mid-year rainfalls have declined considerably since 1997 (Regassa et al, 2010). Most global climate models project an increase in precipitation in both the dry and wet seasons, and the projected increases in inter-annual variability of precipitation combined with higher temperatures will likely lead to increases in the occurrence of droughts. In addition, heavy rains and floods are projected to increase as well (Keller, 2009). Clearly the impacts of climate change and variability will be widespread in both socio-economic and natural systems. In rural Ethiopia the majority who are already poor and marginalized are struggling with the added burden of climate change — both more variability and more extreme weather events. ‘Whole communities are struggling to understand this new variability, identify new patterns, and establish what resources they need to be able to move beyond reacting and coping to adapting to the new realities and being resilient. Policy makers, likewise, face the daunting challenge of how to refine policies [which] focus on poverty and vulnerability reduction in the context of the new realities of climate change’ (Regassa et al, 2010:4).

The impacts of climate variability and change include agriculture and food security (lower productivity); availability of clean drinking water; health (expansion of areas prone to malaria as well as expected increases in cardio-respiratory and infectious diseases); ecosystems and biodiversity (change and loss of habitats, forest
fires etc.); and infrastructure (damage to roads, buildings and communication systems by heavy rainfall and flooding).

All of the above will take place against a background increasing population which will add to pressure on livelihoods and resources, especially the over-exploitation of natural resources such as firewood which is one of the key issues associated with environmental decline. Ethiopia is the second most populous country in Africa and the projected population increases are high. Figures for the current population vary between 85-90 million and Hebel (2008) states that the population will increase by 45 million in the next 15 years.

Where will all these additional people live? At the moment Ethiopia is one of the least urbanised countries in the world – with approximately 17% living in areas defined as urban (Regassa et al, 2010:14). This means that over 80% of the population are rural and dependent on small scale agriculture-based activities for their livelihoods. This is significant at national level as agriculture accounts for 46% of GDP, and climate change could cause an 8-10% reduction of GDP by 2050 (Robinson et al, 2013:2).

Will All These People Remain in the Rural Areas?

The Intergovernmental Panel on Climate Change (IPCC) believe that the greatest single impact of climate change could be on human migration, but with so many factors at work, ‘establishing a linear, causative relationship between anthropogenic climate change and migration has been difficult’ (Brown, 2008:9). A key issue is the impact of climate change on the ‘carrying capacity’ of particular areas –which if compromised, would lead to displacement and migration as adaptive responses to climate stress.

According to the International Organisation for Migration, forced migration to urban areas hinders development by ‘increasing pressure on urban infrastructure and services, by undermining economic growth, by increasing the risk of conflict and by leading to worse health, educational and social indicators among migrants themselves’ (Brown, 2008:10). In rural areas, such forced ‘environmentally-induced’ migration is likely to be increased by those who choose to move both as an expression of dissatisfaction with conditions in rural areas, as well as the aspiration to seek livelihood, educational and lifestyle opportunities in urban areas. In a longitudinal study of the impact of drought on mobility in the Ethiopian highlands, Gray and Mueller (2011) found that men’s labour-related migration increased with drought and that land-poor households are the most vulnerable. However marriage-related moves by women decreased, suggesting a ‘hybrid narrative of environmentally-induced migration that recognizes multiple dimensions of adaptation to environmental change’ (Gray and Mueller, 2011:1). The United Nations Population Fund recognises that migration is an ‘essential part of development, as well as a principal method of coping with environmental change.’ They argue that environmental migration must be integrated into national development frameworks and urban planning policies (UNPF, nd).
Given this scenario of increasing population, climate induced pressures on rural populations and concern about increasing rural to urban migration, it is unfortunate that little has been done in assessing the impact of climate change on rural housing – and hence this paper is a contribution to this discussion. Clearly if large numbers of rural residents move to urban areas, the carrying capacity of the cities will in turn be severely compromised. The basic elements of food, water, infrastructure and shelter housing would become overstressed and cities would have to expand as well as densify on a large scale, almost certainly beyond the economic capacity of the country. In addition such large urban conglomerations would become increasingly unsustainable.

So what can be done to make it possible for more people to remain in rural areas? From a housing perspective, the challenge is twofold. Firstly, to contribute to significantly improved housing conditions. This would not only lead to improved health, safety and comfort but also to play a role in encouraging positive perceptions of rural life – and secondly to encourage the spread of environmentally sensitive construction systems and material uses which avoid undermining natural ecosystems already under stress from climate change, and also offer more sustainable approaches to construction. This includes the development of housing construction systems which challenge the increasing tendency to introduce energy-intensive ‘modern’ materials such as corrugated iron roofing sheets, provide alternative energy sources and at the same time support the development of new livelihoods in rural areas.

Social Processes Not Just Technical Solutions

From a technical perspective it is also vital that any proposed construction systems minimise emissions of greenhouse gases which are recognised as the key factor in increasing global warming. However the challenge is much more than technical. In order to move towards long term sustainability it is vital that local communities are fully engaged in the process to ensure that any proposed projects reflect the aspirations and cultural traditions of particular groups. Without such active participation it will be impossible to move beyond pilot projects to replicate and scale up to larger population groups.

This is what is being attempted by a phased research project initiated by the Housing Chair of the Ethiopian Institute of Architecture, Building Construction and City Development (EiABC) at Addis Ababa University. The Sustainable Rural Dwelling Unit (SRDU) project focuses on developing, constructing and disseminating radically improved housing units with the use of alternative building materials and construction techniques, all within a broader framework which aims to make a positive contribution to reducing vulnerability to climate change.

The project emphasises strategies for capacity building, scaling-up and scaling-out, to ensure it does not remain as a one-time intervention without wider applicability. The transferring of skills is relatively easy compared to the promotion of innovation and its final acceptance by a wider population. Achieving large-scale implementation can take a long time and a careful, culturally adjusted strategy, but without such scaling-up any efforts to improve rural housing conditions and increase
people’s capacity to confront climate change will merely remain as token gestures. So far, the findings of the research indicate that providing hands-on training to local people recruited from different parts of the project area, is one of the key methods for scaling-up.

A key element of the research is the construction of full-size prototypes that embody the positive elements of vernacular architecture within the framework of sustainability. The project has two components: firstly the documentation and study of the existing rural housing, local building materials and lifestyles; and secondly the construction of the SRDU housing prototypes which include renewable energy (solar energy and bio-gas). The project is designed in three phases: Phase 1 focused on the documentation and study of the existing vernacular rural housing and the construction of the SRDU-I prototype; Phase 2 was the construction a revised house type – SRDU-II; and Phase 3 focuses on scaling-up the SRDU units and the contextualization of vocational training. The first two phases have been completed and phase 3 is currently underway and will later include detailed analysis and evaluation by PhD students from both EiABC and ETH Zurich as part of an international academic collaboration programme which also includes the Future Cities Laboratory in Singapore.

THE RESEARCH CONTEXT

The research area is located close to the town of Gubrie in the Guraghe Zone, approximately 175 km from Addis Ababa. The town has a population of about 5,000 and is expected to grow rapidly as many facilities are either under construction or being planned (e.g. Wolkite University). These developments will attract a large number of migrants, who will eventually require housing in or within an accessible distance. However the SRDU approach can be understood as a ‘densified rural model’ (or a low density ruralised urban model) which aims to blur the classic distinction between urban and rural, and where ‘questions of health, energy production and sustainable material application are combined with the question of available local resources’ (Hebel, forthcoming). Such an approach offers much greater opportunities to achieve more sustainable solutions.

The research seeks to draw lessons from the vernacular Guraghe architecture and incorporate it into improved rural housing, with a focus on capacity building through hands-on training through the construction of prototype units. The typical Guraghe traditional house consists of a single room built of wood and mud walls with a straw roof. Those who can afford to will usually build separate houses for livestock and guests, otherwise, the one-roomed dwelling accommodates both animals and humans, only sometimes separated by a wooden partition. The space has a small window or sometimes no window at all, and as a result is dark and lacks ventilation. The smoke from the hearth, although important to control insects, has a negative impact on the health of the habitants, particularly the eyes and lungs. Despite these disadvantages, the Guraghe vernacular house boasts a sturdy construction and unique character.
Although fond of their traditional house typology, many of those who have the resources construct ‘modern’ tin-roofed rectangular houses, and it is now common to see tin-roofed houses next to traditional homes. The homesteads usually consist of three buildings around an open space, and frequently these modern dwellings are used only for guests. The traditional house is good in protecting from heat and cold while the opposite is true for the tin-roofed house. Also the traditional house is comfortable and is seen as an expression of Guraghe identity. For example, the umbrella-structured central pole (echibe) symbolises the unity of the family and the responsibilities of the head of the household. On the other hand, the modern house has advantages in terms of availability of materials and speed of construction, and is considered a status symbol. Hence a key objective of the SRDU research project is to design and implement housing that includes both the advantages of the traditional house and the so-called modern house, whilst simultaneously maintaining the Guraghe sense of identity. Part of this was to consider carefully the building process. Except for some details that require specialised craftsmen, house construction in Guraghe culture is a cooperative community endeavour which the project attempted to reinforce.

The Research Process

Undergraduate architecture students and postgraduate students on the MSc in Housing and Sustainable Development course were involved in collecting data on traditional building systems and lifestyles. This data was analysed by the core team which then developed two housing types. The new designs include separate living
and dining areas, kitchen, bedrooms and an integrated byre for animals, as well as toilet, shower and storage areas.

Traditional houses use a large amount of timber in a wattle and daub construction. The intensive use of wood for both construction (and as fuel) is creating problems of deforestation, hence a key challenge was to develop alternative walling materials which were available locally. Different kinds of material tests were carried out in order to select the appropriate building materials and construction techniques.

![Figure 2. The SRDU prototypes.](image)

Left: section showing double level living areas. Right: central pole with umbrella supports.

A range of materials were tested including sun-dried soil blocks which were found to have sufficient compressive strength for the walls, and woven bamboo was proposed for the roof. The umbrella type central pole was maintained for strong cultural reasons. To enhance the lateral stability and earthquake resistance of the building; bamboo studs were introduced to connect the foundation with the walls.
Participation and Partnership

From the outset it was understood that participation and partnership with locals was crucial, not only in developing a sense of belonging and ownership, but also for the future continuity of the project. At the start 13 local men were recruited to participate in the research not only as trainees but also as insiders giving constant feedback to the research team. They were recruited from the different Woredas (districts) with the vision that they in turn would later train more people. Moreover, a cross-cultural transfer of knowledge and skill was achieved by involving four roof makers from the Chencha region (500 km from Addis Ababa) to provide hands-on training on the technique of bamboo roof construction. The development of knowledge and expertise about bamboo has been reinforced by the formation of the National Bamboo Construction Centre within the EiABC which is headed by the Chair of Alternative Technology.

In addition to the farmer trainees, key stakeholder meetings were held at critical stages of the research and its implementation. The stakeholder meetings included discussions with the Bete Guraghe Cultural Centre (BGCC), the Guraghe Development Association, Federal and local politicians, representatives from the Ministry of Urban Development and Construction, the Ministry of Education and most importantly, elders and prominent people from the Guraghe region.

In September 2011, a small event was organised whereby each of the trainees received three different-sized metal moulds for block making and an illustrated manual in the local Amharic language which describes the construction process step-by-step. This was to encourage the trainees to begin implementing what they had learnt. It was suggested they try to construct a modest structure in their

Figure 3 . Skilled craftsmen fixing the outer bamboo layer over the woven bamboo roof.
localities using the SRDU building materials and construction techniques. At this early stage emphasis was not put in replicating the SRDU in its totality, but rather consolidating what had already been learnt. The response of the trainees was encouraging: within a period of six months, four trainees managed to produce hundreds of soil blocks while one of them constructed an outdoor toilet using the SRDU technique. This was the first milestone in the process of scaling-up and it indicated that the trainees had taken the idea of the research seriously and were committed to taking it forward.

Figure 4. Local people and dignitaries attend the inauguration of SRDU II.

The following January all the trainees returned to the Gubrie research site and worked on the construction of SRDU-II. This is a circular housing prototype as opposed to SRDU-I, which was rectangular – to echo the aspirations expressed in the modern tin-roof houses. The wisdom of changing the form of the original SRDU is to show the local people and the trainees that it is possible to have various options using the same materials and construction technique. The change also responded to the feedback of many local people – who although impressed with quality of the first prototype believed that a circular plan in line with their traditions would be even better. This illustrates some of the contradictions which are present in societies undergoing change and modernisation. Both prototypes were inaugurated and local people from a wide area were invited to visit, experience and learn about the projects. Encouragingly, three well-known affluent people from the region have commissioned houses using the SRDU techniques – and will no doubt
be influential helping to build a positive image for such ‘modern vernacular’
construction approaches.

Whilst undertaking SRDU-II, the third phase of the SRDU research series was
launched under the title “Contextualization of vocational training for the building
sector in Ethiopia”. This focuses on consolidating and enhancing the key issues of
the capacity building, scaling-out and scaling-up process initiated in SRDU-I and II.
The envisioned strategies and further milestones are discussed below.

Capacity Building and Knowledge Transfer

To consolidate and enhance the process of capacity building, with the ultimate goal
of scaling-up and scaling-out the SRDUs, a range of actors are involved at different
levels. In addition to the horizontal transfer of knowledge and skills between local
trainees and researchers discussed earlier, there is a pyramidal cascading knowledge
transfer between senior academics, PhD students, trainees from Wolkite University
and the local Technical and Vocational college (TVET), and local semi-skilled or
non-skilled trainees. The key strategy of the capacity building pyramid is the
development of curricula and the transfer of skills through practical experiments
involving students and trainees. The objective is that at the end of phase 3, the local
university and TVET trainees would continue to provide training to local farmers,
using the newly developed curricula, and thus becoming part of the mainstream
academic training system. At this stage it is anticipated that control and organisation
of future projects would be under the direction of the local university, and the team
from EiABC would be able to concentrate on research and projects in other regions
of the country.

One of the main objectives of the research is to disseminate the SRDU
findings on alternative materials and construction techniques and thereby multiply
the housing typologies and/or their components at a larger scale within rural
settlements and emerging towns. The main strategy to achieve this will be through
entrepreneurship. Trainees who have completed the SRDU curricula will be
couraged to organize themselves into co-operatives and business entities to create
small-scale industries to produce the components of the housing units. Therefore
the SRDU curricula will incorporate entrepreneurship modules given in
collaboration with entrepreneurship experts and experienced business people. These
new enterprises would produce rationalised building elements which could be used
by for the construction of housing throughout wide areas and thus benefit increasing
numbers of rural people. The linking of house construction to livelihoods is a
fundamental component of future sustainability especially as rural livelihoods are
coming under increasing pressure. Such an approach is line with the approach of the
United Nations Population Fund (UNPF) which recognises that small urban centres
will be the destination of many environmental migrants and hence recommend
policies which support the sustainable growth and development of such centres.

The climatic and cultural diversity of the country, with over 80 distinct
cultural groups and dramatically contrasting climatic zones, will pose a great
challenge in scaling-up and applying the findings of the SRDU research to other
parts of the country. The housing units developed for the Guraghe region cannot
SOME LESSONS AND REFLECTIONS

Sensitivity to Context

This project demonstrates the value of detailed, thorough field research and analysis which goes beyond superficial visual surveys. It is vital to understand how people live, the reasons for current choices; the significance of material choice and spatial layouts, and to understand individual, household and community aspirations. Housing is a social process which by definition is rooted in specific climatic and cultural contexts which must be well understood before proposing any changes. Studies of rural life in Ethiopia indicate its rich complexity and how human behaviour is deeply rooted in historic belief systems in which everything in the natural world is divinely inspired and closely interrelated (Carlson and Carlson, 2008: 57). For example this can mean some people believe that inappropriate actions and behaviour can impact on harvests, health and fertility. Hence all proposed changes and interventions must be sensitive to such issues. For example, in the Guraghe region cattle are considered a part of the family and must be housed in the same building. In this project the designers proposed a way of integrating the cattle but at the same achieving sufficient separation for health and practical reason. It is vital not be restrained by ideas of static cultural models: all societies are in a process of change, even when it may not be visible or apparently tangible (Kellett, 2010). The challenge is to direct change in positive, inclusive and sustainable directions and to ensure people are able to appreciate the reasons behind decisions and are willing to adopt them.

The Importance of Testing

The project recognised the importance of thoroughly testing new materials and construction techniques, firstly as individual components then full-size prior to implementation. This was facilitated by the EiABC laboratories). The credibility of professionals rests on avoiding fundamental mistakes. The testing process also allows for testing for more severe conditions and offers the opportunity to build in tolerances for future climate changes such as higher rainfall or drier conditions.
Full Size Prototypes

There is great value in building full size prototypes, not only assess the effectiveness of the design and construction system but equally important to allow people to really experience the new forms, spaces and materials, and hence to assess their cultural and economic acceptability. We can also consider full size prototypes as a type of pilot – which is important in research as well practice.

Locally Sourced Materials

Current traditional solutions develop from materials obtained locally and it is important to continue this approach. However this does not necessarily mean using the same materials. The exploration of alternative materials (and associated construction systems) needs to bear in mind the future natural resource availability and in particular their renewability. The project also examined building approaches from other regions to gather and test examples of good practice which had the potential for wider applicability; for example the introduction of bamboo not currently used for construction in the study area, but which grows locally. As with other aspects of the project, a key aim is to reduce reliance on manufactured goods and those imported from other regions to minimise the additional energy and carbon costs implicit in manufacture and transport. Equally important are locally sourced skills.

Resource Efficiency and Resilience

Future population pressures and climate instability will undoubtedly increase the pressures and competition for limited resources hence it is vital that all human and natural resources and assets are used efficiently. This is a key tenet of sustainability (Chambers and Conway, 1991) and was a constant theme underlying the project. To achieve this requires innovation and creativity and new ways of thinking – which architects should be to offer on all projects – but is especially important for low-income communities who have limited resources. Knowledge and information are key resources – and the development and reinforcement of local knowledge and skill is a vital component of reinforcing resilience of potentially vulnerable communities

Independent Energy Generation

Like most rural areas the Guraghe use wood as the main energy source. This is leading to deforestation and other negative environmental impacts. The introduction of Biogas and solar power reduces dependency on grid and plays a vital role in increasing local autonomy and independence as well offering significant environmental gains.
Involvement of Local People

Local people were involved from the inception. Irrespective of the potential value of the technical and design solutions proposed, unless local people are directly involved at a range of levels it will not be possible to move beyond prototypes. In particular this includes those in influential positions and opinion formers. In this project a particular important moment was when the elders came to bless the project and the workers in an ecumenical ceremony which united both Christians and Moslems. Their public endorsement of the project cannot be underestimated.

![Community elders blessing the project and the workers.](image)

**Figure 4.** Community elders blessing the project and the workers.

In order that new ideas are accepted and rolled out on a larger scale, the backing and support of ordinary people is vital – hence the logic of including local people as trainees. The literature on Participatory Action Research from a range of contexts indicates the value of working with rather than for communities, and echoes John Turner’s early ideas of housing BY rather than FOR people (Turner, 1972, 1976).

**Training**

The project illustrated the importance of focusing on training of local workers who in the future will be able to take the project forward without the continuing support of the project team at Addis Ababa University. Equally significant is the involvement of staff and students from the local university and Technical and Vocational college who are integrating this project into key skill training and
educational curricula. This is vital to ensure future projects have skilled and informed people to lead and implementation them.

**Hands-on Education**

The project involves processes embedded at a range of levels in different academic institutions. This means that the students learn about the vital importance of sustainability and the challenge of climate change in rural areas not from texts books and lectures but from direct engagement in the process. For example masters students and undergraduates from EiABC spent time in the field interacting with local people to gather data on building processes and material use. This is invaluable educational experience. Later they were active in a hands-on capacity to help build some of the prototypes. This suggests that other institutions might consider adopting such ‘learning by doing’ activities in the curriculum.

**Research and International Collaboration**

PhD students will be active in future evaluation and will be joined by students and academics from European institutions who are similarly gaining significantly from engagement in the process. Such international experience sharing echoes the global importance of climate change and the urgent need to develop sustainable responses in the field of architecture and planning. Such actions begin to blur the distinction between education and research, and to illuminate the potential for more practically-orientated and socially-committed curricula. Certainly it underlines the potential for research to be action focused with the aim of making a significant contribution to the development objectives of the country – particularly the issue of substandard housing and the challenge of climate change. The SRDU project is one of a coordinated series of ambitious research/educational projects currently underway in the EiABC which deal with urban as well as rural construction, design and planning issues (Cherenet and Sewnet, 2011).

**An Evolutionary Approach**

In contrast to contemporary commercial projects which put a high value on fast completion, this research-oriented project moved cautiously but steadily to ensure people were moving along with the project team, and to be able to adopt new ideas and respond to unpredicted opportunities. In this sense the breaks necessary for the seasonal heavy rains were helpful as they allowed time for reflection away from the field in order to test and consolidate before moving to the next stage. The team held weekly project meetings and several retreats to reflect and evaluate progress and to plan future activities. Sustainability cannot be achieved overnight, as it is a long term social as well as a technical process. Such a gentle, slower approach echoes some aspects of traditional vernacular approaches in which a series of minor changes, adaptions and improvements are introduced through time (Rapoport, 1969).
Flexibility and Adaptability

The project demonstrated the value of a flexible design which encouraged future change and adaptability. The SDRU projects are not intended to be rigid and fixed. Therefore it is vital that knowledge, understanding and skills reside in the local communities so that as local conditions fluctuate and change (as well ideas, aspirations and lifestyles), buildings can adjust accordingly in a sustainable way. For local people the experience of witnessing and engaging in this project will hopefully demonstrate that positive change is possible and indicates that future change is also possible, feasible and is to be welcomed. Most important in these challenging and unpredictable times, they can be active agents in helping to define their own futures rather than being powerless and vulnerable in the face of climate change.

ACKNOWLEDGEMENTS

The authors are indebted to other members of the SRDU research team, particularly Meron Kassahun, Berhanu Gebrewold, Denamo Addissie, Yidnekachew Tesmama, Yonas Alemayehu, Imam Mahmoud and Yohana Eyob, as well the numerous people from the Guraghe region who actively supported the project.

REFERENCES


UNPF (nd) United Nations Population Fund Fact-Sheet on Climate Change and Migration.

GREEN CONCEPT IN BUILDING CONSTRUCTION

George Ofori
Department of Building, National University of Singapore, Singapore
e-mail: bdgofori@nus.edu.sg

ABSTRACT

Buildings have a major, wide ranging impact on the environment. The features which a building must have in order to be described as ‘green’ or ‘sustainable’ are now well known. Whereas a wholly sustainable building cannot be attained, there is need for action to minimise the adverse impacts of buildings. This contributes to the attainment of sustainable development. In most countries, some efforts are being made by governments, professional institutions and companies to realise sustainable buildings. However, it is evident that much more needs to be done. The effort to attain sustainable buildings has several drivers, including mandatory legal requirements, incentives, benchmarking and labeling schemes, and action by professional institutions. It is suggested here that focus should be on the responsibility of the individual practitioner to work towards the design or construction of sustainable buildings in the normal course of the practitioner’s work. This responsibility is considered from the perspective of the ethics and professionalism of such a practitioner. The roles of various parties in setting out and strengthening this responsibility are discussed.

Keywords: sustainable development, sustainable building, ethics, professionalism, new specialisations

INTRODUCTION

Sustainable Development in Context of Building

Attaining sustainable development is a crucial global concern which is at the top of the policy agenda in most countries, and should be, everywhere. Businesses and practitioners in all sectors, as well as individuals are being called upon to act, and many have indicated their intentions to do so, and proposed appropriate strategies. The Royal Institute of British Architects (RIBA) declares that it is committed to the principle of sustainable development which it defines as (RIBA, 2000, p. 1):

“Development which raises the quality of life and serves the goal of achieving global equity in the distribution of the Earth's resources whilst conserving its natural capital and achieving significant and sustained...
reductions in all forms of pollution especially emissions of greenhouse gases.”

What does “sustainable development” mean in practice, and why does it concern building practitioners? The UNCSD (2012) notes that: “Sustainable development emphasizes a holistic, equitable and far-sighted approach to decision-making at all levels. It emphasizes not just strong economic performance but intragenerational and intergenerational equity. It rests on integration and a balanced consideration of social, economic and environmental goals and objectives in both public and private decision-making.” Thus, decision making and action should involve all sectors of the economy (including the building industry) and society.

Sustainable development is perceived to have several key component issues. The United Nations Environment Programme (UNEP) (2013) outlined its medium-term priorities in the attainment of sustainable development as: (i) climate change; (ii) resource efficiency; (iii) disasters and conflicts; (iv) environmental governance; (v) harmful substances and hazardous waste; and (vi) ecosystem management. It should be emphasised that these factors are closely inter-related; a failure to make progress in one leads to further adverse impact in other areas, and also to an impairment of the capacity and capability of the relevant actors to pursue the others. A glance at the list of UNEP’s priorities shows that all of them are relevant to the building industry.

Climate Change as an Example

Climate change can be used to illustrate how the issues relating to sustainable development are being, or should be, pursued, and the current and potential role of the building industry in these efforts. Skea (2012) notes that the built environment plays a critical role in energy and climate change policies. He observed that the European Union (EU) Energy Performance of Buildings Directive (EPBD) sets the framework for the pursuit of energy efficiency in the UK and other (EU) member states. Guided by this framework, the broad goals of UK energy policy are: to reduce greenhouse gas (GHG) emissions, by a legally binding figure of 80% by 2050; to ensure reliable supplies to consumers; and to ensure that energy is ‘affordable’. To attain the 2050 GHG emissions target, four “carbon budgets” covering 2008-12, 2013-17, 2018-22 and 2023-27 have been set by law. The fourth carbon budget requires emissions to fall by as much as 50% by 2025 relative to 1990 levels. Radical changes to the energy system are needed to attain such deep cuts.

Skea’s (2012) research is among many works which show that if the UK’s ambitious climate policy targets are to be achieved, the building industry must make a significant contribution. Rashid and Ofori (2013) made similar observations with regard to the attainment of Malaysia’s commitment to reduce its emissions. These are in line with the observation by the Inter-Governmental Panel on Climate Change (2007) that buildings offer one of the most cost-effective ways of addressing the challenge of climate change. Thus, like many officials, researchers and commentators, Skea (2012) notes that the way that buildings are designed, built and
used will have to change significantly if the nations’ goals in contributing to efforts to address climate change and targets of GHG emissions are to be achieved.

Research Objectives

The objectives of this study are to:
- discuss the impacts of building activity on the environment, and the nature of “green building” or “sustainable building” as suggested by the literature and in the context of sustainable development, as well as their practical meaning
- consider the courses of action at the construction stage to attain sustainable building
- discuss the possibility of the practitioner’s personal responsibility being a major thrust in green architecture and building programmes in Asian countries
- suggest approaches to courses of action towards sustainable being; and propose a research agenda.

CURRENT STATE OF SUSTAINABLE BUILDING

Building and the Environment: the Problem

The adverse impact that a building can have on the environment and therefore, the process of sustainable development, is evident when one considers the entire building process (see, for example, Ofori, 1992). It starts from the extraction of the raw materials for the processing and manufacturing of the materials used in buildings, and include the raw materials (which is often non-replaceable) and energy used (which can be substantial in the case of some materials such as steel and aluminium) and waste produced. The materials, components and equipment are then transported to sites where they are required. In the globalised era, this can be over several thousand kilometres. During building on site, the likely impacts are the energy and water used, wastes generated, spillages which might pollute ground water, and the production of dust and noise. The impact with regard to energy usage and hence, global warming potential is greatest during the operation of the completed facility (from energy used to cool or warm the building). Another possible impact lies in the demolition of the building and disposal of wastes.

The Chartered Institute of Building (CIOB) (2013a) notes that it takes one third of the world’s resources to build the homes, offices and factories; and the energy to run these facilities is responsible for 40% of GHGs. To relate just one research work, Huang and Bohne (2012) examined nine types of air pollutants emitted by the Norwegian construction industry using input-output and time-series analysis techniques. Their results showed increasing air emissions from this industry, but lower emission intensities (except for NH3), between 2003 and 2007. The industry’s GHGs, acidifying gases, ozone precursors and PM10 grew to 127%, 119%, 108% and 114% from a 2003 baseline level to 2007 respectively. On the
other hand, the total GHGs, acidifying gases, ozone precursors and PM10 intensities annually decreased 2.7%, 4.3%, 6.5% and 5.0% respectively during the period. Intensities of all air pollutants except NH3 are expected to decrease in future; total GHG emissions intensities in 2020 are predicted to decline by 13% compared with 2007. The results also showed that indirect emissions form the largest proportion of the total emissions: thus optimised material use and selection of materials with low embodied emissions is key to further reduce the building industry’s air emissions.

**Green or Sustainable Building: Definition**

“Green architecture” can be considered to result in “green building” or “sustainable building”. These terms have become part of first the professional vocabulary, and then common language. Commission for Economic Cooperation (2009) notes that “Green building refers to the use of environmentally preferable practices and materials in the design, location, construction, operation and disposal of buildings. It applies to both renovation and retrofitting of existing buildings, and construction of new buildings, whether residential or commercial public or private”. The definition of the International Organisation for Standardisation (ISO) (2008) is that sustainable development of buildings (and other construction works) creates the required performance and functionality with minimum adverse environmental impact, while encouraging improvements in economic and social (and cultural) aspects at local, regional and global levels.

The United States Green Building Council (USGBC) Research Committee (2007) notes that:

‘Green buildings depend on the continuous improvement of building processes, technologies and performance to minimise negative environmental or health impacts and contribute to environmental restoration and sustainable resource management. Objectives of green buildings … include (a) climate conditions decoupled from human activities; (b) stable, sustainable energy supplies; (c) clean, renewable and sufficient water resources; (d) restorative use of land for the long-term sustainability of habitats; (e) restorative use of materials and assemblies that account for life-cycle impacts; and (f) enhanced human safety, health and productivity in the built environment’.

The Green Building Index SdnBhd of Malaysia (2009: 2) states that ‘a green building focuses on increasing the efficiency of resource use – energy, water and materials – while reducing building impact on human health and the environment during the building’s life cycle through better siting, design, construction, operation, maintenance and removal’.

The definitions indicate that sustainable (or green) building involves creating buildings using best-practice, clean and resource-efficient techniques, from the extraction of raw materials to the demolition and disposal of its components. It must be noted that building activities will always involve some adverse environmental implications although ‘sustainable building’ should reduce their extent. Thus, sustainable building is an ideal target.

Singapore’s case can be used to illustrate a national programme on sustainable building in South-east Asia.
Singapore’s Green Building Programme

Singapore wishes to be a global leader in green buildings, with particular expertise in the tropics and sub-tropics, and it believes this can be achieved in the next five years (BCA, 2013a). Singapore’s green building programme is pursued with the guidance of a national strategy and set of integrated policies, through the implementation of a benchmarking scheme; legislation setting minimum standards of environmental performance of buildings; financial incentives; and awards. It is estimated that buildings consume about one-third of Singapore's total end-use electricity (BCA, 2013a). Thus, Singapore focuses its efforts on minimising the usage of energy in buildings. To give a stimulus to the efforts to attain energy efficiency in existing buildings and to improve Singapore's energy security, productivity and growth, new legislation for energy efficiency makes it mandatory for existing buildings to attain minimum environmental sustainability standards.

Singapore is making progress in these regards. The number of green building projects in Singapore has grown from 17 in 2005 to about 1,600 in eight years (BCA, 2013a). This translates to 47 million m² of gross floor area (GFA), or 20% of Singapore's total GFA. Thus, Singapore is on track to meet its goal of greening 80% of its building stock by 2030. This pace of growth also means that Singapore is one of the leading green cities in the world in terms of per capita green building space (BCA, 2013b).

Benefits, Obstacles and Enablers

The benefits of sustainable building are outlined in the literature. Focus is often on the life-cycle savings in energy costs. For example, in Singapore, a study by Building and Construction Authority (BCA) on 36 commercial buildings found that an efficient chiller system can improve energy efficiency by up to 42% after retrofitting (BCA, 2013a). This constitutes overall energy savings of 16% of the total building consumption. The total energy saved was 85 GWh per annum. The owners of the buildings saved a total of $22.7 million per year.

Many wider benefits of sustainable buildings are also highlighted. For example, Aho (2013) suggests that both scientific research results and anecdotal business evidence exist to make a convincing business case for sustainable buildings and built environments. The investment performance of sustainable buildings has been shown to be better in the long- and medium-terms than standard practice buildings due to lower risk levels, lower operating and maintenance costs, less vulnerability to changes in the tariffs of energy and other utilities, better service levels and productivity of end users, attractiveness to owning or occupying organisations because of enhanced corporate image, and so on.

Common obstacles as well as enablers of the pursuit of sustainable building are identified. For example, Hakkinen and Belloni (2011) outlined the following process-related barriers: (i) rules of competition and tendering processes; (ii) functioning of value chains; (iii) possibilities to apply integrated design processes;
(iv) lack of knowledge of existing efficient sustainable building technologies; (v) lack of demand; and (vi) drawbacks in sustainable building marketing processes. The issues that promote the adoption of sustainable building concepts include: beneficial operational costs of sustainable buildings; improved well-being and productivity of occupants and users of buildings due to improved building performance; and long-term benefits for the national economy because of reduced emissions and use of natural resources. Thus, Ofori (1992) argues that ‘the environment’ should be the fourth client objective of construction projects (after the traditional criteria of cost, time and quality).

The respondents to the study by Hakkinen and Belloni (2011) addressed the lack of awareness of clients, competence of designers and other actors, availability of tools, lack of economic incentives, lack of sustainable renovation concepts, and relevant services for maintenance and energy supply. With respect to design, they noted the following factors (in descending order of importance): (1) there are not adequate incentives for designers in order to support them to develop knowledge and methods for sustainable building design; (2) there is a lack of adequate knowledge to enable practitioners to consider potential new alternatives (such as renewable energy); (3) the process lacks an actor or a team who manages the overall design of the building; (4) there is a lack of integrated design methods; (5) sustainable building solutions may have unknown risks, for which the designer may become responsible; and (6) designers are not able to interpret the sustainable building requirements set by the client to establish them as design criteria. Concerning contractors, the factors were (in descending order of importance): (i) main contractor is not able to take care that the operation and use of the sustainable building is adequately guided in order to ensure the intended performance; (ii) there is no knowledge to set adequate criteria in the procurement process of products to ensure the intended overall performance of the building; (iii) design documents do not show adequate performance and capacity requirements for the products (leading to competition on the basis of price); (iv) there are no methods to verify the compliance of subcontractors’ work with sustainable building requirements; (v) contractors are not able to explain the sustainable building criteria to subcontractors; and (vi) there are no resources to supervise the realisation of sustainable building requirements.

It is evident that, to attain sustainable building in a routine manner, much needs to change. What change is required? What do these definitions of sustainable building mean in practice? What is the designer’s role? What does the building construction process on site involve?

**Indicators of Sustainable Building**

The RIBA (2000, pp. 2-3) offers the following Key Indicators for Sustainable Design:

1. Minimising the use of fossil-based energy in terms of the energy embodied in the materials, transport and the construction process, and the energy used during the lifetime of the building.
Avoiding all ozone-depleting chemicals in terms of manufacture and system operation, including HCFCs.

Where possible using alternatives to materials containing volatile organic compounds.

Designing to make maximum use of natural light whilst also being aware of its limitations.

Exploiting the potential for natural ventilation in the context of an overall climate control strategy which minimises energy use and maximises comfort.

Making best use of passive solar energy whilst employing heating/cooling systems which are fine-tuned to the needs of the occupants.

Ensuring that building management systems are user-friendly.

Identifying opportunities to generate on-site renewable electricity (embedded systems).

Identifying the potential for exploiting the constant ground temperature for evening-out the peaks and troughs of summer and winter temperature.

Minimising the use of water; harvesting rainwater and grey water and purifying for use other than human consumption.

Minimising rainwater runoff by limiting the extent of hard external landscape.

Creating an external environment which is both a visual amenity and also offers environmental benefits such as summer shading from deciduous trees and evaporative cooling from water features.

Whilst taking account of these key indicators, ensuring that designs meet the highest standards of technical proficiency in combination with aesthetic excellence.

The Singapore Institute of Architects (SIA) (2013) proposed these attributes of a sustainable built environment, it:

1. …seeks to conserve its natural capital which encompasses natural resources and ecosystem services that sustain life

2. …seeks to minimise its contribution to the underlying causes of climate change. In addition, it is designed to adapt to the predicted local consequences of this global phenomenon

3. …opts for renewable resources over non-renewable ones. This principle extends to its demand for energy, water and materials

4. …optimises the use of non-renewable resources by managing demand, minimising waste and optimising resource efficiency

5. …is designed for adaptability and reuse, with a view to extending the life of whole buildings and their components. It seeks to reduce the risk of obsolescence by anticipating changes in programme, technology and land use

6. …has in place principles and infrastructure that support an efficient use of resources and a low-carbon lifestyle

7. …is in harmony with its setting; acknowledging and responding to the pre-existing conditions that physically define a site or describe its social and cultural context
8. …ensures the wellness of its inhabitants, taking into account the physiological and psychological needs of its users, addressing their expectations and preferences relating to comfort and health.
9. …integrates greenery and other landscape elements into urban masterplans, site design and building envelope.
10. …is a product of a collaborative framework known as the integrated design process which seeks to bridge the gap between the various stakeholders across all phases of the design-construct process, driven by a focus on targets and performance.
11. …must factor in the ecological literacy of the population (its awareness of the consequences of its behaviour and/or inaction towards the environment). It can conversely, through its design and interfaces, seek to promote it.

SIA (2013) gives detailed instructions to building practitioners on what must be done to attain a sustainable building at all stages of the development process.

Action at the Construction Stage

The aim of the CIOB’s Carbon Action 2050 is to provide the industry with guidance to reduce the UK’s carbon emissions to 80% of its 1990 level by the year 2050 (CIOB, 2013a). The institution notes that much of it can be applied globally, although it is based on UK policy. The strategy of the initiative “is to find practical ways of saving energy and carbon that can be implemented straight away, and then spread the word among project teams, in particular project managers, clients, architects, building control personnel and environmental specialists, who can act as green champions” (CIOB, 2013a). The proposals of various work groups on Carbon Action 2050 related mainly to contributing to meeting the UK’s GHG emission reduction target for 2012. The actions proposed for the construction stage are outlined below (CIOB, 2013b).

1. Energy-efficient site accommodation “It is claimed that the use of energy-efficient site accommodation has the potential to reduce CO2 emissions from the construction process by 50% or possibly more”; 
   1. Insulation and type of glazing;
   2. Heating and lighting;
   3. Motion sensors to control energy usage;
   4. Metering of heat and electricity usage;
   5. Use of a master switch to control energy system;
   6. Occupant awareness;
2. Efficient use of construction plant;
   1. Choosing the correct, or most suitable, machine for the task in hand, avoiding where possible the use of oversized plant (when employing large machinery, it might be preferable to use it for one-off operations);
   2. Use of fuel-efficient plant;
   3. Use of properly maintained and serviced plant;
   4. Low-carbon fuelling of plant;
5. Efficient operation of plant, avoiding idling and inappropriate use of power. Plant-operator training and reinforcement of skills (such as toolbox talks);
6. Planning and monitoring of plant use (such as telematics).

3. Earlier connection to the grid;

4. Good practice energy-management on site;
   1. Control of generating plant to ensure only essential power is produced;
   2. Control of lighting (such as accommodation, night security);
   3. Use of energy-efficient technology for security and task lighting;
   4. Effective server management of computers;
   5. Energy-efficient site accommodation (as before);
   6. Efficient use of plant and equipment (as before);
   7. Monitor and collect data and disseminate results to other stakeholders in the supply chain. This could be implemented in part by a contractor-appointed energy advisor for each construction project.

5. Fuel-efficient driving – freight,
6. Fuel-efficient driving – waste removal,
7. Renewable Transport Fuel Obligation (RTFO) – freight and waste removal;
   1. Increased use of fuel-efficient vehicles;
   2. Reducing the weight of freight moved;
   3. Reducing the distances travelled;
   4. Use of carbon-light fuels;
   5. Increased utilisation rate of vehicles (i.e. maximised use of vehicles’ load capacity, avoiding part-loads where possible);
   6. Improved driving to conserve fuel including the use of vehicle-performance control units.

8. Construction consolidation;
   1. Initiate measures to facilitate the consolidation of small deliveries to construction sites;
   2. Development of financing models for establishing and running a regional consolidation centre and the implications for instigating an urban congestion-charge for construction vehicles;
   3. Engage with stakeholders to develop flagship consolidation centres for a number of major projects, or development areas (within five years);
   4. Through stakeholder engagement, implementation of strategic planning for future consolidation centres.

9. Reducing the transport of waste;
10. Renewable Transport Fuel Obligation (RTFO) – business travel,
11. Smart-driving training for business travel,
12. Fleet conversion to fuel-efficient passenger vehicles,
13. Restricting domestic flights;
   1. Corporate energy-reviews of premises to establish solutions for reducing consumption;
2. Undertake review of existing ICT stock and replace where required with more energy-efficient equipment;
3. Where viable, install automatic switch-off technology;
4. Review computer-server arrangements and, where necessary, seek alternatives that are more energy-efficient;
5. Engage with Carbon Trust programmes: Carbon Management (CM) and Carbon Management Energy Efficiency (CMee) programmes.

15. On-site measurement, monitoring and targeting;
16. Sharing knowledge about alternative sustainable fuels – for example, “it is estimated that the use of 100% biodiesel for powering generators on site would reduce emissions from site activities by approximately 25%”.

How should practitioners in the building industry respond to this need, and call, for sustainable building?

PROFESSIONAL ETHICS AND PROFESSIONALISM AS A PIVOT

It is argued here that the individual practitioner, of any background, has the responsibility to act to attain sustainable building. The individual practitioner’s professional ethics and professionalism can serve as a pivot in these regards

Professional Ethics

The responsibility of a practitioner in the pursuit of the person’s work is partly guided by the ethics of the profession the practitioner belongs to. The Royal Institution of Chartered Surveyors (RICS) Working Party (2000) suggested that five basic assumptions underpin the understanding of ethics as covered by professional organisations. The first is that Professional ethics is a process, a way of reviewing behaviour against constantly changing standards. What may be ethical today, or in a particular society, may be viewed differently by others or at another time. This view is echoed by Duffy and Rabeneck (2013). The second assumption is that Human behaviour is caused. There is a motive for all human behaviour; examples of the underlying reasons for the actions of practitioners are financial gain and career advancement, whereas examples for general human behavior are power and compassion. The third assumption is that Actions have consequences. The fourth is that What is perceived as ethical depends on the viewpoint of the individual. However, this can be influenced by many factors including codes and statements, such as those of professional institutions. There may also be differences among societies. The final assumption is The foundation stone for good ethical business practice is mutual vulnerability. That is, humans are each susceptible to actions of others and the way a person is treated depends on how the person treats others.

The RICS Working Party (2000) proceeds to define professional ethics as: "giving of one’s best to ensure that clients’ interests are properly cared for, but in doing so the wider public interest is also recognised and respected“. This provides a succinct statement of the professional’s personal responsibility.
To guide their members in “giving of their best”, professional institutions have prepared “codes of ethics”, or “codes of conduct”. The codes tend to be based on certain principles dealing with: (a) meeting the client’s requirements; (b) the professional’s integrity, independence, objectivity; (c) responsibility to the profession and to the institute; (d) responsibility to society; and € commitment to continuing professional development.

An extract from the Code of Ethics and Professional Conduct of the Project Management Institute (2013), obtained from its website states that project managers are committed to doing what is right and honourable. They set high standards for themselves and aspire to meet these standards in all aspects of their lives. The purpose of the code is to instil confidence in the project management profession and to help an individual to become a better practitioner.

As yet, the codes do not cover sustainability, although some refer to health and safety. For example, clause 15 of the CIOB’s (undated) Rules and Regulations of Professional Competence and Conduct states: “Members shall at all times have regard for, legislation in respect of Health, Safety and Welfare as it affects all parts of the building process”. However, the code is silent on environmental issues and sustainability.

Individual companies have also formulated their own codes of conduct for the professionals and others they employ. These codes may run into many pages or paragraphs, or be very short. For example, the code of conduct of the American company, Nordstrom, is: “Use your own best judgment”. Many companies highlight their adherence to good ethical principles and practices as the bedrock of their existence and competitiveness.

There are also efforts at the international level to encourage appropriate behaviour by businesses and thus, executives and professionals. Examples include the United Nations Global Compact (www.unglobalcompact.org); Global Sullivan Principles of Social Responsibility (www.globalsullivanprinciples.org/); the Organisation for Economic Cooperation and Development’s (OECD) Guidelines for Multinational Enterprises (www.oecd.org/dataoecd/56/36/1922428.pdf); and Caux Roundtable Principles for Business (www.cauxroundtable.org/principles.html). It is pertinent to note that although they tend to focus on actions by businesses, these international conventions are relevant in the context of this paper because they cover environmental issues. For example, Principles 7 to 9 of the United Nations Global Compact are on the environment; and they state that: “Businesses should (i) support a precautionary approach to environmental challenges”; (ii) undertake initiatives to promote greater environmental responsibility; and (iii) encourage the development and diffusion of environmentally-friendly technologies. The other subjects of the compact are also related to sustainable development. They are: Human Rights; Labour; and Anti-corruption.

How can these concepts and principles of professional ethics be operationalized? Since professionals work in organisations, it is appropriate to consider the issue from that perspective. Carroll and Buchholtz (2006) suggest that measures for improving an organisation’s ethical climate include:
1. Top leadership management (Moral Management; providing Ethical Leadership)
2. Effective communication
3. Ethics programmes and Ethics Officers
4. Setting realistic objectives
5. Ethical decision-making processes
6. Codes of conduct
7. Disciplining violators of ethics standards
8. Ethics ‘hotlines’ and whistle-blowing mechanisms
9. Business ethics training, to: increase managers’ sensitivity to ethical problems; encourage critical evaluation of value priorities; increase awareness of organisationaland societal realities; examine ethical facets of business decision making; and bring about greater honesty and fairness in the organization
10. Ethics audits and self-assessments – to evaluate, with the view to improving, the organisation’s ethical climate by reviewing its ethics programme, codes of conduct, hotlines, training programmes
11. Corporate transparency – making corporate policies, practices, procedures visible to all
12. Board of director leadership oversight – in the US, this is now required by law.

**Professionalism in the Building Industry**

The responsibility of a practitioner is also influenced by the professionalism of the person. Low (1999) notes that ‘professional’ services differ from ‘normal’ services; they: involve externality effects which impinge upon society whereas other services are internalised by clients; and carry some moral responsibility and invoke some public interest or public good argument. Wilensky (1970), one of the foremost authors on professionalism, noted that the professions are distinguished from other occupations by: the application of a specialised technique supported by a body of theory; the transferability of the skills applied; a group which regulates and supports the persons in the occupation; and an objective and fair set of rules and standards. Moore (1970) ranked these attributes in the following ascending order: motivation; established professional organisation; specialised body of knowledge; evaluative skills; and autonomy of judgment.

The concept and essence of ‘professionalism’ has been of greater interest in many other professions than those of the built environment. For example, the American Pharmaceutical Association Task Force on Professionalism (2000) concluded that one acts professionally when one displays 10 traits: accountability for his/her actions; commitment to self-improvement of skills and knowledge; conscience and trustworthiness; covenental relationship with client; creativity and innovation; ethically sound decision-making; knowledge and skills of a profession; leadership; pride in the profession; and service oriented. Hall's (1968) professionalism scale measures five attitudinal attributes of professionalism: (i) use of professional organisation as a major referent; (ii) belief in public service; (iii)
belief in self-regulation; (iv) sense of calling; and (iv) belief in autonomy. Again, this scale has been applied in many fields. However, again, the notion of environmental responsibility has not yet assumed importance in any of the studies.

A group of UK professional institutions in the UK, led by the RIBA led a study of the UK building professions. Introducing the report, Worthington (2003, p. 8) noted: “The professions are at a watershed. It is timely to set out the background to the origins of professionalism and, within the current social, economic and political context, explore alternative scenarios for the future”.

A special issue of the international journal, Building Research and Information, on professionalism in the building industry has recently been published. In one of the papers, Duffy, and Rabeneck (2013) observe that (p. 117) architects, in general, have: (a) focused on the delivery of individual projects; (b) not amassed a body of shared knowledge based on the ever accumulating experience of designing many types of buildings; (c) failed to speak out strongly enough for the interests of clients and users of buildings; (d) not created an adequate body of professional knowledge based on researching, testing and articulating clients’ requirements; (e) neglected to take advantage of what should have been (and can still be) the profession’s principal source of power – the systematic, measurement of the performance of buildings and classes of buildings over time.”

Enhancing Professionalism in Building Industry

The experience of Singapore around the turn of this century can be used to illustrate the possible importance and relevance of developing high levels of professionalism in practitioners in the building industry. In Singapore, the “Construction 21” study undertaken by a government-appointed committee, reviewed the construction industry in Singapore (C21 Steering Committee, 1999). After analysing the problems facing the industry, and the desirable outcomes, the study proposed a radical restructuring of the industry, offering 39 recommendations under six strategic thrusts. Thrust One was: “Enhancing the Professionalism of the Industry”. Among the issues relating to professionalism in an industry which the committee envisioned as: “To be a world-class builder in the knowledge age” were: a poor image of the industry; variance in the professional standards of industry practitioners; lack of managerial skills and expertise among many practitioners; and fragmentation of the industry which militated against the effective integration of the contributions of the members of the design and construction teams. Thus, the industry fell below world-class standards.

Among the recommendations for enhancing professionalism in the building industry in Singapore were: (i) revision of academic syllabi of the tertiary academic institutions in Singapore to introduce common modules for the education of construction professionals-to-be (specifically, architectural and engineering students), and to include the coverage of soft skills; (ii) continuing university education and introduction of compulsory continuing professional development for professionals renewing their registration certificates; (iii) formulation of a national code of conduct and guidelines for professional practice; (iv) institution of awards...
Many professional institutions and other organisations in the building industries in several countries seek to enhance professionalism. For example, among the objectives of the Project Management Institute Indonesia Chapter (2013) are: (i) to foster world class project management; (ii) to advocate acceptance of Project Management as a profession and discipline throughout Indonesia; (iii) to promote PMI Certifications and continuing competence development; and (iv) to promote the Project Management Institute's Professional Code of Ethics and Conduct.

The vision of the Singapore Contractors Association Ltd (SCAL) (2013) is: “To facilitate members in becoming world class builders”. The association “aims to position its members to achieve greater professionalism and quality in the construction business” (SCAL, 2013). Among its objectives are: (i) to secure the recognition of the Association as the official representative of the building and engineering construction industry by all persons, professional bodies and authorities whose interest extends to and embraces the building and engineering construction and allied trades; (ii) to promote and encourage uniformity in the customs and practice in the conduct of the building and engineering construction industry to promote just and honorable practice in the conduct of business and to suppress malpractice; (iii) to promote means and measures to maintain and improve the standards of the building and engineering construction industry and to enhance the status of members thereof with the general …. The mission statement of Indonesian Contractors Association (ICA) includes: “To enhance ICA members’ competency and professionalism as players in the construction industry”.

Professionalism, Ethics and Sustainable Design

In the context of sustainable building, Aho (2013) notes that professionalism could be defined as a work ethic aiming at promoting and ensuring decisions and outcomes which balance both the short-term benefit of the company and its direct stakeholders, the value expectations of end customers, and the long-term broader good of the society. He introduces the notion of “sustainable professionalism” which means consistency and integrity in applying one’s skills and competencies for the benefit of the community.

Ofori (2012) highlights leadership and actions by the professional institutions as one of the drivers of the pursuit of sustainability in the building industry. Most of the leading institutions have formulated manifestos or strategy documents in these regards. Examples are those of the RIBA (2000) and SIA (2013).
The Singapore Green Building Council (SGBC), a joint initiative by the public and private sectors, with membership from all sections of the construction industry, was formed in 2009. Its mission is ‘to propel the Singapore building and construction industry towards environmental sustainability by promoting green building design, practices and technologies, the integration of green building initiatives into mainstream design, construction and operation of buildings as well as building capability and professionalism to support wider adoption of green building development and practices in Singapore’ (www.sgbc.sg/index.php/green/about/mission/). The ‘key focus areas’ of SGBC are: (a) profiling Singapore as a leading Sustainable Hub in the tropics; (b) enhancing professionalism and knowledge in sustainable development; and (c) functioning as a dedicated certification body for green building-related products and services.

RIBA urges practitioners “to ensure that every intervention into the built environment not only improves the quality of life but also uses all available means to eliminate waste, curb pollution and conserve energy and natural resources” (RIBA, 2000, p. 1). It also provides the RIBA Environmental Checklist for Development to guide designers (RIBA, 2000).

Twinn (2013) suggests that to make a meaningful contribution in society and to sustainability, building professionals must: (i) fill the communications gap in society’s appreciation of sustainability; and (ii) develop reasoned and rounded views about the complex world in which they work. He proposes that a new approach to professionalism is needed. This would entail: (i) being relevant to politicians and the public; (ii) a single authoritative voice for communication; (iii) tailoring the response to a specific audience to present information in ways that speak directly to different and wider audiences; (iv) acting to build confidence across society. For built environment professionals to progress with this, they will need: (i) a unified arrangement that can pull together all the existing professional institutions; (ii) independence to take a balanced, long-term view of society’s needs and to be the defender of the inhabitants of the built and natural environment; (iii) transparency, so that the public can see what gives professionals and their institutions their authority and wisdom; (iv) a service that is more integrated and cross-discipline aware, including the economic and social side of implementing technical issues; (v) institution(s) that become the repositories of collective knowledge to benefit everyone, avoiding the gaps, overlaps and misfits that occur today; (vi) free public and research access to this knowledge; (vii) every professional must be required by their institution to dedicate a mandatory proportion of their time to the common good of society; and (viii) the professions should endeavor to become key players in formulating policy recommendations, and initiating technical standards and regulatory frameworks for the built environment.

Duffy and Rabeneck (2013) note that the concept of public good embodied in the professional principles of trust and mediation between demand and supply is socially valuable, and is now urgently required to address the challenges of sustainability. They note that, in the context of sustainability, the reduced influence of government (owing to privatisation and reduced public-sector budget), the failure of the design professions and the construction industry to relate client aspirations to...
building performance over time is risking future vulnerability of the building stock and the environment as a whole.

Aho (2013) points out that some change is taking place. For example, some younger professionals do not accept opportunities to work for companies whose business model, value drivers and objectives do not match their own value systems. The emerging interest of many clients in seeking to ‘future-proof’ their investments by specifying rating levels in building assessment schemes is a sign of this.

A few codes of professional conduct at the national, institutional or company levels make specific reference to practice with regard to the protection of the environment. In South Africa, the objectives of the Rules of Conduct for Registered Persons: Engineering Profession Act, 2000 (Act No. 46 of 2000) are to ensure that Registered Persons: apply their knowledge and skill in the interests of humanity and the environment; execute their work with integrity, sincerity and in accordance with generally accepted norms of professional conduct; respect the interests of their fellow beings and honour the standing of the profession; continuously improve their professional skills and those of their subordinates; and encourage excellence within the engineering profession.

**FURTHER ACTION**

The Emerging Professionalism

As discussed above, more needs to be done. Hakkinen and Belloni (2011) highlight three main pre-requisites for sustainable building: (a) availability of sustainable building technologies; (b) availability of methods and knowledge for sustainable target setting, design, procurement, monitoring and management of buildings; and (c) the development of sustainable building processes and adoption of new building technologies, methods and working models. They concluded that the most important measures towards sustainable building include the development and delivery of sustainable building information for clients and end purchasers, development and use of tools for assessment, monitoring and comparison of sustainable building solutions, support for designers to enable competence improvement, development and use of economic incentives to increase the attractiveness of sustainable building investments, and the development of sustainable renovation concepts, maintenance services and energy services. The following issues were important in Finland: the need to increase the expectations and awareness of, and thus, demands by, end users about the potential of sustainable building; adoption of methods for sustainable building requirement management; mobilisation of (integrated) sustainable building tools; the development of designers team working, competence and the role of chief designer; and the development of new concepts and services.

Hughes and Hughes (2013) note that the sustainability agenda will require high levels of technical expertise and professional judgment in cross-disciplinary groups of many different stakeholders. The built environment professions must rise to the challenges and evolve new conceptions of professionalism. CIOB (2013b) established the Sustainability Scholarship scheme in 2007 to encourage its
members’ companies to carry out research, each using one of its employees. The subject of the research must benefit both the company and the wider building industry.

Huang and Bohne (2012) conclude that the most important potential for reduction of embodied air emissions in the Norwegian construction industry relies on the industry’s up-stream suppliers. Policies to drive stakeholders to select low emissions materials and material suppliers to release information on embodied emissions will play a key role in the reduction of the construction industry’s air emissions. There should be cross-sector and global co-operation on providing transparent data on embodied air emissions of materials.

Role of Education

The level of knowledge of sustainability among building professionals needs to be enhanced. Hakkinen and Belloni (2011) observe that a number of designers still lack wide competence in sustainable building. Designers also lack powerful and integrated sustainable building design tools. To overcome this barrier, it is important to improve professional education on sustainable building. Attention should be paid to the competence and collaboration of the whole design team and the competence of the chief architect and his/her ability to lead sustainable building design. On the other hand, there should also be a readiness to compensate the professionals for the new tasks and competences required.

In Singapore, there is training to create a Green Workforce: professionals who are educated on aspects of sustainable building. CIOB has encouraged its members or fellows “working on projects where sustainability is important” to seek the qualification of chartered environmentalist. By 2013, some 7,000 professionals had gained the qualification from the Society for the Environment.

Duffy and Rabeneck (2013) propose the use of systematic, well planned and executed case studies of projects to create knowledge for teaching and the professions. Such case studies would take into account client aspirations and resources, social and economic contexts, the parties involved, the management of the decision making process, project delivery, user feedback, and the financial and other consequences of the project. They suggest that construction professionals should place more emphasis on the public good “by creating and sharing an open-ended, disinterested, interdisciplinary body of knowledge about buildings and their use” (p. 115).

Aho (2013) believes that valuing individual professionalism will be a prerequisite for the industry being able to attract and retain talent in future.

Given the nature of the building process, no single profession can do it alone. As noted by Singapore’s Deputy Prime Minister, RADM Teo Chee Hean at the opening of an international conference of engineers recently (Ministry of Home Affairs, 2013) “The magnitude and complexity of the issues posed by climate change require a multi-disciplinary response, at the systems level, and also for specific solutions. For example, we need mechanical and electrical engineers to develop and deploy innovative energy efficient solutions in buildings; … engineers
to develop renewable energy systems and smart grids; create flood-resilient drainage systems, and protect our coasts from erosion or inundation”.

Indeed, there appears to be a need for new specialisations in the building industry. Ofori and Rashid (2011) highlighted the need for professionals who are particularly knowledgeable on how a building can be ‘greened’. Hakkinen and Belloni (2011) note that the findings from their study showed that one of the roles that should be strengthened and developed in sustainable building is that of the design manager.

RECOMMENDATIONS

Progress in sustainable building can be attained through the motivation of building industry practitioners who, in their normal activities as professionals or managers, recognise their personal responsibility as good citizens doing their part to contribute to the efforts by their societies to address the impacts of human action on the environment, and to attain the broad goals of sustainable development. This attribute should be nurtured. Thus, the educational institutions have a key role to play. Environmental responsibility should permeate the whole academic programme of the education and training of building industry practitioners-to-be. The syllabi should be designed to put stress on case studies of various types of projects with varying levels of success and their determining factors, and project work and role-play activities which are based on sustainable development scenarios. The development of appropriate attitudes and mindsets should be an important part of the education. Thus, teamwork, mutual respect and recognition of the merits and contributions of different persons in the project team should be given some attention.

The codes of practice of the professional institutions and the national regulations on professional registration should be formulated to cover the individual social responsibility and ethics of practitioners. The usual definition of “professional ethics” in such documents should be extended to include respect for, and contribution, to the improvement of, the environment. The professional institutions and trade associations, as well as professional registration councils, should also include in their annual continuing professional development (CPD) requirements, a minimum proportion of environmental courses. A series of national awards recognising the Responsible Professional of the Year in each field would also encourage progress towards individual professional responsibility.

Research Agenda

From the discussion in the paper, the research agenda outlined below can be proposed.
1. What are the key drivers and obstacles of sustainable building in Indonesia?
2. What is the relative importance of the architect?
2. What are professional ethics in general? Do they change from one society to another, and in the same society, over time? If so, what are the appropriate ethics of the professional in the building industry in Indonesia?

3. Is there a notion of “professional responsibility” of a practitioner in any particular occupation, or of the national building industry? Can it be the driver of the process towards sustainable building?

4. Is there a notion of “sustainable professionalism” in building construction in Indonesia? If so, how can it be operationalised?

CONCLUSION

A sustainable building is one which has been designed and constructed with due consideration of aspects relating to the broader concept of sustainable development which all countries are now pursuing. These aspects include: (a) preservation of land and effective decision making in answer to the fulfilment of the client’s need for space (for example, is a new building needed?); (b) resource conservation, and maximisation of utilisation of renewable resources; (c) utilisation of existing natural factors such as daylight, wind direction and sunlight; (d) prevention of pollution all types; (e) protection and preservation of natural ecosystems; (f) effective management of waste; (g) enhancing the durability of the built facilities including safeguarding the fabric of the built facilities in changing atmospheric conditions; (h) promotion of the health and well-being of the workers building the items as well as occupants of nearby buildings (during construction), and of users of the built facilities (upon completion); and (i) development of environmentally conscious lifestyles of the users.

Such a building can only be attained if the professionals involved in its planning, design and construction are knowledgeable about these features, consider them to be necessary, and are able to provide them on the project. Thus, the responsibility and professionalism of the individual professional are key.

REFERENCES


BCA (2013b) Welcome address by BCA Chairman Mr. Quek See Tiat at the opening of the International Green Building Conference 2013, World Engineers Summit 2013 and BEX Asia Exhibition 2013 at Marina Bay Sands Singapore, 11 September.


THE GABION HOUSE REVISITED

Regan Potangaroa
Department of Architecture, UNITEC,
New Zealand
e-mail: potangaroa.regan54@gmail.com

ABSTRACT

Most material on a “Green Concept” for addressing the environmental, social, cultural and institutional issues resulting from global warming and climate change through the implementation of architecture and environmental design usually starts with the “big” picture, policy/theoretical statement. And then migrates towards the “specific design” criteria. However, there is a problem with this approach and experience questions whether it adequately or often appropriately connects with practice as it migrates?

The paper revisits a community in Port au Prince Haiti that received gabion houses constructed as part of the response to the 12 January 2010 earthquake. The gabion house was perceived within the humanitarian shelter community as an excellent green concept because it reused rubble, could be built using local skills and was economical comparable to other options. Thus, the question posed to the community after nearly 2 years of living in these gabion houses was whether the houses were more effective than the “standard” house? And from that reflective process are taken design tips for possibly a more humane and Greener Concept.

Keywords: disaster, design, reflective

INTRODUCTION

A green design concept often starts from the objectives of the original Green Concept and consequently are invariably set in a “policy” rather than a “design” format. For example, what does it mean to be “safer”, “healthier”, “more liveable”, “more equitable”, “sustainable” and “productive” under the Habitat II Agenda item 1? (UNHABITAT, 1996). Practitioners invariably “guess” what that means for design but in the humanitarian field (where this case study is situated) issues are defined explicitly by the UNHCR Handbook (UNHCR, 2007) for refugee situations and the SPHERE Handbook (SPHERE, 2011) for internally displaced ones. And despite not having to “guess” the issues still remain such as does a minimum of 3.5 m²/person for the area of shelter with a minimum height of 2 metres at one point
really represent the “dignity” and the “durable solution” sought by humanitarian agencies?

A Richter scale 7 earthquake struck Haiti on January 12, 2010 at around 5pm. It was shallow and located 22 kilometres from the capital city of Port au Prince and resulted in 230,000 fatalities and extensive building damage in the city. Such figures were unfortunately not surprising given that Haiti did not have any seismic code and in the year before there was the collapse of 3 schools due solely to gravity loads with the largest in Petionville causing 92 deaths (Reliefweb, 2008). Building standards are minimal and enforcement essentially non existent in Haiti.

A UN Habitat study (UNHABITAT, 2009) of the informal settlements in Port au Prince in 2009 (one year before the earthquake) indicated that over 50% of it’s 2.7 million metropolitan inhabitants lived in “informal” settlements with minimal if any legal land title. Such areas are characterised by limited or no access to safe drinking water, sanitation and waste collection with 53% living in ravines (steep gullies prone to flooding at the bottom) and 38% on steep hill sides prone to land slides. They are connected by a maze of steps, pathways, alley ways and narrow lanes. Roads are under sized throughout the capital city and hence traffic grid lock is the norm. Despite all this, the houses are built of “solid” concrete materials with concrete floors, reinforced concrete frames and concrete block infill walls. Haiti was identified in the study as the poorest country in the western hemisphere with 76% earning under the $2US/day poverty line with the average income for a poor family being $0.44US/day. Despite that (or perhaps as a consequence) Haiti is one of the most densely populated countries in Latin America with 310 inhabitants per square kilometre.

Figure 1. A Typical Haitian Informal Housing Context.
Source: field survey, 2011

Thus, it was not surprising that the 2010 earthquake also resulted in over 1.3 million people having to live in temporary camps and as the response drew out past
one year and on to its second, pressure mounted on the humanitarian community to find more durable solutions than tents.

One major obstacle was the rubble generated by the extensive building collapses in the ravines and hill sides that blocked the maze of alleyways and lanes. Early estimates put it at around 20 million cubic metres with later more accurate measurements placing it at around 10-11 million (BBC, 2011). But even that lower figure represented 27.4 years of local production with all 3 quarries working 24/7. Moreover, the cost of mechanically clearing and dumping the rubble was estimated at between US$32.50-$58 per cubic yard (New York Times, 2010) by one source and US$26-$80/tonne by a second source (SKAT,2000) with a cost of between US$20-25/tonne (based on local costs to a “typical” site) to bring in new material. Hence, it was going to cost in the order of US$500 million and take 27+ years just to get ready to reconstruct the houses lost in the earthquake.

Hence, the idea of re-using the rubble in the form of gabion blocks to rebuild rather than extract, remove and dump it. This was also combined with the option of hand and mechanical crushers to further re-process the rubble into aggregates for concrete, alleyway base course and plastering sand (CHF, 2011).

**WHAT IS A GABION HOUSE?**

A gabion is a wire cage (Geiger, 2012) into which are placed rocks that are stacked vertically to form retaining walls. In this case they were designed for housing (Temporality 109, 2012), (Mulligan, 2012), (Enviromesh, 2008). The cages were lined with chicken mesh and the rock material selectively placed and compacted into the cage and topped with smaller aggregate material. The cage sizes were typically 600mm long by 300mm high and 300mm wide. They were laid in a stretcher bond,
wired together both vertically and horizontally with the gabion tops open to enhance interlock between layers (Brennan, 2011).

Figure 3. Gabion House 1 Walls Under construction.
Source: field, 2011

Seismically, they were reinforced vertically with 12 mm threaded rods at approximately 2 metre centres that were anchored into the gabion foundations and clamped at the top of the wall to a 150mm deep concrete bond beam. Plan dimensions were kept under 3:1 (length to width) and 1:1 for walls (height to length). A low ductility of 2.5 was used for an earthquake with a 10% exceedance in 50 years (Brennan et al, 2011).

Figure 4. The Gabion House Green Concept

The overall cost of constructing a 9x4.8 metre gabion house (as shown in figure 4 above) in December 2010 was US$3964.50 (US$92/m2). This would be less depending on labour costs, proximity of rubble, and size and amenities included in the house. Typical costs for other new houses were in the US$170-200/m2 and therefore the gabion concept was an economic housing option.
METHODOLOGY

The opportunity was taken to revisit and interview the 4 families in Lilavois (a suburb of Port au Prince) who were supplied with a gabion house as part of the earthquake response to see whether the perceived advantages of a gabion house over more standard housing solutions had succeed or not? The interviews were done in February 2012 but only 3 of the 4 were eventually available. All 4 were neighbours with households 1 and 2 being part of an extended family (or “Lakou” in Haitian) and houses 2 and 3 being redesigned from the original concept shown in figure 4 to one where they shared a common boundary wall. This was done for spatial and social equity issues that allowed better use of the surrounding space and also so that house 3 did not extend past its original foundations and thereby become larger than his brother’s house that was on the same site.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PROJECTED COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>GABIONS</td>
<td></td>
</tr>
<tr>
<td>5 Rolls of square mesh</td>
<td>$900.00</td>
</tr>
<tr>
<td>6 Rolls of chicken wire</td>
<td>$500.00</td>
</tr>
<tr>
<td>CEMENT</td>
<td>$262.50</td>
</tr>
<tr>
<td>35 bags @ $7.50</td>
<td></td>
</tr>
<tr>
<td>JOINERY</td>
<td></td>
</tr>
<tr>
<td>3 sheets of 18mm ply @34 ea.</td>
<td>$102.00</td>
</tr>
<tr>
<td>Doors &amp; Windows</td>
<td>$250.00</td>
</tr>
<tr>
<td>RUBBLE</td>
<td>$200.00</td>
</tr>
<tr>
<td>Cost of collection &amp; transport</td>
<td></td>
</tr>
<tr>
<td>LABOUR</td>
<td></td>
</tr>
<tr>
<td>Making of gabions</td>
<td>$130.00</td>
</tr>
<tr>
<td>Filling gabions</td>
<td>$130.00</td>
</tr>
<tr>
<td>Crushing rubble</td>
<td>$480.00</td>
</tr>
<tr>
<td>THREADED ROD</td>
<td>$160.00</td>
</tr>
<tr>
<td>PLASTERING</td>
<td>$250.00</td>
</tr>
<tr>
<td>ROOF</td>
<td>$600.00</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$3,964.50</td>
</tr>
</tbody>
</table>

Figure 5. The Gabion House Costs.
Source: field, 2011

Figure 6: The Gabion Houses 2 to 4 and the Boundary issue between 2 and 3.
Source: field, 2011
A short narrative survey based on observations and expected outcomes for families from the gabion house concept team and from a literature review was compiled and this is in appendix A. The interviews were completed by local Haitian shelter field staff who worked for a large aid organisation that was not the original International Non Government Organisation INGO constructor of the gabion houses. Prompts and some background details and intents of the survey questions were added but it was emphasized that it was their narrative rather than a response to each question that was being sought. The interviews were digitally taped and responses analysed using the categorisation from the Kestle Value Adding Framework (as defined by the “customer”) that are as follows (Kestle, 2009):

- **Timely Decision Making:** the characteristic of summing up a situation/s and making a decision in a time frame relevant to it. This can be with less than full information and hence there can be a trade off between being ‘timely’ on one hand while on the other being ‘impulsive and impatient’.
- **Process Integration:** is essentially a holistic approach that underlines the unity of the overall process rather than the optimization of any part of it.
- **Knowledge Integration:** is the process of threading, merging or possibly synthesizing of knowledge from various viewpoints into a larger more expansive model or framework.
- **Value Generation:** refers to the value that the client and stakeholders place on the project outcomes, and will vary according to the differing clients’ and stakeholders’ expectations of the project/s, and these can vary not only between stakeholders but also between client groups.

**RESULTS**

Comments from the full interviews were noted in each of the framework characteristics and matches and mis-matches identified. In the “match up area” it seemed that the major value adding component was via value integration. The perception amongst all of the households was that the gabion house felt safer, offered better protection and security and was stronger than other existing houses or new houses provided as part of the earthquake response they had visited. This largely seemed because of the extent and thickness of the gabion units at around 400+mm thick once they were plastered from their original 300mm. This can be felt in the photographs in figure 7 below. This had not been expected by the original Green Concept team (which the author had been a member) but it was nonetheless, pleasantly surprising. Interestingly, the thickness created “unintentional” transitional spaces at doors and window reveals.
The other aspects of the Value Adding Framework of knowledge and process integration and timely decision making were minor though the process integration and timely decision making related to house additions was apparently prevented for the first 3 years. Despite that house occupants had installed “kitchens” which can be seen in the photographs of figure 7 (refer to “1 Back”: kitchen can be seen in the back of the house; “2 Wall Thickness”: kitchen on the side of the house). What is interesting about both is that the wall thickness allows hot kitchens to be placed directly against them. This can be done against concrete block for example but would quickly lead to degrading of the low quality blocks commonly used and perhaps a more slower one for quality one.
DISCUSSION

The house owners felt safer and certainly the seismic design was to a high level being both conservative and being based on low ductility and internationally accepted seismic standards. Moreover, it had several other advantages such as cost, low skill levels making training readily transferable, recycled and reused what would have been otherwise a waste material and allowed direct contracting and expenditure within the affected community. However, the main conclusion from these interviews in terms of design was that “big was beautiful” and certainly something akin to human scale seemed to be about “right”. (Alexander et al, 1977). Thus, the design problem initially formulated and outlined earlier did not seeming matter to those occupying the house. They wanted/needed to feel safe and some solid and larger appeared to suit that need. They made use of the particular spatial layout which could have been the case with other house types. The expected thermal lag advantage of the house’s mass was perhaps disappointing but may have been because two of the houses had a common boundary wall; which is supported by Zhou (Zhou et al, 2008). Thus, a gabion house may not be advantageous with row housing and is perhaps best suited for individual ones. That would need further quantitative work.

One of the difficulties of researching the design interface (as has been attempted thus far) is that it does not necessarily follow scientific distributions and is not dependant on achieving sample sizes to find potential solutions to problems.
These are the so-called patterns and as noted by Alexander and his team “At the core... is the idea that people should design for themselves their own houses, streets and communities. This idea... comes simply from the observation that most of the wonderful places of the world were not made by architects but by the people”. And that there was in this case a difference between what was seen as a Green Concept and how that was interpreted by those occupying the houses.

On the other hand, the reflective approach above can be biased and possibly shallow in its application. Thus there is a need for some level of triangulation in the analysis which in this case is back stopped by the household surveys, the Kestle framework and existing literature. I suspect that this tension will never fully be resolved and that there will exist a sense of ambiguity when policy and practice meet (Kates et al, 2005).

Collier has an interesting perspective and suggests that for the poor one would find the other aspects of Kestle’s framework collapsing into value generation as we found with this small study. He suggests that from there would form 3 social capital mechanisms (Collier, 1998); “Different parts of the literature on social capital focus on different economic benefits. I suggest that social capital is economically beneficial because social interaction generates one or other of three externalities. It facilitates the transmission of knowledge about the behaviour of others and this reduces the problem of opportunism. It facilitates the transmission of knowledge about technology and markets and this reduces market failures in information. It reduces the problem of free riding and so facilitates collective action. I distinguish between whether the social interaction is reciprocal or unidirectional; and whether it is organized or informal. For example, knowledge transmission may depend upon information pooling, which occurs through reciprocal interactions such as networks (informal) and clubs (organised), or upon copying, which only requires unidirectional interaction.” Since that work in 1998 there has been growing empirical evidence that social capital contributes significantly to sustainable development. Sustainability is the intergenerational desire to control your present situation as Collier describes “to leave as many, or more, opportunities as we ourselves have had”. His comments are particularly relevant to the interpretation of the interviews but not to the role of the gabion house. Any type of house provided would/should have resulted in a similar collapse into value generation but have been included so as to delineate the impacts of a gabion house compared to any other house.

Sustainability is increasingly been sought in humanitarian response, post disaster reconstruction (Natural Hazards Center, 2005) and development (IFRC et al, 2013). However, the translation to design has been problematic as seen in the small case study above. The convergence between sustainability and disaster management continues (Dovers, 2004) with the impacts of phenomena such as global warming, climate change and rising sea levels being increasingly seen in the number and nature of disasters.
CONCLUSION

The basic question was whether the gabion house added value over and above the other standard houses offered as part of the earthquake response in Haiti? And the answer would be a qualified “yes”.

ACKNOWLEDGMENT

The author would like to acknowledge the Gabion Concept Team who were Chris Howe as the innovator/designer, Hugh Brennan as the constructor and Rafael Matter-Neri as the designer/urban planner.

APPENDIX A: Gabion House Survey Instrument November 2012

The comments in italics are for those doing the interview.

1. How is this house better and worse than the house you had before the January 2010 earthquake? (we want to know the advantages and disadvantages of the gabion approach from their experience as a starter question to set the context for the remainder of the interview. Another similar question would be what have been the big changes to your life since moving into this house?).
2. Is your house cooler than other nearby houses you know or visit? (the research data suggests that this should be the case and we are trying to confirm it)
3. Is your house drier in the rain? (we are trying to find out whether larger wall sections shed water better than standard thin wall houses?)
4. What improvement have you made to the house? (In general, people will invest money into areas that they see as priority. This may not be the case depending on the household income; nonetheless we would like to know if there has been any renovation/changes/improvements and what they are?)
5. If we were to come back and offer to do one improvement to your house, what would you ask us to do? (similar question to the above and depending on their answer to the early question will determine how their answer/s should/could be interpreted here).
6. What do your kids think of the house?
7. If you were able to say “thank you” to your house, what would it be for? (this question firstly seeks to understand how people feel about their house but also what benefits it provided. It invites them to think of their house as an actual person, and what they would say to that person. Note and draw out any specific benefits of a gabion house over say a more “standard” house.)
8. Are there favourite places for you in the house say in the morning, afternoon or evening? Is this different from your earlier house before the earthquake?
9. What do your neighbours, friends and family feel about a gabion house rather than other house types?
10. Have your feelings about your home changed since January 12 2010? How? (Prompts: security, who are living there, cooling, social standing, the aspect of haven, safety, asset, liability, pride, invest time & energy, want to leave, stay)
11. What does this immediate neighbourhood/street mean to you? (Prompts: connections, identity, time/history, familiarity, social interactions such as school/church, shops, other natural and built features)

12. Have your feelings about your immediate neighbourhood/street changed since January 12 2010? How?

13. What would you like to change in your neighbourhood?

14. How do you feel about Lilavois as a place now after the earthquake? (Prompts: connections, identity, time/history, familiarity, work, social interactions such as school/church, other natural and built features such as shops, cultural and sporting activities)


16. What changes in the environment have led to changes in how you feel about your home/ immediate neighbourhood/street/Lilavois? (Prompts: rubble, roads access, drainage, disused buildings, blocked pipes)

17. What other influences are you aware of that could be affecting your answer to the above question? (Prompts: media reports, NGO’s, UN, Govt Depts, local or central government officials) Note: Explore feelings of powerlessness, vulnerability, alienation, ambivalence.

APPENDIX 2: A SELECTION OF INTERVIEW NOTES
Comments and observations by the survey team are noted in italics.

House 1: A strong church family, that according to them meant they should be prepared to welcome other people even those just passing by. No apparent change or differences with her relationship with others because of the house; [Comment: though it was observed how the front design of the house enhanced this capability with chairs being placed in it and that children from the house and others played in this area though this was not dependent on it being a gabion house]. There is a lot of things that need to be changed in the neighbourhood, it is very noisy. However, it seems to be similar to that before earthquake and that the house has not changed the neighbour hood. [Comment: However, it was noted that noise level at least qualitatively were lower in this house than other non gabion ones]. People still kept to themselves as it was before the earthquake. Mosquitoes, dust in the air but they now have a good house. There was some confusion and people said that if you accept a house it would give you other opportunities such as being able to travel to the USA. [Comment: this is the dream of most Haitians] No improvements to date because they understood that they were not allowed to do any changes to the house until after 3 years of occupation. [Comment: all the others owners said a similar thing] Nonetheless, the owner did seem keen to add to it [Comment: it is not exactly clear what that could/would be given the compact site] The roofing material used was not good and had started to lose it’s corrugated shape [Comment; and also its strength] and had gone “flat” in the Haitian temperatures [Comment: the roofing used was a bituminous corrugated roofing material marketed as Onida in Haiti]. Grateful to the house for providing the shelter and protection (apart from the...
roof) that their previous house did not. Likes all parts of the house that is not especially affected by morning or afternoon or presumably evening. She spend most of her time in the back gallerie (kitchen/laundry area). Everyone in the family likes the house and when they replace the roof their feeling was that it would be second to none in the neighbourhood. The mother found that when she was in other houses even though they were strong she would still run out; where as in the gabion one she felt safe. [Comment: She did not offer any reasons why she felt “safer”] Others commented that it was a “better” material than timber and that gabions “felt” stronger [Comment: perhaps because of its thickness? This was mentioned by several people] The gabion house seemed more durable. House was more water proof during recent hurricanes and wasn’t sinking (like the previous one). The kids like the new house but the roof is the issue, it seems that the roof on the previous house was better. She didn’t have any problems with the questions.

House 2: House is better than previous, the mother of the household feels safe even when there are ground movements; Trust’s the house whereas the previous house was “broken”. This house is not cooler than other houses in the neighbourhood. Not enough windows. [Comment: this house shares a common boundary wall with its neighbour and hence has no windows on one side though it has better useable space on the other side] Cool in the morning and afternoons but hot at mid day. Can’t say the house is drier as the roof leaks because of the valley gutter detail between the houses [Comment: This house was combined with the neighbouring one and hence the valley gutter detail because of spatial constraints of existing houses for both houses] When it rains they have to wait till it stops and then mop up the floor. They have not spent any money on the house, [Comment: similar to household 1] and were also told that people would return to check out the house. The kids like the house more space to play. The only way to say thank you to the house by giving it a big “hug”. Favourite place is the gallerie (balcony or porch area) and in her own room [Comment: subdivision inside the house using curtains]. Friends and passerby frequently asked questions as to who did it and they like the design and its relationship to the site and other buildings. However, some neighbours are critical though her church people like it. There did seem to be issues between the mother and the neighbourhood. [Comment: this household did seem to be distant from the other families on the block of land] Despite this there were apparently no changes in feelings after the earthquake compared to before. There was the comment that the house should not be somewhere that looks good but should be a place that makes me feel “safe”. Would like others (such as those in tents) to have the same house so that they could have a safe life. The community has changed, people have to travel alot further to get work- lack of time so people don’t have the same contact now as opposed to before the earthquake. The mother felt that people are affected and there are new diseases for those living tents and hence her perception of houses (as being safer) have changed. No problems with the questions.

House 3: Like the house because it is habitable, earthquake safe and secure. (presumably because of the gabions). The mother said that she would not die in it and was more confident in gabion than in concrete block. Feels that it is cooler in the day time and at night. Also drier than other houses in the area. [Comment: this was from flooding rather than from a leaking roof] She and her kids like it, it is
perceived as a “gift” so “what more is there to say”? After the earthquake they lived in a house with a concrete roof, the kids were worried about its fragility and they had lots of questions about everyone’s safety and possible injuries. They do not with the gabion house. And even though there is only one room and have to share that one room, they are managing. [Comment: the house complies with the SPHERE Standard for space but it is tight nonetheless hampered by insufficient land space] Haven’t spent any money but she will build a kitchen. Don’t have anything else to add.

REFERENCES

IFRC and BRE Global, 2013. Quantifying the Sustainability In the Aftermath of Natural Disasters QSAND Information sheet
Natural Hazard Center, 2005. Holistic Disaster Recovery Ideas For Building Local Sustainability After a Natural Disaster, Revised December 2005

SKAT, 2010. Private Sector Participation in Municipal Solid waste Management; part iii by Sandra Cointreau-Levine pub by SKAT 2000 pg 5; prices adjusted for inflation


International Conference
Green Concept in Architecture and Environment

Sub Theme:
Green Concept in Architectural Design

Department of Architecture ITS Surabaya, September 2013
SUSTAINABLE ARCHITECTURAL DESIGN
IN A TRADITIONAL BALINESE HOUSING
IN ACCORDANCE TO THE CONCEPT OF TRI MANDALA

Aryani, Ni Putu*, Tanuwidjaja, Gunawan**
*) Part-time Lecturer of Department of Architecture, Petra Christian University, Indonesia and Freelance Architect
E-mail: niputuaryaredana@yahoo.co.id
**) Lecturer of Department of Architecture, Petra Christian University, Indonesia
e-mail: gunte@peter.petra.ac.id

ABSTRACT

Global challenges such as natural resource depletions, irregular weather pattern, and pollutions were imminent. The Home Green Design proposed by other countries was not suitable to Bali Island because of the local social context. The Balinese House is regulated with the Tri Mandala and Sanga Mandala to achieve the harmonious relations between Macrocosms (Bhuana Agung) and Microcosms (Bhuana Alit) [or Tri Hita Karana]. The Sanga Mandala guides the spatial pattern both on the house and the settlement scale. The Tenganan traditional Village implemented Tri-Mandala which organized the house into the Utama (upper and sacred), Madya (middle and human), and Nista (lower and profane). The Tri Mandala concept is very adaptable to the environment, even in the middle of the economic-driven activities and fast home development. However, the Tri-Mandala really supported the sustainability in the functionality aspect, the social acceptance aspect as well as thermal comfort aspect. Therefore, the Tri Mandala concept could be implemented in the contemporary house design in Bali.

Keywords: sustainable architectural design, cultural approach, appropriate green technology, socially-sustainable house

INTRODUCTION

Rapid technology advancement offered opportunities for observing architectural design trend abroad. The development affected the architecture design trend in Indonesia, causing abandonment of local cultural values by modern Indonesian design trend. Furthermore, the design trend was influenced by the environmental issues in a decade such as: limited natural resources, climate change and global warming, pollution, excessive energy consumption, etc. The abandonment of local cultural values and unsustainable development, a sustainable architecture principle...
was needed. The principle actually defined by Sustainable by Design concept that was prescribed by International Union of Architect (UIA) on Copenhagen Declaration in 7th December 2009 (http://www.uia-architectes.org/image/PDF/COP15/COP15_Declaration_EN.pdf). UIA stated that Sustainable by Design (SbD) Strategy was needed to solve the climate change and reduce the impact of environmental changes to future generations. Furthermore, the SbD also highlighted the UNESCO’s recommendation to facilitate cultural diversity preservation. This encouraged the writer to understand the sustainable design based on the local Balinese heritage. The purposes of the research are to find implementation of Tri Mandala in Tenganan homes, and relationship Tri Mandala to social and economical sustainability of the home zoning.

LITERATURE REVIEW

Balinese Traditional Architecture Concept

The Balinese principle of living is to live in harmony with nature, and it is facilitated by the Traditional Balinese architecture concept. The Balinese way of life is related traditions and cultural related to individuals and society. The Design and construction of traditional Balinese architecture was influenced by the philosophy of life, attitude to life, religion, beliefs and ancestral culture of Balinese (Meganada, I W, 1990).

Originally, the ancient Balinese perception to space is bounded by the earth beneath and the sky above (Raharja, I.G.M., Remawa, A.A.G.R., Cora. T.I.R., 2010). Later on, the traditional Balinese spatial concept was developed to sky-earth spatial orientation (Bali Mula period); mountain-sea (Bali Aga period), and sunrise-sunset (Bali Arya - Majapahit period) (Gelebet, I.N., et.all., 1986). The development of spatial regulating system actually evolved in modern time, with Sanga Mandala and Tri-Mandala (Lansing, J.S.,1983 and Budihardjo, E., 1985, quoted in Aranha, J., 1991).

Base on several traditional rules of Balinese Architecture (Lansing, J.S., 1983 and Budihardjo, E., 1985, quoted in Aranha, J., 1991, and Sulistyawati, et.all., 1985), the basic principle of Balinese Architecture came from:

1. Tri Loka is the spatial hierarchy consisting of:
   a. Utama (the upper, sacred, Gods)
   b. Madya (the middle, human)
   c. Nista (the lower, profane, demons)

2. Hasta Kosala Kosali is the application of Tri Loka and Tri Angga in all planning and architectural design such as: measurement units, proportion, ceremony, orientation, sitting and spatial order in the Balinese villages and homes’ design.

3. Tri Mandala is the application of Tri Angga in the vertical zoning.

4. Sanga Mandala is complex zoning applied all principles above. The most important, sacred, or private part of a village or dwelling are located to Kaja (Mountain) as possible. The spaces that are used for day-to-day life are located in the center of the Sanga Mandala. The most impure or potentially profane areas
are located in the direction of Kelod (Sea). The most important sacred is oriented toward sunrise while the most profane is oriented toward the sunset.

**Figure 1.** The Basic Concept of Balinese Traditional Houses  
Source: (Budihardjo, E., 1985, quoted in Aranha, J., 1991)

**Sanga Mandala**  
of Balinese Traditional Home

**Figure 2.** The Sanga Mandala (from Tri Mandala) in the Balinese Houses  
Source: (Budihardjo, E., 1985, quoted in Aranha, J., 1991)
The implementation of Sanga Mandala is related to the Sustainable Design Strategy with local flavor. Unfortunately, the implementation of Sanga Mandala faced difficulties recently, because of land using, the gradation of their way of life, etc. In the other hand, Tri Mandala which is simpler to apply had been used by Balinese in Tenganan for their housing. The Tri Mandala regulated the sacred activities in Utama (the upper, sacred, Gods) area, the activities of a social, economic and living in the Madya (the middle, human) area, and profane activities Nista (the lower, profane, demons) area. One example of the application of Tri Mandala is on the Tenganan Village and Homes.

Kumurur, V.A., Damayanti, S., (2009) described the Tenganan Village is one of the traditional village in Bali. The village could be categorized as the Bali Aga village was not influenced by Javanese Hindu kingdom. The village residential is located in a mountainous area, expanding longitudinal in the center of Bali Island. The physical form of Bali Aga traditional villages was characterized by the line-shaped main road serving as a community-owned open space and the main axis of the village. The Tenganan village was still preserved and became a cultural attractions although was located quite remote in Karangasem regency (is about 60km by road from downtown Denpasar, Bali).

Furthermore, the Tenganan traditional housing was built based on the belief concept to God Indra. It was reflected upon the settlement structure concept of “self defense”. Four zones (lawangan) were found divided into North, East, West and South areas. The North area was designated for economy defense, while the South area was designated ancestor worship. Lastly, Western and Eastern areas were used for funeral activities. The traditional housing has 15,000 acres of wide land and divided into three Banjar, Banjar Kauh (West), Central area and Banjar Kangin (South). Meanwhile, Banjar Pande (East), inhabited by people who have violated or the outsiders who were asked to stay for ceremonial purpose. The Tenganan traditional housing is contained by the Penyengker wall (enclosure wall) and two accesses (front and back gates). The housing is located regulated by the Tri Mandala and in relationship with 3 sacred buildings namely: Pura Desa, Pura Puseh, Pura Dalem. The Tenganan traditional village had 3 clusters of housing, namely: (1) the settled residents cluster, (2) plantation cluster, and (3) paddy field cluster (Kumurur, V.A., Damayanti, S., 2009).

The Sustainable by Design Strategy and Heinz Frick’s Sustainable Design Strategy

Related to Sustainable by Design, International Union of Architect (UIA) prescribed some strategies that connected to the local cultures such as (http://www.uia-architectes.org/image/PDF/COP15/COP15_Declaration_EN.pdf):
1. Sustainable by Design recognised that all architecture and planning projects were part of a complex interactive system, linked to their wider natural surroundings, and reflect the heritage, culture, and social values of the daily life of the community.
2. Sustainable by Design endeavoured improving the quality of life, promoting equity both locally and globally, advancing economic well-being and providing opportunities for community engagement and empowerment.

3. Sustainable by Design endorsed UNESCO’s statement that cultural diversity, as a source of exchange, innovation and creativity, was very important for humankind.

Frick, H., Suskiyatno, B., (1998) prescribed the Sustainable design as ecological design which balancing the natural cycle and consider the natural condition. Secondly, it would consider the health of the building residents. And lastly, it should use user-friendly materials. The ecological design principles recommended comprises:

1. Adapting design to local condition. Any design is important to be adapted to the local condition.
2. Saving the natural energy resources. The renewable energy resources should be utilized to minimize the use of non renewable energy resources.
3. Maintaining and improving the environmental system. The ecosystem should be understood and the energy usage needed to be preserved.
4. Self-supported concept. The residents should be able to produce their needs with utilizing the yard as a farm, pond, and livestock.

Therefore, the local design principles should be implemented with understanding of local cultures and relationship of microcosms and macrocosms to achieve more economic and social sustainability.

METHODS

The research is conducted with literature study on Balinese traditional housing concept, especially for Tenganan traditional housing and Sustainable Design regarding to Frick, H., Sukiyatno, B. A site visit and analysis are conducted on the implementation of Tri Mandala concept in Tenganan traditional housing with qualitative method. The research also conducted with interviewing the dweller Tenganan villagers.

Finally, the sustainability of Tenganan traditional is measured whether they fulgill four sustainability factors such as Frick, H., Suskiyatno, B., (1998):

1. Considering the local condition.
2. Saving the natural energy resources.
3. Maintaining and improving the environment system.
4. Having the self-supported concept.
DISCUSSIONS

Context of Pagringsingan Tenganan Traditional Village

Tenganan Pagringsingan village was located on the mountainous terrain. It is a Bali Aga traditional village which is unique in the tradition, culture and beliefs. As the traditional village the Tenganan Pagringsingan has several characteristics, namely of layouts such as:

1. The settlement is regulated by Tri Mandala among the Kaja – Kelod (North – South) axis. The traditional housing is connected by Awangan (Common plaza) that possess function of The village is divided into three Banjar, West Village (Banjar Kauh), Central Village (Banjar Tengah) and East Village (Banjar Kangin or Banjar Pande). The Banjar Pande is inhabited by villagers that violated the customs or outsiders for ceremonial purposes.

A Bali Aga Traditional Settlement
Tenganan Village, Manggis District, Karangasem Regency, Bali, Indonesia

Figure 3. The Village Structure
Tri Mandala in a Bali Aga Traditional Settlement
Tenganan Village, Manggis District, Karangasem Regency, Bali, Indonesia

Figure 4. The Village Structure and Tri Mandala Rules

Bali Aga Traditional Home
Tenganan Pegtingsinan Cultural Village
Tenganan Village, Manggis District, Karangasem Regency, Bali, Indonesia

Legend:
1 - Sanggah Pesimpangan (North Praying Table)
2 - Sanggah Kelad/ Kemulan/ (South Praying Table)
3 - Bale Boga (Pavilion for Elder and Storage for Sacred Artefacts)
4 - Bale Meten (Pavilion for Unmarried Girls)
5 - Bale Tengah (Pavilion for Birth and Death Ceremony, Meeting Guests, and Weaving)
6 - Natah (Courtyard)
7 - Awangan (Front Plaza)
8 - Jelanan Awangan (Front Gate)
9 - Puca (Kitchen)
10 - Jelanan Tela (Back Gate)
11 - Delod Puca (Bathroom)
12 - Tela Pisam (Pathways)
13 - Tetangga (Neighbour Home)

Figure 5. The Home Structure and Tri Mandala Rules
2. The Tri Mandala zoned the house into Utama, Madya and Nista. The Utama is designated for worshipping activities, sleeping for elderly and storage for Sacred Artifacts. Meanwhile, the Madya is designated for sleeping of the unmarried girls, birth ceremonies, death ceremonies, meeting guests, and weaving. Lastly, The Nista is designated for service such as cooking, toileting and pig farming. The main entrance to the house (yard) called Jelanan Awangan (Front Gate) or Kori Ngeleb. It is a boundary of the internal part of the house and Awangan (common plaza). The elements of the house are categorized into two, namely mandatory elements and non-mandatory elements. Mandatory building include: Sanggah Pesimpangan (North Praying Table) and Sanggah Kelod/ Kemulan (South Praying Table). The non-mandatory elements are Bale Buga, Bale Tengah, Pelipir (sitting place), Paon (kitchen), Bale Meten, Delod Paon (Bathroom) and Sanggah Kaja (Intersectional Praying Table). And the elements of the houses are:
   a. Sanggah Pesimpangan (North Praying Table)
   b. Sanggah Kelod/ Kemulan (South Praying Table)
   c. Bale Boga (Pavilion for Elder and Storage for Sacred Artifacts)
   d. Bale Meten (Pavilion for Unmarried Girls)
   e. Bale Tengah (Pavilion for Birth and Death Ceremony, Meeting Guests, and Weaving)
   f. Natah (Courtyard)
   g. Awangan (Front Plaza)
h. Jelanan Awangan (Front Gate)
i. Paon (Kitchen)
j. Jelanan Teba (Back Gate)
k. Delod Paon (Bathroom)
l. Teba Pisan (Pathways)
m. Tetangga (Neighbour Home)

In every house, a barrier of 1 meter wide gutter and 5 meters backyard (Teba Pisan) was found. It further reduced the environmental impact from pig farming or bathroom to the neighboring housings.

3. The Tenganan traditional village apparently is organized with the simple Tri Mandala concept. The Tri Mandala rules of the traditional village and housing brought positive aspect. The Tri Mandala was actually easier to implemented, and the Tri Mandala concept required less area. The Tri Mandala also fulfilled the heritage, culture, and social values of the daily life of the community and preserved the cultural diversity of the Bali Aga people as recommended by UIA (http://www.uia-architectes.org/image/PDF/COP15/COP15_Declaration_EN.pdf).

4. The zoning arrangement in Tri-Mandala also reduced the natural energy resources with cross ventilation, as well as it would consider the health of the building residents and less energy usages. It also preserved the ecosystem because the village was not allowed to develop towards the mountain areas. Tri Mandala also allowed the residents should be able to produce livestock. It showed that the local knowledge or wisdom actually is already sustainable as prescribed by Frick, H., Suskiyatno, B., (1998).

Sustainability of Tri Mandala Application in Tenganan Housing

1. Every building in the Pekarangan (courtyards) was regulated based on the Tri Mandala. Each building was located at a certain distance, and it was completed with its own walls and roof. Thus, it provided space for air flow more freely between each unit in the building.

2. By the regulation of distance for every unit and has its own walls and roof, then direct sunlight will also be able to come into the house. Thus, the sunlight can illuminate every corner space maximally. This advantage could reduce the use of artificial lighting by electricity power.

3. The Tenganan traditional housing was located in a mountainous terrain and drained sufficiently. The positioning created positive impacts, such as better ventilation and drainage.
4. The natural materials for buildings also created the comfortable in the house. The roof’s materials were the dried reed and wood construction. Meanwhile the wooden and bamboo (gedhek) walls were found. They modify wood columns with wood reinforcement on the bottom of the columns. All materials (material) which were applied in every house (Pekarangan) are obtained from Tenganan traditional residential area. Local materials are very easy to obtain and easy to applied.

5. The Tenganan traditional houses were connected by dirt road and paving stone roads. In the corner of the open space, a paving stone of different sizes was provided. The use of natural stone pavement is very environmentally friendly. Lastly, the rain water were absorbed into the ground. Meanwhile, the stone reduced slippage during the rainy season.

6. The dwellers of Tenganan used to work as a farmer. Therefore, the location of padi field/gardens are lower areas. The products produced by the Tenganan community, is one of the best products in Bali. The dwellers always use natural
manure to fertilize the plants. In addition, residents also have the space to raise (pork or chicken) which is located near the back of the house. In the end, the needs of residents can be met properly.

![Image of manure used for fertilization]

**Figure 10. One of The Product of Tenganan Village**
Source: Aryani (2013).

7. The harmonious relationship between human and nature, was also embodied in the cautious usage of building materials. For example, a person needs wood to repair the house, he must be listed by the Kelian Adat (traditional Administrator) and he has to wait for his time to have the tree to cut or he has to use fallen tree or replant the trees as well to keep the environment in the balanced.

**CONCLUSION**

The architecture design trend in Bali had abandoned of local cultural values. On the other hand, the Tri Mandala is the concept that is important to be maintained because of its social, environmental and economic sustainability. The Tenganan Traditional Housing was regulated by Tri Mandala. The concept has many positive impacts to implement to the housing as it is supported sustainable way of living. Unfortunately, the Tenganan Traditional Housing faced current challenges because of the tourism activities in the village. A new design strategy with Tri Mandala approach needs to be implemented to reduce the unsustainable impact.

**ACKNOWLEDGMENT**

We would like to express our gratitude to Architecture Program Study of Petra Christian University
2. Ir. Joyce M. Laurens, M.Arch., Lecturer of Architecture Program Study.
REFERENCES

Book and Journal:


Gelebet, I.N., et.all. (1986), *Balinese Traditional Architecture, Project of Inventarization and Documentation of Local Culture (Arsitektur Tradisional Daerah Bali, Proyek Inventarisasi dan Dokumentasi Kebudayaan Daerah)*, Department of Education and Culture (Departemen Pendidikan dan Kebudayaan), Denpasar.


Website:
http://www.uia-architectes.org/image/PDF/COP15/COP15_Declaration_EN.pdf
SUSTAINABILITY CONCEPT OF BALI AGA ARCHITECTURE

Ni Ketut Ayu Siwalatri*, Josef Prijotomo**, Purwanita Setijanti**
*) Lecturer of Architecture Department Udayana University Denpasar Bali; Doctorate Program of Architecture Departement, Civil Engineering and Planing Faculty, Institut Teknologi Sepuluh Nopember (ITS) Surabaya, Indonesia
**) Professor in Critics and Traditional Architecture, Architecture Departement, Civil Engineering and Planing Faculty, Institut Teknologi Sepuluh Nopember (ITS) Surabaya, Indonesia
**) Doctor of Housing and Settlement, Architecture Departement, Civil Engineering and Planing Faculty, Institut Teknologi Sepuluh Nopember (ITS) Surabaya, Indonesia
e-mail : ayusiwalatri@yahoo.com

ABSTRACT

Architecture is one of human works that consumed a lot of energy. Present reaserch have shown that has done that architecture consumed more than 50% of total energy in the world. That is why awareness of sustainability issues become prominent issues among architects, architecture students and academics. Practically sustainability concept is not some thing new for some countries. May traditional settlements have used similar concept o sustainabililt. One of these is Bali Aga settlement. The settlement showed how the community used the concept as tradition and way of their life.

The Bali Aga architecture was developed between 9 to-11 AD and mostly located in the highland or the mountain of Bali. The word “Aga” is used to distinguish the highland settlements from the rest of traditional settlements of Bali which mainly located in the down line of Bali, particularly in the southern Bali. Bali Aga settlements are located mostly in eastern and northern Bali. The village of Tenganan is the prime example of the genre, and for this dicourse, the village to be studied is Julah village in Buleleng Regency. This village is located on the northern part of Bali.

Referring to Bali Aga’s traditions and customs, the community recognized the relationship between the people and the environment. Bali Aga architecture shows the expression of their tradition that keep the environment sustained. This paper will discuss about tradition of Bali Aga community and how they articulated through their architecture. The aims of this study are to increase the awareness of modern soceity on sustainability issues and learned from tradition of Bali Aga community to how keep environment friendly.

Keywords: sustainability, Bali Aga Architecture, tradition and customs
INTRODUCTION

Sustainability issue is one of the problems that discussed by the various fields of science. After passing the 20th century people realized that the environmental quality began to decline. Global warming, climate change and the greenhouse effect are the topics that discussed recently to get a solution on how to manage sustainable development.

Protecting the environment is one of man's choices to keep the earth sustain to be handed down to the next generation. Through the advance of science and technology, the modern architecture tend to exploit natural resources to meet human needs. Actually architecture is one subject that plays an important role in protecting the environment. Architecture in one of the largest energy users in the world through the exploitation of natural resources used to develop building materials, more energy is needed to operate the buildings (Former and Guy, 2005) With the increasing standards of comfort demanded by building users, energy consume and resources needed are increasing too. Recent decades scientists have begun to look for alternatives to reduce the energy consumed by buildings, such as the low energy lighting (LED), green air conditioning, recycle materials, renew energy such wind, sun light and other materials that gives minimal pollution on the environment.

Sustainable architecture has been developed since the last three decades, but has not reached the goal of the concept of sustainability architecture. Many professional architects ignore the influences of their design to environment and resources. But on the other hand contemporary architectural practice tends to ‘confuse’, rather than ‘reinforce’, an ecological friendly architecture (Wines 2000: 11 in Former and Guy, 2005).

Vernacular buildings are considered to be the reflection of human civilazation that is more resilient to the modern change and have been handed down to the next generation by pracitces. Vernacular architecture which created by local soceity mostly applied sustainability concept, event they did not have intention of sustainable development. Through tradition they regulated the relation between man and environment. Julah is one of the ancient villages in northen part of Bali. Julah village had been well known as an important harbour during Warmadewa dinasty in 9-12 AD. The local peopleJulah community have tradition that regulate relation of man and environment. The village and architecture still exist until recent time and they still traditionally keep the harmonious relationship with the environment.

MATERIAL AND METHODS

Julah is one of five ancient villages that located at Tejakula district at eastern Buleleng regency. To reach this village we can go via Bedugul to Bulleleng city and it takes about three hours from Denpasar or we can also go through Payangan going North and we will arrive at this village from eastern side. Julah Village is easy to find because the location of the village is on the main road toward the eastern Bali. For this study, data collection were done through observation into the village to
study the settlement and the architecture. Interview was conducted with the head of community (*kelian desa adat*) and members of the community to understand their tradition on architecture. For this paper, types of information gathered in the field are building typology, building materials and technology that is applied by local people. All this information will be analyzed by using interpretation approach so we understand the sustainability concept of Julah community.

![Figure 1. Map of Julah village and other villages around it](source)

**SUSTAINABILITY AND ARCHITECTURE**

Sustainability is discussed not only by scientists but also by politicians around the world. Sustainability is problems for elites, but also an issue of human being such as traditional societies, social organizations or anyone who wants to maintain the environment for the future. The definition of sustainability is still debatable, for example the use of woods for building material. Sudjic 1995 states that: using the wood need a bit of energy and the use of aluminum requires a lot of energy to produce it, but the wood can not be recycled, and aluminum is easy to melt and reuse it. Between these two materials which are considered as a sustainable material?

To understand sustainability architecture should be seen in a broader context and involves many fields of science.

As Jamison argues, sustainability is not related with practices only but can interpret it from scientific side. He questioned the definition of being “green knowledge” that is, the ways that different producers of knowledge take their point of departure, their problem formulation, from different aspects of reality. By focusing on the process of making environmental knowledge we can avoid setting up bipolar oppositions between different paradigms of thought: the light versus dark green architects or the sociologists versus scientists (Jamison 2001: 32 in Former and Guy, 2005).
Debates and discussion about what sustainability architecture is have been done in the last three decades, but the result may not satisfy many people. Many architects try to obliterate their responsibility in destroying environment and nature, but some of them are still confused in understanding sustainability architecture. Sustainability Architecture has a narrow focus on energy efficiency. The Brundtland Report of 1987, the Earth Summit of 1992 and the subsequent Kyoto Protocol of 1997 have tended to be instrumental in framing the environmental problem in the macro-physical mainly terms of greenhouse gas emissions and ozone layer depletion. The main outcome sustainability architecture is continuing emphasis on improving physical performance generally and the efficient use of energy in particular. (Former and Guy, 2005)

TRADITION IN VERNACULAR ARCHITECTURE

Vernacular architecture is the property of a place, and an expression of local or regional dialect. Vernacular architecture is an expression of the human relationship with the environment. Vernacular architecture is the text, in which people save their knowledge in it. Traditions and architecture have a close relationship in which traditions creates architecture and it works the other way within architecture there are traditions to tell. Traditions that use as reference in vernacular buildings and some times force certain authority and sometimes applying unwritten codest. Tradition is a reference to the past, therefore tradition is fixed idioms, but as a social structure tradition is often re negotiate by next generation in every community (Bronner, 2006).

Tradition can be seen in either a cultural context or be seen as a text, because architecture is a medium to express their comprehension of the environment (Schulz, 2000). Tradition in a society is a convention that has been agreed upon and considered ideal by the community itself. Tradition has a long process of trial and error and is considered as something that best suits for the community. Tradition passed on from one generation to the next, and in the process of inheritance tradition is always a process of reinterpretation by future generations and do justification to adapt the needs of the community. Tradition is not something static but dynamic following the development of the society (Bronner, 2005).

Using the model of linguistic vernacular, tradition can be seen as a local language to get the respect due to the use of frequent and long. Local knowledge is important because it has been accepted by the community and has inherited and has been tested in a long period, and may get various impact of public perception on certain environmental conditions.

On material culture, tradition relates not only to building skills and how the process occurs, but also how science was inherited, adapted and passed on to subsequent generations. In the broader context of the variations that occur through space and time, but the pattern can occur in identification that can be mapped. Vernacular building has weak characteristic in terms of theory and aesthetic pretensions, but the vernacular usually work with a footprint and a micro climate, respect for others and their homes, and therefore to the total built environment,
working in an idiom with the given order. Although vernacular buildings always have limitations, but at the same time they can suit for variety of situations be and able to create a place. With all the limitations of expression, vernacular buildings are able to make the communication possible, and one must learn to communicate with language, beliefs and shared vocabulary (Miller 2007: 28)

Vernacular architecture typically has almost the same expression, the actual difference is allowed, but in traditional society togetherness and equality is something which is considered important because of the differences in the expression of architecture is still given a chance but on a small scale and are not dominant. Tradition as a social construction shows little changes, therefore if there are major changes in the tradition may be an indication that there is a greater change in the social conditions of the people (Bronner, 2005).

BALI AGA ARCHITECTURE

History of Julah Village

The terms of “Aga” derivied from ancient Javanese language, which means mountain or hill. Bali Aga is used to distinguish the Balinese cultures of mountainous regions from other regions of Bali. Reuters says there is no empirical data that distinguishes coastal and mountain culture, because there are some Bali Aga village located in the down land. Terms Aga only to distinguish the Bali Aga culture that flourished in Bali from the point of view of the down line of Bali (Reuter, 2005)

History of cultural development in North Bali is some how different from South Bali. Bali’s northern region has long been in contact with outsiders like China, Arab and Bugis. In this area relics are found from the pre-Hindu bronzes and heritage and it seemed that it was at times when political and economic power was dominated in northern Bali (Pringle, 2004:6). Bali’s northern region especially Julah, Pacung and Sembiran attract many ethnographic researchers as they are considered as one of the remaining part of the development of the original pre-Hindu culture, that is still survived, still displayed feature animistic and not in contact with the culture of the 16th century eastern Java (Schäublin, 2008).

Bali Aga culture develops around age 9-11 AD, as written on 20 bars of copper inscription found in the village of Sembiran. This relic covered about six royal records, and in this inscription it mentioned Julah had complex social stratification. In the inscription the village Julah was part of the mandalic state or "Balidwipamandala" or one of the seven states "sapthanagarari". At that time people of Julah consisted of several levels of community groups (candha / caste) and also mentioned about priests and monks as Siwa and Buddhist priests are called to mpungku cewasogata rsi (Schäublin, 2008).

According to archaeological evidence found in Julah, The village used to be a port and an important international market for ruling the kingdom in Bali at the time and was one of the spices trade routes in Indonesia. At certain seasons the ships
from India, China and Arabian landed in Julah to trade goods. Interaction between Bali and foreigner have occurred approximately since 2000 years ago, but until now archeologist could not be determin exactly where the location of the port is. According to folk stories obtained seaport located around Pura Sang Hyang Marek, because the place is still known as the customs (Schäublin, 2008: 15). In further developments during the reign of king Sri Maharaja Jayapangus, Julah was told as the region of the kingdom defence (Julah pinaka pagar ida ring nagara), and therefore the people of Julah were exempt from paying taxes. Location of Julah village is close to the coast causing this village are suffers from robbers, and their refuge Upit and Batu Gambir. The name of “Julah” is taken from the words in-tantrum (expelled) who later became Julah. According to information from the interviews, but the name of this village is Kerta Sari Wringin (interview with Julah officer: 2013). Based on interview with the head of the village, indigenous village name wa Cutak at first, turned into Cakrasari, Ponjokbatu and became Julah.

**Architecture of Julah Village**

Julah village sometimes include into the group of Bali Aga village, although the location is not in the mountains, but on the waterfront of northern Buleleng regency. But Julah is also categorised into a group of Bali Mula village, the settlement seen as a native resident of Bali (mula = the original). However, there is no empirical evidences have been found to prove this theory. In this paper Julah village incorporated into the Bali Aga village as it develops at the same time in 9-11 century AD.

The settlement pattern of Julah village is gridding, but if we seen it from the main access of the village it canbe seen as a pole pattern. The Julah settlement use the main road as an access to the main temple Pura Bale Agung. According to local cosmology, the road showed an expression of kaja-kelod (kaja=mountain; kelod=sea) axis. The settlement consist of three or four layer of housing site, and they located in the left and right sides of the main road. Every layer is divided by narrow streets/gangways where the main gate of the house is located. All of the streets are connected to the main road, like nest of spider (Figure1 and 2).

![Figure 2. Maps of Julah Village](source: Laporan Akhir Dept PU)
The residential units consist of several stages, one structure for the kitchen, one for residential building and the other structure is design as a place of worship. In some houses another structure was added, which is called *bale sakenem* (building with six columns), the function of the building is *sumanggen* (*sumanggen* is a multi porpuse building). The configuration of this three buildings are based on the cosmological concept of Julah tradition, that is implementation of the *kaja-kelod* axis. *Kaja* side of the site is a position to place worship/sucian/sangghah kemulan and side kelod is for kitchens. These buildings should be in the same axis and the line of sight. While residential building its position in the kaja side, and be located on the left, right or in front of sucian, adjusted to the width of the site. Site of the house consist of 3-4 dwellings unit, and between these families, they usually have family ties.

These building units lined up from the entrance to the east or west without a border between the household units and in the middle of the structures will form an open space called *Natah*. *Natah* serves as a common space, circulation paths and places to social activities among family members. On the back of the kitchen there is usually a pigsty, a place to put the firewood, or garbages, etc.

**Figure 3.** pattern of house hold

**Figure 4.** variety of of house hold pattern
The meeting point of the two axis were the place where people perform *pemendak* ceremonies (*pemendak* = sacred welcoming). The meeting of axes is considered as the meeting point of *catus patha* meeting point of the horizontal and vertical axis. This point is the centre and place where people symbolically connected with God through prayers and offerings.

Pattern of the three buildings have been prepared using the concept of *luan-teben* (upstream-low). Upstream direction is the direction of the mountain / *kaja* which is believed to be the holliest value, while *teben* the direction towards the sea is the lowest value. The architecture of the Julah where kitchen and *sucian* play the key role to determine the position of the other buildings. Spatial concept of kitchen and worship must face each other to form a strong *kaja-kelod* axis.

**Tradition and Expression of Julah Architecture**

A sustainable neighborhood is an ideal vision of environment. However when making an ideal architecture and built environment we have limitations and constraints. Climate condition and the availability of resources are the main constraints for human to develop a better architecture. People have to adapt the resources in habitat and climatic conditions because vernacular architecture is an expression of the choice made by the people and the possibilities offered by the environment (Schulz, 2000).

The structure of the Bali *Aga* architecture are mostly using organic materials and the size of the buildings are quite small. Couples that had married in Julah are not allowed to live with their parents, they must built a new house. The chance for the spouses to build a new residence must not exceed the time permited which is three years. This tradition is still followed untill recent generation. In time being after the couple raised their family and their children already married and the spouses were dead, the building should be left without inhabitant. The sons of spouse not be willing to live in their father house before completing a certain ceremony and because of this tradition therefore building for dwellings are quite small.

The construction of a residential unit should start by made a kitchen. After a well-established family, they built *sucian* and the last structure to be built will be a bed room unit. By the time when the newly married just had a kitchen, the domestic activity strated to be carried out in the kitchen including sleeping, cooking and for praying. The kitchen is a structure with 8 poles/pillars. The building dimension is about 2 x 3 meter. Fire place is put on the west side and halls on the east side of the building. On the top of the fire place is the rack to put stuff and also to lay offerings during Galungan holiday. Pole is made of wood, and walls made of woven bamboo or woven palm leaves (Figure 5 and 6).
Place for worship is a simple building with four pillars (*bale sakapat*) and measure of the building around 1:00 to 1:25 meters. The structure is half-open, where there are only wooden walls in the back and part of three sides opened. In normal day the four sides of the building walls covered with woven bamboo or boards. This worship will opened when the praying ceremony. The position is located at *kaja* side, dealing with kitchen. In some tread for *sucian* elevate to express differences in hierarchy, but in general has equal level.

The expression of sacred buildings of worship is not done by making a large building, vertically or using a lot of ornaments. In Julah public worship seen as medium for doing offering to their ancestor but not as a house for God as we seen in Balinese architecture in downland of Bali. That is why they demolished the building after the owner passed away. This concept is distinct from south Bali, where the *sanggah*/worship should be maintain and inheritance to their childrens. In addition to *sucian* in some places there are worships which is called ancestor worship/*sanggah misi* (*misi* = some one/some thing inside). The building is made if the family or family members get sign through dream or other ways that their ancestors are willing to placed in the worship. Then the family groups make a place of worship besides *sucian* and *sanggah misi* belongs to a family group/clan.
The type of residential buildings are the followings: bale jajar, bale umpak, bale sedandan, bale meten and bale jait. The residential buildings are named according to the amount of poles and its structure. Bale jajar are mostly used for residential unit. Bale jajar is building that has six poles and half of this building is enclosed by brick wall and the other half is terrace. The function of this building is for sleeping and working.

Figure 7: suci an and sanggah misi
Source: observation 2013

Figure 8. Bale Jait, building with 12 wooden poles
source: observation 2013

Figure 9. Bale jajar (building with 6 wooden poles) bale meten (building with 8 poles)
Source: observation 2013

SUSTAINABILITY CONCEPT OF BALI AGA ARCHITECTURE

Before developing ideas regarding sustainability Naess made a statement about deep ecology and he said that people should think about the ecology in different viewpoints. Ecological problems can not be solved only with a technical solution,
but must be solved holistically and look at the problem from the point of view of other people / other species (Naess. 1989: 4). Although these concerns are certainly nothing new in architecture, the interweaving of the concept of 'environmentally friendly' with resource efficiency has tended to be a defining characteristic of the environmental debate since the energy crisis of 1973.

Tangible factors that influence the form of vernacular architecture are availability of materials, technology that owned by society and geographic condition (Rapoport, 1969). On the other hand socio culture also is one of determine factors in building form. Principles of sustainability architecture are concern about sustainability of supply for building material, minimize in using energy, and applied of 4 R (reuse, reduce, recycle and replant). For Julah architecture all these principles are not studied in term of quantitative analyse, instead will be analysed in order to find the concept of sustainability of residential building in Julah Village.

In Julah architecture the type of materials that is used are organic materials such as Intaran wood/Nimba wood (Azadirachta Indica), coconut and bamboo. For wooden column they mostly used Intaran woods and this species are grown in dry land. Intaran woods are common building material in Bali Aga culture. These materials were selected by society, because these are offered by nature and there are plenty in their environment. All materials that exert over building are provided and made by the user/owner and local workers. By this tradition skills and knowledge of making building are transferred to next generation as a process of apprenticeship. By providing almost building material by themselves is one of ecology concept, because we just exploit nature as much as we need (Naess,1985). For keeping Intaran wood sustained, offering that made for certain ceremony in the temples and house shrine should add with Intaran leaves, so every house hold must planting Intaran trees in their yard or in their farm. Intaran trees have many advantages such as for medicine, for wind barrier and can fertile the soil. Environment is maintained with the concept of providing all of its own needs and replant trees that have been felled for the building. Environment is considered as a partner to be maintained so that its continuity can be used by the next generation.

In making building for residential, people of Julah have some considerations. Many of them have capability to build big or grand houses, but they deny to do it. Making a big house become a burden for their offspring, because their children should have to implement the same building as their father’s. Beside that a house is built just for a life time and not allowed to inheritance to their children. Small buildings only need small amount of resources and caused less exploitation to the nature and by using organic materials, it minimizes pollution to the earth. In practices Julah community only developed small buildings for their houses, even for their shrine. In vernacular architecture sacred institution have an important role in the society, but they dont expressed it by making big and grand building for shrine as we see it in the downline of Bali. Sacred building for the house hold is small, simple and with minimal ornament.

The house are not used for articulating the financial capability of the society, which keep them away from jeaulousy in the society. According to inscription found, it is said that once Julah community had many of layer caste and this condition made people stratified. To solved this problems, Julah make concensus
that every body in Julah should take off their caste and lived as common people and all can call themselves as jero. One of the architecture task is to improve the quality of human being and by making a similar building by discouraging them to create distinctive building. This create peace for the community. Sustainability is not only to keep earth sustained, but should be give opportunity for the people to create better live.

As mentioned above that every site of houses is consisted of 4-5 house holds and it has one main gate and they share open space/natah with the other member of the family. With this kind of building lay out, every single person in that site should respect each other and create high tolerance between themselves. Respect and tolerance are way of life of the Julah community, respect for human being, the nature, all species and always be tolerance to other human and to the environment. By this way of life people adapted, modified their practices, adjusted their norm and choosed better possibilities offer by environment. These concepts are the way that we could sustain the nature.

Concept of sustainability architecture is mostly applied in physical performance of the building, and energy efficacy is the emphasis of this concept (Former and Guy, 2005). Tropical climate is hot and humid, so most of the people stay outside in the day time. Julah village are located near the sea and according to the geologic characteristic is dry land with stones, the village does not have wet rice field, but only dry field which planted with trees such as mangos, coconuts and corns. The climate is hot with salty wind. Julah community mostly are farmer and they do their daily work outdoor or in the field, so the building function mostly as a shelter for sun heat, that is why most building are opened. Their activity mostly done in open space/natah that roofed by coconut leaves or under the shade of the trees and they are moving around open space/natah according to direction of the sun light. This practices maybe in contrast with modern life style, where we spend most of our time inside the building, and we consumed more energy for air conditioning, for lighting, etc. Bali Aga architecture does not consume much energy to operate it, if they stay out side most of their daily time, enclosed building usually dark because they use it just for sleeping.

**Figure 10.** Slate stone for property’s wall and figure 14 organic and non organic utensils

*Source: observation 2013*
The concept of reused material is not suited for Julah architecture, because according to their tradition is not allowed to use building material that have been used. Building material have to be new and not defected materials. If it turns out known that the building material are defective, the building should be demolished and replaced with new ones. This action seem to be contrary of the sustainability concept. But the concept may be developed based on life time of the timbers. They are mostly use ordinary timber like Nimba woods and this material do not have good durability, that is why concept of reuse are not allowed in this society to guarantee safety for the people. Beside forbidden for using defected material, Julah community also have tradition that the building should not be exposed to "catastrophe", and this statement make sense that the community is very careful and meticulous. If a house or part of a building is exposed to fire only slightly, the building should be demolished and replaced with new ones. This tradition express that Julah community have high awaeness of catastrophes to secure for the people and buildings.

LEARNING FROM TRADITIONS OF BALI AGA COMMUNITY

In western world architecture is more considered as a container of human activities, but for Balinese people especially Bali Aga community architecture is a part of nature and can not be separated from it. Human have a responsibility not only to themselves but also on their surrounding. Keeping environment sustainable is not only physically, but also spiritually through the process of ritual ceremony. Environment in some reason some times is considered spiritually dirty or cuntaka. 

When this happens, the community will hold spiritual cleansing ritual for the environment. The dirty condition according to local tradition such as some one have twin children, some one die, or catastrophe. During this condition, every community members is not allowed to conduct any ritual even in their house and the sucian and Bale Agung temple are closed. After certain times they have special ritual to clean the environment. By this customs and traditions, local people try to harmonize between people and enviroment.

Although architecture and settlement of Julah were developed in the period of ancient Balinese culture, however sustainability concept seem remain suitable for this era. There are some kind of knowledge that we can learn from the tradition of Julah community.

1. Environment is considered as a partner not a resource that can be exploited for the benefit of human being. Human needs are increasing slightly and some times unlimited so that the environment become exhausted. Environment must be seen as partners where people take some resources from nature and give back by replanting trees, minimize pollution, do cleansing ritual or minimize their needs. By these action environment are keep it sustained.

2. Respected to the others (nature, human and other species) and see them as partner is one of the concept of deep ecology and it can be applied where ever we live. Respect to each other also means that respect to the diversity of culture,
customs, traditions and give more chance to local authority to decide what they need and how to sustain their environment.
3. Minimize human need and does not use houses or architecture as a media to articulate economic achievement. Every body have the same right and duty to sustain the environment.
4. Try to fullfill all needs, by this action people will try to replant trees, reduce the needs , recycle waste material. Application of these concepts will keep environment friendly.

CONCLUSION

Sustainability is not a simple concept, but stem from the interaction between a wide range of factors. An ecological approach should be seen as how people doing their tradition, practices in constructing houses, values that added in their architecture and the social organization of the people. Built environment of the sociey are reflection of orders of environment and comprehension of the universe. In developing sustainability concept, we should not ignore local culture and ecological diversity and develop it from the comprehension of the people about their environment.

REFERENCES

Miller Lane, Barbara. (2007), Housing and Dwelling, Perspective on Modern Domestic Architecture, Routledge, Taylor and Francis Group, London.
Reuter, Thomas. (2005), *Custodians of Sacred Mountains, Budaya dan Masyarakat di Daerah Pengunungan Bali*, Yayasan Obor Indonesia, Jakarta.
MANAGING GREEN ARCHITECTURE THROUGH LIFE STYLE

Titien Saraswati  
Department of Architecture, Duta Wacana Christian University, Yogyakarta, Indonesia 55224  
e-mail: titiens@ukdw.ac.id, titiens10@gmail.com

ABSTRACT

Anywhere in the world, whether in rural or urban area, we cannot avoid the issue of global warming. In the urban area, about 80% of our activities are inside the buildings: in the houses, schools, offices, manufacture buildings, hotels, etcetera. Only a few of our activities take place outside the buildings. The conditions inside the buildings for our activities are far from comfort right now. In other words: our activities inside the buildings need some devices to help us to support the activities running well. In fact, some devices to support our activities generally exploit our natural resources and energies that in turn, degrade our environment. 

There are also some statements that the efforts to fight degrading environment are the domain of the government only. In fact, the efforts to fight degrading environment are our business, the responsibility of all people. “Green” now is the popular word for us, and the new trend for our daily living. Whereas, this is not a new trending topic in our life, but this must be the change in our life style. That is, the need for architectural design, specifically architectural engineering that green enough for the condition of the earth, the changing climate, and degrading environment; need the changing life style. 

The objective of this paper is to explore the possible things to manage green architecture through green life style. The methods used by examining life style that contributes to green architecture. The conclusion is that some simple life styles can have influencing factors to green architecture.

Keywords: energy, green architectural engineering, life style.

INTRODUCTION

“Green” becomes a popular word right now, almost in all aspects of our daily life. As mentioned above, it is not the new trend in our life, but this should be the responsibility of all people in the world.

Life style can be a choice for people. But this choice, I think, should be consider properly right now, in order to save our environment and our earth. It is a matter of choice, but it is also a matter of saving the environment and the world.
But, whatever the choice it can be, we have to think that our choices should contribute to fight degrading environment.

Of course this paper just explores the possible thing, simple life style that contribute to have influencing factors to green architecture. It is really more about opening up ideas and issues for identifying simple life style that contribute to have influencing factors to green architecture.

GREEN ARCHITECTURE THEORY

What is green architecture? According to Karyono, 2010, green architecture is the impact of the concept of sustainable architecture. He also explains that green architecture minimizing using natural resources by people in accordance to make future generation to meet their needs of natural resources. Green architecture also about the need for minimizing negative impacts of the buildings to the environment where the people live.

Furthermore, Wines (2008) also explains that the most complex and problematic issues facing humanity over the next century that is, how to construct a human habitat in harmony with nature. This means, eco-friendly environment should be accomplished. In other words, we should save our environment, or we should fight degrading environment and save the earth.

From the two above explanations, it can be summarized that green concept, green architecture, eco-friendly environment can be meant as adopting the systems which are very economical in using water and electrical, should be using renewable energy, water conservation, good air quality, using friendly environmental and economical building materials. These kinds of thought that never be happen before as the basic requirements for modern people in architectural engineering. Whereas architectural engineering, also known as building engineering, is the application of engineering principles and technology to building design and construction.

There are also some simple life styles that can have influencing factors to green architecture, specifically to green architectural engineering. In other words, simple life styles that contribute to minimize the energy used for architectural engineering. What kind of life style? Let me explore as in the following.

RESULTS AND DISCUSSION

Some examples of simple life styles that can have influencing factors to green architecture, as in the following.

HBKB (Hari Bebas Kendaraan Bermotor)

HBKB (Hari Bebas Kendaraan Bermotor) means a day without motor vehicles on Sunday (Kompas, 2010). This happened in Indonesia for the first time in Jakarta, and now follows by Surakarta, Yogyakarta, and any other cities in Jawa. This life style more and more gets many followers. This can cut the energy and reduce toxic
gases in the city in a big amount. In turn, this can make the quality of the air in the city cleaner and healthier.

The impact to green architectural engineering will be: cleaner, healthier air in the environment. This means we can design more natural ventilation.

**Refrigerator**

Inside the house, according to Green Initiative Forum (Kompas, 2010), the fridge (refrigerator) which is full of food stuffs is better than that which is empty. The fridge that full of food materials can be economical in using the energy than the one which is empty.

![Refrigerator](image)

**Figure 1.** Do not let the refrigerator almost empty, because this will consume more electricity

Source: Author’s documentation, 2013

The impact to green architectural engineering will be: economical in using the energy. This means we do not have to exploit our natural resources for the energy. We also can use renewable energy for architectural design, i.e. photovoltaic panel for electricity.

**Television**

Television, in this case is LCD (liquid crystal display) television, can be economical in using the energy or electricity (Kompas, 2010) compares to conventional television or tube television. Energy can be saved.
The impact to green architectural engineering will be the same as above aforementioned for the fridge, that is economical in using the energy. This means we do not have to exploit our natural resources for the energy. We also can use renewable energy for architectural design, i.e. photovoltaic panel for electricity.

**Earth Hour 60+**

Earth Hour 60+ was initiated by World Wide Fund for Nature, that is a movement to cut off the lights during 60 minutes or more. This third Earth Hour 60+ was happened in Indonesia for the first time on March 26, 2011 (Laksmi, 2011). The minimal act was to cut off at least two lamps inside the house in the night. More than two lamps is better! This movement has taken place in Jakarta, Bandung, Yogyakarta, Semarang, Surabaya, Malang; and up to now are followed by many other cities in Indonesia. This movement in 2010 and 2011 were claimed as the greatest enviromental movement in the world. Around the world there were more than five thousands cities involved in the movement and this involving more than one billion people in the world. How great! How much more energy has been saved! It is hoped that the above movement can be a starting point to change our life style. So that it is not only just turn the light off, but in a more big step, the aim for the future will be changing the life style and saving the earth.

The impact to green architectural engineering will be: reduces electricity, reduces the energy. This means saving the earth from exploitation of natural resources.

**Computer**

Laptop computer is much more better than desktop computer (Kompas, 2010). Accordingly, laptop computer can be economical in using electricity, say that a laptop computer can save about 80% in using electricity than that of desktop computer. Imagine, if an office replaces one hundred desktop computers to one hundred laptop computers, how much more electricity can be saved. So that, this
also reduces using energy. Knowledge and technology make the modern people in nowadays era can live modernly and also environmentally friendly.

![Image of laptop and desktop computers]

**Figure 3.** Laptop computers (left) much more better in saving the energy than desktop computer (right)
Source: Author’s documentation, 2013

The impact to green architectural engineering will be: reduces the energy, economical in energy. This means saving the earth from exploitation of natural resources. With the form and the size of laptop computers that handy enough to be moved, we do not have to make conventional office design as usual. We can design an office that compatible enough with our need whether we have to use the laptop or not.

**Plastic bags**

Reduce to use plastic bag and styrofoam material for food, because this material will be absorbed in the food, especially hot food. In turn, this will remain in our bodies and can be dangerous for our health. Also, these kinds of materials, when throw away, cannot be degraded for a long time, and can contaminate the landsoil in a long time. Better to bring our own mug or bowl when buying hot food, according to the advertisement in Kompas, 2009, from PlasticFreeBottles.com, Trent University, USA.

The impact to green architectural engineering will be: not polluting the earth, healthier for human. This means landsoil will be better. In turn, vegetation can grow up healthier, our environment will be dense with vegetation. We can design more natural ventilation. Furthermore, even though there is no direct impact to other area, but with the better landsoil make it the rainforest grows up better. The wood/timber will be abundance to support the building materials in architectural design.

**Renewable energy**

Not using energy from fossil, but using alternative energy such as photovoltaic panel for electricity, and windmill if possible. This will save natural resources. Also, using
energy of wind, sun, and rain water. This will also affects the design of the building with more openings for natural lighting and ventilation.

The impact to green architectural engineering will be: saving natural resources. This means we can use the above renewable energy for our architectural design.

Be Vegetarian

I would like to explain the relationship between global warming, climate change, architecture, and life style in this section that concerning vegetarian life style. According to the report from Food and Agricultural Organization (FAO), United Nations (UN), entitled Livestock’s Long Shadow on November 29, 2006 in its website, mentioned that about 18% contribution to global warming was came from animal farms or animal husbandry world-wide. Whereas the meaning of animal husbandry is the act or practice of cultivating crops and breeding and raising livestock. The percentage number of contribution to global warming from animal husbandry was much more bigger than that of all kinds of transportations world-wide that only 13% (Febriani, et al, 2008). From this issue of global warming then can be stated the important thing of sustainable architecture, in which the impact of sustainable architecture is green architecture as stated by Karyono (2010) aforementioned before.

Activities in animal husbandry sector contributes 9% CO2 carbon dioxide gas, 65% N2O nitrous oxide, and 37% CH4 methane gas. Nitrous oxide gas N2O – resulted from the faeces of animals from animal husbandry – 296 times more potential producing greenhouse effect compares to CO2. Whereas the greenhouse effect is a process by which thermal radiation from a planetary surface is absorbed by atmospheric greenhouse gases and is re-radiated in all directions. This illustration does not include the effect of the pollution and contamination to the earth (landsoil) and water from the faeces of animal husbandry.

Figure 4. Vegetarian food, no meat
Source: Author’s documentation, 2013
Febrianie, et al (2008) also stated that the research by Gideon Eshel and Pamela Martin from University of Chicago came into conclusion that changing the habit from eating meat to vegetarian life style is 50% more effective to protect the earth from global warming, compares to changing SUV (sport utility vehicle) to hybride vehicle.

Furthermore, Kompas (2009) explained about human and emission, that animal husbandry contributes gas emission. These three gases from animal husbandry (CO2, N2O, CH4) contribute greatly to greenhouse effect gases. And green house effect gases is responsible for increasing the temperature of the atmosphere in the earth. Animal husbandry sector contributes 51% to greenhouses effect gases world-wide. So that, Dr Rajendra K. Pachauri, the Head of Intergovernmental Panel on Climate Change (IPCC) in Paris, in January 25, 2008 persuaded people world-wide to reduce consuming meat in accordance for minimizing global warming. That’s all the above explanations about the relationship between global warming, the climate change, and vegetarian life style. It is not an easy thing to change our life style to be a vegetarian, and it is highly likely will be rejected by the people and the communities world wide.

The impact to green architectural engineering will be: not polluting the earth and the air, reducing global warming. This means saving the earth so much! The result will be more and more amazing for architectural design, i.e. natural ventilation, natural lighting, more vegetation can be planted, availability of building materials from timber, etcetera.

The above life styles can have a very big impact fighting degrading environment. So that it can be summarized in a table as in the following:
Table 1. The Impact of Life Style to Green Architectural Engineering

<table>
<thead>
<tr>
<th>No</th>
<th>Life Style</th>
<th>Impacts</th>
<th>Specific impact to Green Arch Eng</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HBKB</td>
<td>-cut energy, reduce toxic gases in the city and the environment</td>
<td>-cleaner, healthier air in the environment, more natural ventilation</td>
</tr>
<tr>
<td>2</td>
<td>Fridge</td>
<td>-full fridge is better than empty one, reduces the energy, economical in energy</td>
<td>-not exploit natural resources, use renewable energy for architectural design</td>
</tr>
<tr>
<td>3</td>
<td>LCD television</td>
<td>-reduces energy, economical in energy</td>
<td>-not exploit natural resources, use renewable energy for architectural design</td>
</tr>
<tr>
<td>4</td>
<td>Laptop computr</td>
<td>-reduces energy, economical in energy</td>
<td>-not exploit natural resources, office design compatible enough for our need</td>
</tr>
<tr>
<td>5</td>
<td>Earth Hour 60+</td>
<td>-reduces electricity, reduces the energy, saving the earth</td>
<td>-not exploit natural resources</td>
</tr>
<tr>
<td>6</td>
<td>No plastic bags</td>
<td>-not polluting the earth, healthier for the human, landsoil will be better</td>
<td>-more vegetation, more natural ventilation, rainforest grows up better, timber/wood will be abundance for building materials</td>
</tr>
<tr>
<td>7</td>
<td>Renewable energy</td>
<td>-saving natural resources</td>
<td>-renewable energy used in architectural design</td>
</tr>
<tr>
<td>8</td>
<td>Vegetarian</td>
<td>-not polluting the earth and the air, reducing global warming, saving the earth</td>
<td>-natural ventilation, natural lighting, more vegetation planted, availability of building materials from timber</td>
</tr>
</tbody>
</table>

Source: Results of Author’s Analysis, 2013

CONCLUSIONS

Green architecture also stated the need for minimizing the negative impacts of the buildings to the environment in where the people live. Simply, green concept can be meant as adopting the systems which are very economical in using natural resources and the energy, good air quality, using friendly environmental economical building materials and energy. These kinds of thought that never be happen before as the basic requirements for modern people in architectural engineering.

The above life styles are simple enough in reducing the energy, means fighting degrading environment. In turn, even though it is not in a short time but in a long one, the above life styles can contribute to cleaner and healthier environment that we can design buildings with more natural ventilation and natural lighting in the days.

It is hoped that the above explanations can be a starting point to change our life style. So that it is not only just change the life style, but in a more big step, the aim for the future will be saving the earth.
ACKNOWLEDGMENT

I would like to thank to the Head of Architecture Department, Duta Wacana Christian University, who encourages me to write my paper for this International Seminar.

REFERENCES

This page intentionally left blank
THE DEGRADASI (ANGLE DEGREE, GRADIEN, DISTANCE, STEM DIAMETER)
STUDY OF MANGROVE *Rhizophora apiculata* FOR ECOTURISM DEVELOPMENT BASED ON MANGROVE Rhizophora Chitecture (MRAC)

Aprilia Fitriani*, Firdha Ayu Atika*, Lilis Wahyu Astutik*, Fithrotul Mumtaz*, Yahzun N. Firmansyah*, Murtijas Sulistijowati**
*) Student, Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
**) Lecturer, Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
e-mail: archapril@ymail.com

ABSTRACT

*Mangrove RhizophoraChitecture (MRaC)* is a green alternative in architecture that utilizes future *Rhizophora apiculata* as the major structural component of the building biomaterials. The development of the idea supports the concept of ecoregions which prevents damage to the mangrove area while maintaining and even continuing its existence. Unique configuration formed by the roots is creating a space between the mangrove trees that allow for human activity. Space can be created through configuration on the mangrove roots or by a collection of mangrove trees. The research will explore the proportion of mangrove roots, the distance between two individuals mangroves, mangrove stem diameter, and slope inclination figures especially in the roots of mangrove arial roots that can be considered in determining the shape space leveling embodied space between the root configuration as the base elevation of footing (space leveling) that could potentially form a space. Result of the research will be a data comparison of distance, angle degree, and elevation, and also design leads to ecoturism.

**Keywords:** ecoturism development, biomaterial, mangrove rhizophorachitecture

INTRODUCTION

Human life cannot be separated from nature. Maintain viability, human exploitation of nature. Exploitation of nature can cause a variety of problems, particularly in the natural resources that cannot be update. Increased population means increasing the need of our current natural.
Mangrove Rhizophora Architecture (MRaC) is an alternative architecture that utilizes green future *Rhizophora apiculata*, as the major structural component of the building biomaterials. Development with the idea to support the concept of ecoregions, which prevents damage to the mangrove area while maintaining and even continue to exist (Prawiro, 2009).

Roots of mangrove species *Rhizophoraceae* has unique characteristics and is composed of three kinds like prop roots, stilt roots, and aerial roots. Unique configuration formed by the roots to created a space between the mangrove trees that allow for human activity. Space can be created by the configuration on the roots of the mangrove (Prawiro, 2011). In 2009, Ridho Prawiro and teams tested the strength of the roots of *Rhizophora apiculata* and generate data mangrove root strength reached 50 Mpa in this case equivalent to the power of high quality concrete. Then in 2010, Arya Brima and teams conducted research on the space of morphological *Rhizophora apiculata* in cultivated area. In the following year, Lisana Shidqina and teams more detailed research on space based Hi-LDA (high, length, diameter, angle) and the comparative figures obtained for the 3D modeling is applied to the roots of mangroves to make human settlements and the angle of each hierarchy mangrove prop roots *Rhizophora apiculata*. Specifically in 2012, Arwita Sari and teams conducted research on *Rhizophora apiculata* maximum volume of space with a triangulation based on GPS and Hi-CaD (high maximum roots, root canopy diameter, and stem diameter). From these studies the measurement data obtained maximum chamber volume mangrove *Rhizophora apiculata*.

However, the researches on *Rhizophora apiculata* maximum chamber volume calculations still ignore the angle formed between two individuals mangrove. Therefore, the need for research related to the proportion of mangrove roots, the distance between two individuals mangroves, and the slope of the trend rate of mangrove roots on the stilt roots especially to be considered in determining the space leveling embodied in the form of a configuration between the mangrove roots.

**SPACE LEVELING**

![Figure 1. Standard Tilt Angle](source: Neufert, 1936)
According to Architect Data Book 3rd Edition belongs Neufert, data obtained on a standard angle of a ladder. This shown in the Figure 1 above. The above data obtained several types of ladders that have a specific tilt angle. Elements forming the ladder includes 2 parts namely the horizontal (flat ground) and vertical sections (foothold to step up). Stair widths for occupancy ranged between 20-33cm and for the vertical parts of the steps it ranged between 15-18 cm to the size emergency stairs usually reaches 20 cm vertical section. Size is also important to note the width of the stairs, to the length or width of the stairs in residential dwelling is at least 90 cm, while for household services typically smaller which is 75 cm.
In this study the standard requires for the stairs outside the room, which is not necessary the handrail. This shown in the Figure 2 below.

![Figure 2. Comparison footing and climbs](source: Neufert, 1936)

The data above obtained several types of stairs with a rise of less than 1: 4 do not required handrail. on the Figure 2, showed the footing maximum is 41 cm and climbs maximum is ± 10 cm for stairs not including the handrail. Step without handrail on Figure 2 very suitable if used in nature place like cultivated area, ecoturism, and enclosure.

**TRIGONOMETRY**

Trigonometry is a part of mathematics that studies the relation between the angles and sides of the sides of a triangle and the basic functions of these relations. Trigonometry as a method of computation to solve problems associated with comparisons on geometry, especially in the wake of the triangle. In principle trigonometry is one of the science related to large angles, which are useful for measuring the height of a place without directly measuring it is more practical and efficient. This shown on the Figure 3 below.

![Figure 3. Trigonometry Method](source: Sudirman, 2005)
The data above obtained several of the triangle trigonometry, then the triangle must have a right angle (90°). Means that no other triangle is a right triangle. Angle unit is radians degrees apart, where one radian is the large corner overlooking the circular arc of length equal to the radius.

**RESEARCH METHOD**

The study of Mangrove *Rhizophora apiculata* as ecotourism development based on Mangrove RhizophoraChitecture (MRaC) was held in Labuhan mangrove forest, Brondong, Lamongan. Field research by survey methods and calculations by trigonometry methods taht aim to get angle between two individuals mangrove *Rhizophora apiculata* accurately. Methods to be used in the study are as follows on the Figure 4 below.

![Figure 4. Hypothesis Method Illustration](image)

Source: Personal analysis, 2011

Methods used in the research was to collect data on *Rhizophora apiculata* in the field based on location, then measured the morphology of *Rhizophora apiculata* in the field included gradient, distance, and angle degree. Manual measurements in the field using the unit (m) on the gradient and distance. While the angle degree using units of degrees. Angle degree measurements were measured using trigonometry methods of data with unknown slope between two individuals of mangroves as well as the base of the lowest stilt roots mangrove highest level with the base of the tallest stilt roots mangrove up with the lowest base stilt roots mangrove. Distance is the length between two individuals mangrove with manually system using the pitch meter.
EMPIRICAL RESULTS

In this section the empirical results for the proposed forward procedure are presented and discussed. This research have done in location Labuhan mangrove forest, Brondong, Lamongan. This shown on Figure 5 below.

![Mapping Mangrove Area](image)

Figure 5. Mapping Mangrove Area
Source: Personal analysis, 2013

Point spread of 35 individual mangrove, in each individual is connected to each other to determine the resulting distance. Mapping mangrove area and the point spread of sampling have done with using the equipment to determine the distribution of mangrove coordinates is GPS (Global Positioning System) Hand Held type. It can get the coordinates of the point where the mangrove *Rhizophora apiculata* accurately. The results of distance used to determine the length of the slope between the stilt roots mangrove with the angle degree both of them. So, the data can be used as a basic reference in determining the function of a foothold. The following data table range is presented in Table 1 and shows the average distance, elevation, angle degree, steam diameter, and gradien.
Table 1. The Condition of Tempe Lake on the Rainy and Dry Season

<table>
<thead>
<tr>
<th>Analis</th>
<th>Min</th>
<th>Max</th>
<th>Varian</th>
<th>Avarage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance (m)</td>
<td>0,47</td>
<td>7,46</td>
<td>2,11</td>
<td>3,25</td>
</tr>
<tr>
<td>Elevation (m)</td>
<td>-0,43</td>
<td>0,70</td>
<td>0,10</td>
<td>-0,02</td>
</tr>
<tr>
<td>Steam (cm)</td>
<td>6,80</td>
<td>19,30</td>
<td>8,77</td>
<td>11,20</td>
</tr>
<tr>
<td>Gradien (m)</td>
<td>0,95</td>
<td>7,46</td>
<td>2,03</td>
<td>3,40</td>
</tr>
</tbody>
</table>

Source: Personal analysis, 2013

The data minimum and maximum elevation above ground Table 1 is a primary data obtained directly by observation in the field. Results of the first output is then used to complete the second output. Elevation data (height difference between the two stilt roots of mangrove trees) is an early reference to determine the space formed by leveling some individual clusters of mangroves.

The following are the three dimensional design visualization from the application this results of research, which are presented in Figure 6 below.

Figure 6. Visualization in 3D of Space Leveling
Source: Personal analysis, 2013
This research can be used in eco-friendly architecture approach that uses a calculation method especially in mangroves. In addition, can also be useful in designing an ideal ecotourism, with the possibility of spaces formed between mangrove roots configuration with the planned development of the region by the district Lamongan.

**CONCLUSION**

Degradation is the key to realizing these ideas in biomaterials residnetial building above configuration mangrove roots. At the configuration has minimum footing elevation is 43 cm and the maximum 70 cm with the distance and slope ratio is 1 : 1. Elevation data and comparison of the data used as a basis for visualizing leveling design in 3D space formed by the configuration of mangrove roots.

**ACKNOWLEDGMENT**

The authors of this paper would like to acknowledge everyone involved in this project; first and foremost to our lecturer, Ir. Murtijas Sulistijowati, MT for her unending support and guidance throughout every part of the study.

**REFERENCES**


Sonny. (2009), *Karakteristik Mangrove,* (http://www.mangrovecentre.or.id-katalog21htm [diakses pada tanggal 9 Oktober 2009]).

Sudirman. (2005), *Cerdas Aktif Matematika,* Ganeca Exact, Jakarta.
RECTORATE BUILDING EXPANSION DESIGN IN SUPPORT OF ITS ECO CAMPUS PRINCIPLES WITH SOLAR ENVELOPE CONCEPT

Satya Wahyuputra Santosa*, I.G.N Antaryama**, Totok Noerwasito**
*) Master Student, Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
**) Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
e-mail: satyasantosa@yahoo.com

ABSTRACT

Technology in 21st century made human life now even easier, the modern industrial era has been growing rapidly, human needs are now starting to peak and deterioration of earth begin to show. The buildings that exist in the world today have started to realize the importance of a sustainable development, including in Indonesia, especially in one of the state universities, namely ITS. ITS is one of the major universities in Indonesia, but the presence of ITS is not supported by the campus building that supports the principles of eco campus. Rectorate building has yet to follow the principles of sustainable development and environmentally friendly. Problems faced today is the excessive use of energy due to the use of large amount of energy for cooling so that the buildings can not meet the energy efficient building standards. "Rectorate building expansion design in support of ITS Eco Campus principles with solar envelope concept" is proposed to solve the problems of sustainable development and environment, this design aims to produce rectorate building with the building envelope that able to generate energy and withstand heat as needed. ITS Eco-Campus will be environmentally friendly and energy efficient. The method used in this design is Designing With Evidence method, (Hamilton 2009). With this method is expected to create rectorate building design concepts and meet the new standards with the use of energy-efficient building envelope which solar energy is used to generate and retain heat.

Keywords: Green Architecture, Office Building, Eco Campus, Solar Envelope.

INTRODUCTION

Since modern times, humans have had technologies that enhance human life, such as machinery and vehicles. This also applies to the building. Sustainable technology and efficient building design helps architects in designing an energy-efficient and
sustainable building, thus leaving minimum carbon footprint and environmentally friendly. Energy efficiency will help the earth in order to sustain life. One campus is already aware about this problem, ITS campus is one of the big campus in Indonesia and has a high record in academic and as well developing the country. Along this journey towards success and a great campus, ITS has a good history, aside from the high record, ITS campus buildings conditions are less concerning to save energy, high electrical energy consumption makes the buildings in ITS is less sustainable, from the eco-campus ITS website obtained the data that the fees paid by ITS is Rp. 500,000,000/month or 6 billion /year. It is equivalent to the electricity consumption of greenhouse gas emissions (GHG) emissions by 3,650,000 kg CO2/year (Yanto, Puri and Assomadi, 2011). Currently ITS campus reform itself to preserving the environment and saving it, today it is expected the campus will be able to reduce its energy consumption. In this rectorate expansion design is focusing in energy efficiency, thus maintaining sustainability, energy efficiency is achieved with generating energy via solar panel, these solar panel is integrated with the building skin, with this solution is expected able to reduce building energy consumption.

METHODS

Methods discusses about stages in the form of design methods. Method that will be use is Designing With Evidence method, (Hamilton 2009). This method use evidence to work on a design, in this design the evidence are studies about solar envelope and solar panel.

In the design process will be divided into a number of processes which will result in a design. According to Zeisel (1984) reveals a design process divided into several stages that form the imaging, presenting, and testing. This method also uses feedback, and thus will form a cyclic process.

According to Zeisel (1984) in the design, there are five characteristics, namely:

1. According to Zeisel, there are three main steps:
   a. Imaging, which which will provide design criteria for the new form.
   b. Presenting is the results of the criteria used for a design.
   c. Testing is evaluation that has been generated using design criteria, is based on the third stage of empirical knowledge or based on existing data.
2. Use of information for design as a catalyst that contained 2 heuristics to perform imaging and as body of knowledge for testing.
3. The process of designing is the process of perfecting a concept (conceptual shift).
4. In the design process which will invariably lead to a region that is certain and which will not change (a domain of acceptable responses).
5. This process of the process in the form of a spiral metaphor always moving so it appears feasible design.
DISCUSSION

Site Location

Figure 2 showing location dan existing condition of rectorate and surrounding environment, explanation are as follows:
1. Picture a and g showing the rectorate main entrance
2. Picture b and f is front parking area and the entrance road to rectorate
3. Picture e is ITS main road to rectorate and other campus area
4. Picture d the location for rectorate building expansion

Existing site conditions of rectorate is a vacant land and adjacent to the rectorate, the vast vacant land is efficient for shading to meet the parameters for energy generation, then the new building must be able to have enough sunlight and good air circulation, for the solar panels able to work well.
The design use parameters for the solar envelope and act as shading, and solar energy generation, thermal insulation or heat retention, aesthetics and characteristic conservation.

**DESIGN PARAMETER**

Parameter that must be fulfilled are as follows:

1. Energy generator:
   a. Optimum angle, for shading and the generation of electrical energy
   b. The area of the panels
   c. The optimum temperature to operate
   d. Direction or orientation of the solar panels optimum

   According to Boni (2012) research, gained several references parameters to energy generator, the parameters are as follows:
   a. The best time to generate electrical energy is in August and September, but not the temperature conditions around these months are not at comfortable temperature, only close to comfort temperature.
   b. Orientation with high winds most often is the axis East-Northeast, Southwest, the orientation of the existing rectorate faces the Southwest and Northeast. This is quite advantageous considering the orientation of the building does not need to be changed, so that the orientation of the front view of the building rectorate does not have to change.
   c. Optimal panel tilt angle is 25°
   d. Operation of solar panels may reduced by the high temperatures that affect the performance of solar panels, but temperature around 50°C and 75°C the performance may dropped dramatically.

2. Heat Retention

   According to Gonzalo (2006), the heat radiation can be reduced in various ways:
   a. Direction of the sun and sunpath
   b. Design of the window glass
   c. Using sunshades on building

   The position of the panel will be placed on each floor of the building, the position of the solar panels provide shade to the room exposed to direct sunlight, shading provided by the solar panels have a limited area of shading, thus design of the building shape have to follow the shading provided from the solar cells.

3. Aesthetics

   Sustainable aesthetics which is explained by Douglas (2008), sustainable aesthetics is considered able to fit with the design, these aesthetics are:
   a. Represent a practical architectural philosophy
   b. Use sustainability as a concept generator
   c. Create universally specific solutions to local site forces

   Design should be applied to the understanding that architecture is a building that is functional, usable, or practical, second, the concept of sustainable act as a generator for the architecture concept, the concept of sustainability is a
concept that is used in buildings, such as the re-use of rain water, energy and material efficiency, and so on, the third is to create a solution of a specific solution or a specific design for a design problem that requires a specific solution.

4. Conservation for Existing Rectorate

The existing rectorate has its own characteristics, and conserving this characteristic is must, because rectorate in ITS has already became an icon for ITS, thus this encouraged the new rectorate to blend in with the characteristics of the existing building. Preserving old or historical building can be done in a few ways, whether to rebuild or add a new architecture which could be more beautiful. According to Foster (1999) in conversation about the new Reichstag design,

“What do you preserve or reveal? Maybe you can add something of today which is even more beautiful. The sense awareness of history is often heightened by the context of the new. Many of these judgements are essentially aesthetic.”

The history and the iconic status of existing rectorate will be the catalyst for the design, style and characteristics is the main parameter for conservation.

The position of the solar panel is also influenced by winds which cools solar panels in order to work and generate electrical energy optimally. Cavity ventilation on each solar panel acts as a passive cooling, this ventilation helps in cooling solar panels that must be kept as cool as possible, the panel surface in the humid tropics area can reach 50.1°C according to Boni (2012) research, the solar panel surface temperature increase should be kept as low as possible, cooling the solar panels can be done with airflow for the humid tropics area as suggested by Stulz (1980).

The solar panels energy production should meet the minimum requirement for the rectorate which is approximately 50% of the total electricity needs of the rectorate office, this according to ISO 6197.2 which stated that office lighting needs is estimated around 15 Watt/m². The solar panels that are going to use must be able to generate about 100 watts of power per hour.

**Table 1. Design Parameter**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter criteria</th>
<th>Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Energy generator</td>
<td>Optimum angle for the solar panel is 25°</td>
<td>25° angle is used for solar panel integrated with the building</td>
</tr>
<tr>
<td></td>
<td>Minimum energy requirement according to SNI 6197.2 is 15watt/m² for lighting. Total watt needed is 46,800 watt, at least 50% must be fulfilled</td>
<td>Numbers of panels solar panels required is 174 pieces, however with the vast area of the roof, the solar panels integrated with the building is able to exceed 174 pieces, thus giving an advantage in generating more power</td>
</tr>
<tr>
<td></td>
<td>Optimum operation for solar panel is 25° C</td>
<td>Utilizes the wind for cooling, thus the orientation of the building facing the southwest and northeast, and each panels separated to optimise cooling.</td>
</tr>
</tbody>
</table>
Parameter | Parameter criteria | Concept
--- | --- | ---
Optimum orientation for solar panel | Solar panels positioned at southwest and northwest, following the sun path to maximize sun exposure
Surabaya common wind direction is southwest and northeast | Mass of the building following the optimum orientation of the southwest and northeast

2. Heat Retention
Use overhangs on each window
Use double glazing or window glass double
Use jalousie on the outside of the window

Overhangs and jalousie used the on each window for heat retention.
Jalousie and overhangs collaborated with the solar panels.

3. Aesthetics
1. Represent a practical architectural philosophy
2. Use sustainability as a concept generator
3. Create universally specific solutions to local site forces

Using solar envelope as concept generator, this concept will represent a practical architecture that able to fulfilled the needs for energy.

4. Conservation
Characteristic and history conservation.

Style and character from the existing rectorate are used for the new rectorate, this means using tropical architecture style with solar envelope as shading from tropical sun

Solar Envelope Design

The design of the solar envelope is divided into two, namely to design energy generation and heat resistant. The design of energy generation is the solution to the energy problem by using solar panels, this design focuses on the use or integration of solar panels on the building, solar panels have a specific design that must be met, including the solar panel orientation, tilt angle, and the minimum area for the cooling panels.

The design for energy generation in the rector building integrated on the left and the right building, the direction of the wind that is coming from southeast and southwest which affect the integration of solar panels at the most optimal area it is on the side of the building, and this side of the building is the longest side exposed sunlight, parameter solar panels can work optimally, the integration of solar panels on the roof is also integrated with solar panels, the roof has an area that can accommodate solar panels with a large number, the orientation of the solar panels on the roof is divided into two orientations southeast and southwest, following the orientation of panel solar on the side of the building.
Figure 3. Solar Envelope design

Figure 3 shows solar panel position, aside from generating energy the solar panels also able to act as shading for the building. Solar panels on the side of the building only works effectively at sunrise until noon, because the vertical arrangement of solar panels this cause shadowing on other panels lower, therefore the role of the solar panels that replaced with an integrated solar panel on the roof.

Figure 4. Building Perspective

Figure 4 shows roof perspective, integration of solar panels with visible arrangement of lined up solar panels, roof as solar harvesting areas, this are is very effective for generating electricity, the position of the panel on the roof also have a very good ventilation for cooling well as free from the masses that block or reduce the wind speed required for cooling.

Figure 5. Solar panels
Building Design

The building design is affected by sustainable aesthetics and preservation. Shape of the rectorate is the result of all the parameters which used later after elaborated with aesthetic parameters, this aesthetic act as producers form. Sustainable aesthetics consists of three, using the understanding that architecture is a building that can be used or functional, sustainable concepts which act as producers concepts used for building forms, and used a specific solution to a specific problem in the design is a factor that must be explored to produce a form, in this case the solar envelope.

The concept of solar envelope is producing a form that plays a major role for the aesthetics of the building, this deals with a problem that should be solved with a specific solution of the issue of energy which is then solved by the solution concept of the solar envelope, the aesthetics of the building are the results earned from the use of and retaining heat energy generation which is then after elaborated with the functional architecture of a building and is able to solve the energy problem.

Preservation acts as the reference for the design to conserve existing rectorate and its style.
Figure 8. Human eye perspectives

Figure 9. Entrance area perspectives

Figure 10. Bird eye view

On figure 7 to 11 shows the design result with solar envelope concept.

Figure 11. Front Entrance perspectives
CONCLUSION

This design shows that the use of solar panels for solar building shell or envelope is effective enough to generate electricity, the result shows that is 81,900 watts per hour is generated while the basic needs for lighting 46,800 watts per hour, the electricity generated is not only able to used for lighting, but can also be used for other needs and other buildings around the rectorate. The conclusion of this design is that the design of the building should be designed to form a sloping mass, so that the entire integrated solar panels on the building is able to get enough sunlight to operate, this is the requirement from the solar panels parameters, and each parameters on this design is influencing each others, the solar panels parameters is influenced by the heat retaintion parameters because the needs of heat retaintion each panels has to give extensive shading to windows, thus this kind of interaction on each parameters must be solve with optimazation. Roof design is also affecting the ability to integrate solar panels with the building, this rectorate for example, the solar panels on each side of the building unable to integrate solar panels in large numbers, this cause optimization for integration of solar panels on the roof.

REFERENCES

DESIGNING WITH VERANDA IN JAVANESE ARCHITECTURE

Mohamad Muqoffa
Department of Architecture, Sebelas Maret University, Surakarta, Indonesia
e-mail: mmuqoffa@yahoo.com

ABSTRACT
The traditional architecture in Indonesia has been implementing local wisdom or genius loci to sustain their both tradition and built environment. In contrast, the modernity and global paradigm reduce the local paradigm. In fact, most traditional/vernacular built environment has many potential aspects, such as design of roof, building material etc. Omah Laweyanan has implemented some elements of building which refer to ecological architecture. Those are design of roof, doors and windows, and yard of house [open space] and veranda. The doors and windows have shape and size which cross ventilation be done.

This paper consist of discussion that veranda are an approach and design strategy in Jawanese Architecture, which they can sustain the environment. This paper will focus on omah Laweyanan in Surakarta. According to field study, it shows that veranda in omah Laweyanan is an alternative that attempts to minimized the impact of global warming and climate change, which can be developed through the implementation in architecture design.

Keywords: design of roof, doors and windows, veranda, omah Laweyanan

INTRODUCTION
Javanese Architecture has developed appropriate in cultural change and their needs change, particularly related to community factors. As it developed in Surakarta, where there is an area that have houses and adapting Java Architecture refers to the elements of European Architecture. The district known as Laweyan, a district that is culturally include some three areas (Bumi, Sondakan, and Laweyan). The administration is used to refer to a village and sub-district at the same time (see Figure 1).

There are some houses which identified as Javanese Houses. That house consist of Javanese Architecture spatial system e.g. pendhapa, dalem, senthong, gandok. In contras, that house has a European Architecture Style (Art Deco, Gothic, and so on), as in Figure 2. It is almost certain that these houses have a spatial system
called *pendhapa* that in the context of other architectures is a veranda (porch). The veranda is technically able to reduce the heat so as to provide thermal comfort for the occupants.

![Figure 1. Location of Laweyan District](source: field survey, 2011)

**RESEARCH METHODS**

This paper is based on field research to investigate the old houses that have specific architectural appearance (style). According to *omah* (house) Laweyan in contemporary context, then be organized a field research, further examination in more detail. Research sample has chosen by purposive method as representing three sub areas (Bumi, Laweyan, and Sondakan). *Omah* (house) Laweyan as sample has investigated by using descriptive qualitative method. This attempt associated with
the architectural sustainable context. The data are spatial system, building orientation, roof elements, materials and wall elements.

<table>
<thead>
<tr>
<th>Bumi Area</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Bumi Area 1" /></td>
<td><img src="image2" alt="Bumi Area 2" /></td>
</tr>
<tr>
<td><img src="image3" alt="Bumi Area 3" /></td>
<td><img src="image4" alt="Bumi Area 4" /></td>
</tr>
<tr>
<td><img src="image5" alt="Bumi Area 5" /></td>
<td><img src="image6" alt="Bumi Area 6" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Laweyan Area</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image7" alt="Laweyan Area 1" /></td>
<td><img src="image8" alt="Laweyan Area 2" /></td>
</tr>
<tr>
<td><img src="image9" alt="Laweyan Area 3" /></td>
<td><img src="image10" alt="Laweyan Area 4" /></td>
</tr>
<tr>
<td><img src="image11" alt="Laweyan Area 5" /></td>
<td><img src="image12" alt="Laweyan Area 6" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sondakan Area</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image13" alt="Sondakan Area 1" /></td>
<td><img src="image14" alt="Sondakan Area 2" /></td>
</tr>
<tr>
<td><img src="image15" alt="Sondakan Area 3" /></td>
<td><img src="image16" alt="Sondakan Area 4" /></td>
</tr>
<tr>
<td><img src="image17" alt="Sondakan Area 5" /></td>
<td><img src="image18" alt="Sondakan Area 6" /></td>
</tr>
</tbody>
</table>

**Figure 2.** Typology of *Omah* Laweyan.  
Source: field survey, 2011
RESULTS AND DISCUSSION

Laweyan is an area in Surakarta has a long history, even before the town of Surakarta established. The historical record makes Laweyan have physical evidence (legacy) architecture that can be seen to this day.

The history of Laweyan is inseparable from the history of Great Mataram, well when put up period (17th century) as well as when standing in Kartasura (1730-1743), and moved to the village last moment Sala (Surakarta Hadiningrat-1745). In the historical context of Javanese Mataram (Kasunanan Keraton Surakarta) Laweyan well known as a province with special status (perdikan area), the meaning is Laweyan have opportunities to grow without being bound by Sunan, or in other words have specific authority to develop territory. Position as the implications on the physical footprint of the house is located in Laweyan. Exist in the home building Laweyan have different appearance (typical) compared to other houses in the other village.

Form of Laweyan house can be grouped into three typologies, namely: house building that has existed as Javanese Architecture, a house that has existed between the architecture hybrid Javanese Architecture and European Architecture, and the house has existed as Modern Architecture building. Java Architecture house is still there several buildings, with not too mani cured condition. The houses are a feature of the home that is inherent Laweyan mixture Java Architecture and European Architecture. In general, the condition of the houses are well maintained, and still occupied or used for specific functions. This house typology further into Architecture Laweyan (omah Laweyan).

In this paper will discuss the houses that represent the three areas, Bumi, Laweyan and Sondakan.

Figure 3. Plan of typology of omah Laweyan.
Source: field survey, 2011
Case 1.
In the first case (Figure 5): the house is located in the Bumi district (kelurahan), where it is still used as a residence, while batik activities are not carried out. The front and side of house as semi-public domain, it called verandah. In verandah, inhabitant doing some semi public activities. That is transition area which can reduce thermal. In this section made possible reduction of heat, so the temperature in the house to be comfort. While the shape and size of the roof is quite a relief and allow large residential shelter system that cause indoor air temperature (microclimate) more comfort.

Case 2.
The case of a second house (Figure 6), is located in the Laweyan district (kelurahan), where the condition is still well populated. This house which located faces south is situated on the rear of the other house. Concerning this spatial usage, the inhabitant usually doing their habitual activities such as reading. In science building context, this house has the ability to make the temperature inside the house (microclimate) quite comfortably.

Case 3.
Compared to the former omah cases, which consists of multi pavilion, this omah has a quite simple house. In the third case (Figure 7), the condition is no different: it has monetary affairs and building components that can condition the thermal factors in the home remains comfortable. Using some parts of their house for producing batik, they employed a couple of dozen workers until the factory closed down in the late 1970s due to the coming of printing technique batik.

Figure 4. Aaxonometry of typology of omah Laweyan.
Source: field survey, 2011
Figure 5. Omah (house) Laweyan as case 1
Source: field survey, 2011
Figure 6. *Omah* (house) Laweyan as case 2
Source: field survey, 2011
CONCLUSIONS

Most of *omah* Laweyan have called veranda (the porch of the house), which be used to serves the guests, or other semi-public activities. Omah Laweyan also technically capable of making the house a thermally comfortable, so it can be a cause *omah* Laweyan architecture capable of adapting to internal factors (the changing needs of occupants) and external factors (climate change).
REFERENCES


THE ROLE OF HOUSING’S REAR WALL AS GENERATING WIND VELOCITY IN NIGHTTIME ON HUMID TROPIC

Ima Defiana *)
*) Architecture Department, Institute Technology of Sepuluh Nopember Surabaya
e-mail: imadefiana@yahoo.com

ABSTRACT

Ventilation is one aspect in the discussion of green design. In humid tropical area, ventilation is a strategy to expand passive thermal comfort zone. On the nighttime wind velocity is lower than the day, it causes problems in humid tropical area. However, the occupants lean on wind velocity for physiological cooling.

In this research, simulation was used as a method to achieve research goals, which examines the role of the rear’s wall of housing in order to generate wind velocity. CFD Fluent was used as a tool to predict the wind velocity at nighttime in housing backyard.

The research results show that rear’s wall in the backyard has role to increase wind velocity at nighttime. Wind velocity increase significant which could accommodate the needs of physiological cooling at nighttime.

Keywords: backyard, simulation methods, physiological cooling

INTRODUCTION

Energy saving is a global issue today in various countries. It has needed to reduce carbon emissions. One of the factors that affect the global temperature rising is carbon emissions.

The building is considered as a contributor of carbon emissions significantly. It is shown that the building uses energy more than energy for transportation etc. Building uses energy to operate the systems. It uses 60% of electricity, 40% of another electricity and 20% of water consumption (Wigginton and Harris, 2002; Jamar, 2006). The energy used which are intended to fulfill the thermal comfort.

Ventilation is one aspect of green building strategies (Yudelson, 2007). According to Lechner (2009) and Szokolay (2004) ventilation distinguished on daytime ventilation and night ventilation. In this paper, night ventilation on humid tropics refers to applied opening windows in nighttime. In contrast to previous studies which refer to aspects of night ventilation of thermal mass discussion.

In humid tropics comfort ventilation is an expansion thermal comfort zone by providing wind flow. Application of natural ventilation in buildings would support...
green design strategies. Availability of wind flow could increase thermal comfort is called physiological cooling (Szokolay, 2004).

Physiological cooling are necessary in the humid tropics, due to the humidity has always above of comfort zone, approximately in the range of 80-95%. High relative humidity often makes people uncomfortable. The existence of the wind flow could reduce humidity and support physiological cooling. However, the wind velocity is relatively low for a time period during the nighttime. Although at nighttime the wind velocity available is lower than during the day, it is still needed by the occupants in the room to reduce humidity in humid tropics.

The previous studies show that the distance between buildings affect the wind velocity in the building (Oke, 1988; Givoni, 1998). The distance between buildings also affects indoor wind velocity. On residential buildings, the distance between the front of building and back of building gives availability of house yard. Studies of distance between buildings on the front (front yard) as aspects discussion has a lot to do. Aspects backyard discussion could provide a flow of wind at night is rarely done. Backyard becomes an important aspect to provide opportunity of wind flow at nighttime when bedroom’s window orientates to the backyard. This research focuses on the role of housing’s rear wall in the backyard as generating wind velocity in the nighttime on humid tropic.

**METHOD AND MATERIALS**

**Method approach**

CFD FLUENT was used as tool to predict outdoor wind velocity in backyard of housing. Cheong (2003), Posner (2003) also Stamou and Katsiris (2006) states that the CFD has the ability to predict fluid flow in 2D and 3D models on the steady-state condition. The modelling simulation was assumed using a standard k-Ɛ rans in turbulence model.

According to the previous studies, this research applied double precision (dp), the Reynolds averaged Navier Stokes equations (rans) and the standard turbulence models k-Ɛ (ske) on steady state conditions to predict out door wind velocity in the backyard. This equation has been widely used by previous studies such as Evola and Popov (2006), Chan et al (2003), and Parra et al (2010).

**Climate Analysis**

One of the inputs required in CFD simulation is the climatic data. Therefore we need a climate analysis. In addition to the input data, climate analysis is used to determine the hottest month in the last 10 years. A critical point in climate analysis on nighttime ventilation is the hottest month. In the hottest month where the need wind velocity for physiological cooling at nighttime reached its peak.

In the span of last 10 years (2000-2009), the Bureau of Meteorological, Climatological and Geophysical (BMKG) data Surabaya shows that July is the coldest month and November is the hottest month. Wind velocity in July (the coldest
month) is higher than in November (the hottest month). In November, highest of wind velocity during the 24-hour period occurred between 02.00 p.m-04.00 p.m, while the lowest occurred in 01.00 a.m – 03.00 a.m. After that time, wind velocity have increased again until noon. In period which the occupants start to close the window at 05.00 p.m, the out side wind velocity is still quite large (3.96 m/s). It has potential to remove internal heat load to the outside building with the convection process, especially at 05.00 p.m to 10.00 p.m. In that period the peak of internal heat gain, due to timelag of building envelope material, the use of electronics and the lighting in the room.

**Housing Pattern in Indonesia**

Provision of housing can be divided into two sectors, namely informal and formal. The formal sector such as real estate. Street pattern in the realestate are generally grouped into straight, cul de sac and loop (Kwanda, 2000). The order of typology commonly applied in Indonesia realestate is grid pattern. The grid pattern will receive a perpendicular wind or parallel wind to the building (Defiana, 2012).

**Experiment Design**

In this study, the period of utilization of nighttime ventilation are 05.00 p.m to 06.00 a.m. This period was chosen because at the time the occupants generally often close the window.

Outdoor simulations performed at 01.00 a.m and 05.00 p.m have aim to identify trends of wind velocity that occurs at a certain time period. At 01.00 a.m. the wind has the lowest velocity. 05.00 p.m was selected because at that time, the occupants tend to close the window although the outside wind velocity is still quite large.

This study takes two types of models commonly applied in Indonesia. The first, building has tendency to receive perpendicular wind to the building. The second, building receive the parallel wind to the building (see fig. 1). Simulation used 2-storey residential model which have front yard and back yard. 2 storey residential models designed to accommodate the needs of inhabited space after more than 5 years.

![Figure 1. Position model on wind direction at site plan](source: Defiana, Ekasiswi and Satwiko 2011)
Physiological Cooling Indicator

Wind velocity indicator is required for physiological cooling refers to the Macfarlane in Aynsley (1990, 2007). Comfortable humidity around 60%, each 10% increase of humidity will raise 0.88K temperature of comfort zone. When temperature raise around 0.55K from comfort zone, required wind velocity 0.15 m/s to provide physiological cooling. Comfort zone for occupants in warm humid tropic is 25.9°C-28.6°C.

RESULT AND DISCUSSIONS

Rear’s Wall at Backyards on Existing Condition

In general, housing in Indonesia has a rear’s wall in the backyard. Rear’s wall or fence has function as ownership limits footprint. The characteristic of rear’s wall is solid wall. In existing design of housing has a gap between the site boundary wall to the outer building wall. The distance can create an open space in the backyard as shown in figure 2.

![Figure 2. Existing design of housing](image)

The building changes after inhabited by more than 5 years. It was developing horizontally towards the backyard. The horizontal residential development results in the loss of backyard (see figure 3).

![Figure 3. Building after inhabited more than 5 years](image)
Results of simulation on 05.00 p.m show wind velocity in backyard is 0.288 m/s (Defiana, 2012). This is different when building horizontally developments. Wind velocity could not able to reach up to the back. This condition is caused no pressure difference between the outdoor space at the front and the outdoor space at the back side. The pressure difference is one of the mechanisms that was important to create wind flow. In order to achieve physiological cooling and fulfill need of space, housing proposes vertically development and making rear’s wall as porous wall.

**Design proposed of rear’s wall in backyard**

One of factors that support the achievement of physiological cooling for occupants is cross ventilation. Cross ventilation requires openings connected to the open space. This study proposes changes in the characteristics of the massive wall being porous wall. Changing in these characteristics create an open space in back side behind the wider. It means that the distance between the buildings becomes wider. Post occupied after more than 5 years, housing should be vertically developing or becoming two-storey building (see figure 4).

![Porous wall in backyard](source:Defiana, 2012)

**Figure 4.** Porous wall in back yard as rear’s wall between housing

a. Illustration of 2 dimension (2D) porous wall in backyard

b. Illustration of 3 dimension (3D) porous wall in backyard
The existence of open space at the back side allows the wind flow due to the pressure difference. Pressures difference factors is an opportunity that allows the wind flow into the indoor space, especially for the humid tropics.

**Effect of Rear’s Wall in Backyard of Building**

This study describes the importance of a outdoor space so that wind velocity available at nighttime. Wind velocity at nighttime is very necessary in order to provide a physiological cooling. It is necessary that at the nighttime wind velocity tend to be lower in the humid tropics. This study proposes a porous wall in the backyard to make available sufficient wind velocity at the back side of the building.

Rear’s wall in the backyard becomes an important aspect to provide outdoor space in back side. It relates to the goals which put openings of orientate to the backyard. One is a bedroom, because its have a high occupancy range (Antaryama and Ekasiwi, 2006). Therefore the backyard was conditioned to receive wind velocity required for physiological cooling at nighttime.

Simulations used two different sites in accordance with wind orientation dominant. Simulation results are shown in figure 5 using a minimum wind velocity input. Minimum wind velocity occurred at 01:00 a.m to 02:00 a.m. Input of wind velocity is 1.55 m/s. Site 1 obtain dominant perpendicular wind to the building while site 2 obtain dominant parallel wind to the building. Simulation results on two different sites show expected results of wind velocity that support physiological cooling (Figure 5).
If we compare with the existing condition to the development plan show significant increasing of wind velocity is about 100-170%. This suggests that maintaining open space in the backyard and change the massive wall being porous wall, wind velocity can increase significantly. Increasing of wind velocity significantly can support the utilization of nighttime ventilation in the humid tropics. Utilization of nighttime ventilation in the humid tropics occur with pressure difference mechanism.

Available wind velocity in the backyard at nighttime indicates to support the fulfillment of physiological cooling. The air temperature in the period still in the comfort zone, approximately 26.0°C. However, wind velocity is needed to lower the humidity level, particularly when humidity is above 83% (Defiana, 2012).
CONCLUSIONS

In the nighttime, humidity is always above the comfort zone. The occupant in humid tropics need wind velocity to restore humidity and fulfill the comfort zone. Availability of wind velocity indicated capable to fulfill physiological cooling when considering aspects of the rear’s wall in backyard and also considering the distance on the backyard. Distance on the backyard create an open space that encourage pressure difference mechanism.

Aspects of rear’s wall in the backyard and conditioned porous could increase wind velocity up to 100-170% compared to its previous condition. Increase in wind velocity occur in parallel wind to buildings and winds perpendicular to building.

REFERENCES

Givoni, Baruch (1998), Climate consideration in building and urban design, Van Nostrand Reinhold, USA

Lechner, Norberg (2009), Heating, cooling, lighting. Sustainable design methods for architects. John Wiley and sons, Canada

Oke, TR (1988), ‘Street design and urban canopy layer climate’, *Energy and Building* 11 (103-113), www.science direct, 27 April 2011, pk. 08.15


Wigginton, Michael; Harris, Jude (2002), *Intelligent Skins*, Architectural Press, Burlinton MA.

This page intentionally left blank
SPATIAL CONTROL TO REDUCE URBAN HEAT ISLAND EFFECT IN URBAN HOUSING

Nurrahmi Kartikawati*, Arif Kusumawanto**
*) Department of Architecture and Planning Gadjah Mada University, Indonesia
**) Department of Architecture and Planning Gadjah Mada University, Indonesia
e-mail: elnajma@gmail.com, kusumawanto@gmail.com

ABSTRACT

As the world’s critical issue is global warming, the built environment has to be designed to reduce global warming effects, such as urban heat islands. A large building coverage with small amount of vegetation tends to produce an urban heat island effect. Some urban housing has typical spatial character that triggers such an effect. Some physical aspects give significant contributions to urban heat island effects, such as space configuration, vegetation and land coverage. The influences of these aspects can be examined by simulation. Because of heritage preservation regulations, some urban housing such as Kauman Jogjakarta can’t be redesigned by changing its main buildings. Therefore, space configuration changing in a simulation can help to explore the influence of space configuration on thermal comfort. Choosing the right material type to cover the ground will give a good contribution to reduce temperature. The presence of vegetation of various types can reduce overheating. Some types of vegetation give a big contribution to reduce temperature. As the material study, choosing the right type of vegetation can reduce temperature and increase microclimate comfort. Plants with high density foliage give better contribution to microclimate comfort. High leaf-density plants in existing area were planted with various configurations. The existing space configuration as rectangular street pattern gives better microclimate condition than a random pattern. Urban heat island effects in urban housing can be reduced by controlling urban housing space in terms of three main factors: land coverage, vegetation and space configuration.

Keywords: urban housing, spatial control, urban heat island

INTRODUCTION

Nowdays, global warming is the crucial issue, which has wide effects on human life and environment. It is caused by high pollution in the atmosphere, CO₂ emissions from fossil fuels in energy consumption of various fields. Buildings take a large of
part in fossil energy consumption to ensure comfortable conditions inside and around the buildings.

The amount of solar radiation absorbed and reflected back by land coverage affects the temperature. The region with land coverage that easily absorbs the solar heat, tends to increase the temperature and create the phenomenon known as the ‘urban heat island’. As a result, the energy requirements for air conditioning in buildings in the area are increased (Tursilowati, 2008).

Since the rapid development of built environments around the world, planning and designing of such developments need to be considered in relation to environmental preservation, to avoid or at least reduce urban heat island effects. Urban housing is a built environment which tends to experience urban heat island effects. By controlling some spatial aspects, the increasing temperature in urban heat islands can be reduced.

Kauman Jogjakarta is an urban housing region in the center of Jogjakarta. Its spatial characters trigger urban heat island effect which has uncomfortable microclimatic condition. In the other side, Kauman is a heritage region, it has precious historical values. Related to heritage regulation, all kinds of physical renovations of this region must be allowed by government and obey the regulation. The problems to be explored in this theme are:
1. What physical factors influence microclimatic conditions in urban housing
2. How to reduce urban heat island effects in urban housing area

THEORY AND METHOD

Thermal Comfort

ISO 7730:1994, thermal comfort standard refers to Fanger, comfort is influenced by:
1. Air temperature
2. Mean Radiant Temperature
3. Relative Humidity
4. Air velocity

Other factors are metabolism and clothing type. (Karyono, 2001 and Sugini, 2004). According to SNI T14-1993-03, in Kusumawanto, 2005, thermal comfort in Indonesia can be specified in terms of effective temperature as:
- Cool mild comfort (20,5-22,8°C ET)
- Comfortable optimum (22,8-25,8°C ET)
- Warm comfort (25,8-27,1°C ET)

Urban Heat Island

Urban heat island is certain urban area which has higher surface temperature than other surrounding areas. Releasing of air conditioner energy system, energy emission of industrial activities, transportation machine, difference amount of land coverage and difference amount of heat capacity of building material with natural
material. Urban heat island implies to air pollutant movement, influence bioclimatic condition, heating and cooling. (Tursilowati, 2008).

Microclimate of Urban Housing

According to Golany, 1996, there are some aspects to be concerned on designing urban housing, such as:
1. Street orientation
   Grid system street orientation will enhance air circulation into region.
2. Street width
   In tropical humid climate, a wide street enhance urban ventilation but needs a lot of shading because of big absorbance of sunlight. Sunlight radiation increases on the asphalt surface and decreases when stone or cement is used.
3. Vegetation
   Trees absorb dust and pollutant, decrease noise, sunlight radiation effect, albedo, and build shading area. Vegetation type and its density influence urban thermal comfort, wind velocity and relative humidity.
4. Evapotranspiration
   Evapotranspiration increase relative humidity and decrease air temperature while the environment become warmer and its relative humidity is low. Vegetation absorb radiation and functioned as wind breaker.

Wonorahardjo, 2007, the main physical factors of built environment are:
1. The changing of natural land coverage by artificial land coverage, buildings and other infrastructures.
2. The decreasing plants can cause the decreasing of natural cooling effect from shading and transpiration of soil water and leafs (evapotranspiration)
3. Increasing of buildings causing narrow roads which trap the heat and air velocity (geometry effect)
4. Increasing of heat waste from machines of vehicles, factory and air conditioner also other human activities causing increasing of environment heat and make worse anthropogenic effect.
5. Increasing of air pollution causing the green house gas in the atmosphere.

Jusuf and Hien, 2009, physical factors of built environment influence microclimatic condition such as wall surface, land coverage area, ratio of building height average and building areas, vegetation, sky view factor and albedo of built environment surface areas.

Vegetation

Shading is an important aspect influencing microclimatic comfort. Ideally, each building is designed by adopting shading as an architectural aspect. Plant as a shading in outdoor area can reduce sun radiation almost all the year (Lechner, 2007).

Plants have a big influence in microclimatic condition. Loures et all, 2007, in Panagopoulos, 2008, plants have some benefits such as oxigen sources, reducing
noise, refresh the air, controlling microclimatic condition, preserving soil and water, preserving bio diversity, increasing humidity, decreasing thermal stress, increasing local air velocity, recreation, cultural, social and increasing living quality.

Plants reducing surrounding temperatures by shading the soil, therefore the sun radiation is less on the soil surface and less heat adsorbed, the rest radiation is reflected back to the atmosphere (Panagopoulos, 2008).

The temperature difference between shaded soil surface and without shading, showed significant level. In summer, the soil surface beneath olive trees had 11°C lower than plain soil surfaces. In winter, the soil surface beneath olive trees is warmer 4°C than the plain soil surfaces. The trees can decrease microclimatic temperature and also control surrounding temperature. (Panagopoulos 2007, in Panagopoulos, 2008). The light colored roof and land coverage and also trees shade influence energy saving directly or indirectly (Rosenfeld, 2001, in Panagopoulos, 2008).

Green roof with vegetation planted surface increase ecosystem performance in urban areas include increasing of water storm management, better building temperature regulation, decreasing of urban heat effect and increasing of biological habitat in urban areas. In cold climate areas, green roof is filter and save water storm on site. (Panagopoulos, 2008)

Spatial Configuration

According to Toudert and Mayer, 2007, outdoor thermal comfort is influenced by ratio of circulation width and building height and circulation orientation. Other aspects are arrangement of supporting elements, such as vegetation arrangement, additional shading, etc.

Golany, 1996, urban ventilation in tropical humid climate needs air velocity and urban ventilation to reduce urban temperature. So it is important for urban areas to receive a lot of air or wind into site. Street grid system supports air penetration deep into the region. In the other side, blocked streets slow air penetration into the region.

Land Coverage

Cool Pavement Report, 2005, material for land coverage characters consist of:
1. Albedo
   Albedo is averaged solar reflectance on material surface to reflect the sun radiation to the atmosphere. The dark colored surface has lower albedo, that adsorb the sun radiation more than the light colored surface.
2. Permeability
   Permeability is material ability to be water passed as well as its porosity condition. The material with high permeability and porosity is well water passed and less to transfer the heat inside and around the material.
3. Conductivity
   Conductivity is material ability to conduct or adsorb heat from the surface into the material. Material with high conductivity tend to increase the surface temperature
faster. Otherwise, material with low conductivity increasing the surface temperature slower.

4. Emissivity
Emissivity is material ability to radiate the heat inside the material out to the surrounding. Material with high emissivity tends to increase the surrounding temperature faster.

5. Thickness
The material has its effective thickness which can be cooler faster. Too thin material can be warm faster or too thick material can adsorb the heat.

6. Convective airflow
The material porosity condition influence the convective airflow inside and around the material. The more porosity of material means the more permeable material, the convective airflow inside and around the material is better.

**Research Method Approach**

Research method approach is experimental method by simulation to know optimalization of thermal comfort in Kauman. Groat and Wang, 2002, by changing variable in controlled setting, an interaction of a variable to another variable can be observed. Experimental research tends to be supported by numerical data than narrative one. This research is done by three steps of experimental plan, refers to Ghozali, 2008, about experimental research design, such a table below:

<table>
<thead>
<tr>
<th>Table 1. Experimental Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation (V)</td>
</tr>
<tr>
<td>Space configuration (C)</td>
</tr>
<tr>
<td>Material (M)</td>
</tr>
</tbody>
</table>

Vegetation is modified by adding trees T1 (shady crown, 10 m) and T2 (shady crown, 15 m) types. Existing’s space configuration is modified by grid system circulation pattern and material is modified by replacing existing’s land coverage with light-colored brick stone (yellow, in Envimet simulation).

1. Collecting Data Method
Collecting data method by interviewing structurally (purposivesampling), spatial datas and thermal measurement in typical spaces.

2. Data Analising Method
Measurable data is analised by PMV calculator and spatial data is analised byEnvimet 3.1.

3. Research Variable
Research variables are measurable variable, subjective variable and spatial variable. Measurable variables are temperature (°C), relative humidity (%), Mean Radiant Temperature (°C) and wind velocity (m/s). Subjective variable is thermal
perception of users, spatial variables are land coverage, vegetation presence and spatial configuration.

4. Research Border
This research is limited to Kauman Jogyakarta area with the main focus in urban housing. Result and discussion focuses are interview result, thermal measuring result, physical aspect and modification result in optimalization of thermal comfort.

5. Research Locus
Kampung Kauman Jogyakarta lies in Kelurahan Ngupasan, Kecamatan Gondomanan, Jogjakarta City. Its building coverage is approximately 80%. Kauman had average temperature 28°C in 2009 and its area is about 192,000 meters square (Maslucha, 2009).

Existing thermal condition can be seen at the figure below:

![Figure 1. Average Temperature](image)

**Figure 1.** Average Temperature
Source: field survey

The existing condition results average temperature as figure above. Mostly, the average temperatures are not in comfortable range or out of maximum temperature 27.1°C, according to SNI T14-1993-03 or ISO 7730:1994. The average temperature showed the microclimate condition in the area. The microclimate condition is uncomfortable and tends to be warm and hot. Interview result shows the same condition thermal comfort which is uncomfortable, tends to be warm and hot.

![Figure 2. Thermal Perception](image)

**Figure 2.** Thermal Perception
Source: survey
As the typical condition of urban housing area, Kauman existing condition can be seen on the figure 3. The dark green color showed the presence of shady crown trees T1 (15 m) and the light green color showed the T2 shady crown trees (10 m). The brightest green color showed grass (gg).

Mostly, existing condition is covered by artificial land coverage which can absorb heat easily. The vegetations are on the east side and some of open space among the buildings. The solid area is cover most of existing. Circulation lines are shown as light grey space among the buildings with various pattern.

![Concrete, Sandy soil, Dark stone, Natural soil](image)

**Figure 3.** Existing’s condition in Envimet v 3.1
Source: Envimet v 3.1 simulation

![Figure 4. Existing Simulation Result. (a) Simulation result of existing temperature at 12.00 (b) Simulation result of existing wind speed at 12.00](image)

**Figure 4.** Existing Simulation Result. (a) Simulation result of existing temperature at 12.00 (b) Simulation result of existing wind speed at 12.00

The existing temperature and wind speed at 12.00 are showed in figure above.
RESULT AND DISCUSSION

The Experimental Modification and Simulation Result

<table>
<thead>
<tr>
<th>Modification Type</th>
<th>Simulation Result (Temperature)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Material Modification</td>
<td><img src="image1" alt="Simulation Result" /></td>
</tr>
<tr>
<td>(c) Vegetation Modification</td>
<td><img src="image2" alt="Simulation Result" /></td>
</tr>
<tr>
<td>(e) Spatial Configuration Modification</td>
<td><img src="image3" alt="Simulation Result" /></td>
</tr>
<tr>
<td>(k) Material and Spatial Configuration Modification</td>
<td><img src="image4" alt="Simulation Result" /></td>
</tr>
<tr>
<td>Material, Vegetation and Spatial Configuration Modification</td>
<td><img src="image5" alt="Simulation Result" /></td>
</tr>
</tbody>
</table>

**Figure 5.** The Experimental Modification and Simulation Result
The best result of all modification is combination modification of vegetation, material and spatial configuration. The decreasing temperature level can be seen on table below:

**Table 2. Decreasing Temperature**

<table>
<thead>
<tr>
<th>No.</th>
<th>Modification</th>
<th>Decreasing Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vegetation</td>
<td>2-4 C</td>
</tr>
<tr>
<td>2</td>
<td>Material</td>
<td>3-5 C</td>
</tr>
<tr>
<td>3</td>
<td>Vegetation and material</td>
<td>2-4 C</td>
</tr>
<tr>
<td>4</td>
<td>Spatial Configuration</td>
<td>2-4 C</td>
</tr>
<tr>
<td>5</td>
<td>Spatial Configuration and Material</td>
<td>3-5 C (small part)</td>
</tr>
<tr>
<td>6</td>
<td>Spatial Configuration and Vegetation</td>
<td>3-5 C</td>
</tr>
<tr>
<td>7</td>
<td>Spatial Configuration, Vegetation and Material</td>
<td>3-5 C</td>
</tr>
</tbody>
</table>

**Simulation Result of Wind Speed**

The simulation result of wind speed showed the new spatial configuration with grid system circulation pattern, gave better air velocity into the region. The plant pattern influenced the wind speed, the grid pattern gave better air velocity into the region.
Spatial Pattern

The existing’s space configuration is random circulation pattern. This type of circulation pattern tends to block air velocity through the area. According to Golany, 1996, the grid system pattern smoothen air velocity through the area. Grid system circulation pattern in urban housing area should give better air velocity.

Figure 6. Simulation Result of Wind Speed

Figure 7. A closed configuration of an open space type
Source: envimet 3.1 simulation

Figure 8. An open space with undirect circulation pattern
Source: envimet 3.1 simulation
A closed small open space among the buildings tends to have higher temperature. The air velocity is small in the other side the relative humidity and radiation are high.

A small open space with undirect circulation pattern also tends to have smaller air velocity and higher temperature.

![Figure 9. An undirect circulation pattern](image)

Source: envimet 3.1 simulation

The undirect circulation pattern decrease the air velocity causing the temperature higher. In the other side, grid system circulation pattern tends to smoothen air velocity and reduce temperature.

Some small open space are closed by wall on its sides. This type of configuration blocks the wind with high relative humidity and radiation. The result, temperature of this area tends to be higher. Open space should be linked by direct circulation to other open space to get better air velocity.

The circulation pattern with culdesac pattern can block the wind speed, therefore, grid system direct circulation pattern will smoothen air velocity. Grid system orientation is better to be suitable with main wind direction.

Alley type should be better with ratio of circulation width and wall height is 1:1 or higher. This type of alley give better airflow through the urban housing area.

![Figure 10. Alley type section with wind speed](image)

Source: envimet 3.1 simulation
Considering the main wind direction from south, the new space configuration had south-north and west-east grid system pattern. The new space configuration pattern smoothened wind velocity inside area.

A small open space in the side of direct circulation area results a good air velocity also. The principle thing for the better air velocity is continuous pattern of circulation area inside urban housing area. A culdesac circulation pattern can reduce wind speed, it means that the relative humidity can not be distributed well. The high sun radiation and relative humidity results to the worse microclimate comfort and the tendency of increasing temperature.

**Land Coverage Type**

The wide part of the area is covered by concrete. This type of material absorb heat easily due to its low permeability and its high capacity of heat. Area in the Masjid yard is covered by dark stone which absorb heat easily. The dark color tend to absorb the heat better than the light color.

Land coverage should be chosen by looking for the higher albedo and higher permeability. According to Pavement Report, 2005, material type with lower albedo tends to adsorb radiation better than higher albedo material type. The smaller permeability tends to conduct heat better than the higher permeability material type.

Dark stone has lower albedo than light colored stone. Concrete has smaller permeability than natural stone. Then, light colored natural stone can be chosen to replace the existing land coverage because of its high albedo and high permeability. Artificial permeable stone with lighter color also can be chosen for better microclimate as its small conduction of heat.

In this case, the dark stone coverage absorb the radiation more than light colored stone. The concrete has lighter color but it has smaller permeability than natural stone. Some kinds of light colored natural stone, according to EnviMet 3.1 simulation can reduce urban housing temperature.

![Permeable artificial paver](http://www.perviouspavement.org/)

*Figure 11. Permeable artificial paver*

source :http://www.perviouspavement.org/, July, 26th 2013
Vegetation Type and Pattern

The vegetations on the existing are mostly in the east side of area, lining along the pavement. Some of them in the open space and Masjid yard. Vegetation has shading effect and reduce temperature around it. Beside the cooling effect, vegetation also reduce wind speed. Thus, the pattern plant should not block the wind. Vegetation with wide crown and grid system single pattern, according to Envimet 3.1 simulation gave better effect to microclimate comfort. Some pattern type of vegetation:

1. Single Pattern
   Single pattern is using a wide crown tree type, which result shading space below its crown. The large crown such as trembesi tree can be planted in wide open space. The medium crown such as Kiara Payung can be planted in urban housing area which has medium open space.

2. Group Pattern
   The group type pattern is usually like a small forest which the trees are planted in large or small grouping. The tree type for this pattern usually is a medium width crown tree, for example Kiara payung or Fillicium decipiens.

3. Line Pattern
   The line pattern can be found along the roads or boulevards. The tree type of this pattern has vertical crownor medium width crown. The type of tree such as pine for vertical crown. Palem also gives vertical effect but small shading space.

4. Vertical pattern
   Vertical pattern is used as green wall in urban area with limited space. This type is consists of small plants which set on the panel. The green panel can be set on indoor or outdoor wall.

5. Roof Garden
   Roof garden type usually uses small plants with certain structure follow the roof shape. This structure type can be seen on figure above which has some layers. A roof garden can cover the roof with plants whichits effect is similar with common garden.

   Single pattern can use a large crown tree such as Trembesi tree for large open space. Trembesi tree or *Samanea saman* has large crown so that a large space can be found below this tree. Trembesi tree is suitable to give shading in public open space such as city park or urban housing park. Trembesi tree can be 25 height with 30 m diameter of the crown. According to Dahlan, 2008, trembesi 15 m height can absorb CO2 28.5 ton every year. That is much better than average trees which can absorb 1 ton CO2 or less every year. In the other side, the strong water absorbance of trembesi is worried reducing soil water and the wide shade of this tree disturbing other smaller plants.
Kiara payung tree is about 10 m height and it has medium width crown. The medium width of its crown is suitable for shading urban housing area with single pattern, line or group pattern.

Pine trees can be planted in side of road or pavement. This vertical shape is suitable to be planted in a line pattern.

Vertical pattern can be applied in limited urban housing space. This pattern is flexible to set indoor or outdoor.

**Figure 12.** Trembesi tree with large crown
Source: http://probosetiawan.blogspot.com/2012/12/macam-pohon.html, 26 July 2013

**Figure 13.** Filicium decipiens or kiara payung

Kiara payung tree is about 10 m height and it has medium width crown. The medium width of its crown is suitable for shading urban housing area with single pattern, line or group pattern.

**Figure 14.** A type of pine tree

Pine trees can be planted in side of road or pavement. This vertical shape is suitable to be planted in a line pattern.

Vertical pattern can be applied in limited urban housing space. This pattern is flexible to set indoor or outdoor.

**Figure 15.** An indoor vertical garden

**Figure 16.** Green wall along the pedestrian as a vertical plant pattern.
Roof garden can be applied in limited urban space on the roof top. The roof garden structure can be seen below.

![Roof garden structure](http://greengarage.ca/greenroofs/features.php), July, 26th 2013

![Roof garden](http://homedesignlover.com/landscape-designs/roof-garden-landscape-designs/), July, 26th 2013

The various pattern and plant type can be chosen match to the urban housing area. In this case, vertical pattern and roof garden can be applied in suitable areas such as wall along the circulation areas for vertical pattern and on the top of the roof of some houses. Single pattern can be applied in some wide open space. A large open space can use group pattern. Line pattern can be set along side of the pavement. The vegetation can absorb the dust, reduce noise, reduce temperature and absorb CO2.

As the important role of vegetation, some pattern type can be applied. Urban housing with limited open space can use vertical garden pattern and roof garden. In this case, vertical garden can be applied along the circulation wall and also grid system single pattern plant in the wide open space.

**CONCLUSION**

Land coverage type, space configuration and vegetation type and pattern influence the microclimate comfort. Land coverage type with high permeability and high albedo will give better contribution to microclimate comfort. Natural stone and artificial permeable paver have higher permeability than concrete. Dark stone has low albedo which means has bigger ability to absorb heat. In the other side, light colored stone has higher albedo which means less heat can be absorbed. Light colored natural stone and light colored permeable material gave better result than dark stone and concrete.

Certain type of vegetation and planting pattern also influence the microclimate comfort. Vegetation with high dense leaves gives good influence on decreasing temperature. With the right pattern, this type of plant can contribute well to decrease microclimate temperature. As the important role of vegetation presence, type of plant pattern can be chosen suitable with the areas. Vertical plant pattern and roof garden type are suitable for urban housing with small open space. For urban housing with large open space can use single, group or line pattern plant of wide crown tree to get better microclimate condition.
The air velocity gives important role to the better microclimate condition. Grid system circulation pattern smoothen the air velocity, this kind of circulation pattern is recommended to be the main urban housing circulation pattern. Urban housing area must have open space to get better air ventilation and vegetation. An urban housing area with limited open space can use grid system circulation type with some small open spaces with direct circulation interrelated with some small open spaces.

REFERENCES


**Figure Download:**
http://www.perviouspavement.org/, July, 26th 2013
http://probosetiyawan.blogspot.com/2012/12/macam-pohon.html, 26 July 2013
http://greengarage.ca/greenroofs/features.php, July, 26th 2013
This page intentionally left blank
GREEN ARCHITECTURE AND ENERGY EFFICIENCY
AS A TRIGGER TO DESIGN CREATIVITY:
A CASE STUDY TO PALEMBANG CITY LIBRARY

Meivirina Hanum, Chairul Murod
Program Study of Architecture, Faculty of Engineering UNSRI
e-mail: meivihanum@gmail.com

ABSTRACT

Facts said that the main consumer to energy is a building; or high and big scale ones. This sector needs almost 100% of artificial energy. Dependability to this artificial energy results in environment destruction: energy’s exploitation and global warming. This conditional was triggering architects to be wiser and be more creative in designing to the energy efficiency concept.

Green Architecture is one of the answers to this challenge in architecture design process. The exploration to architecture design concepts that based on energy efficiency became an alternative and also demands to professional architects this era.

Palembang City Library design—which its 60-70% area is a swamp—was using stage concept to minimize the swamp piling up. Beside that, it’s choosing innovative and green material technology to fulfil the needs of lighting and circulation of library.

Keywords: green architecture, energy efficiency, creative designing, innovative material technology.

INTRODUCTION

Compared to other sectors, architecture is the highest one that consumed energy, caused of almost 100% its progress and result using artificial energy. As cited from Arvind Krishan, Climate Responsive Architecture (2001: 18).
This is also supported by Madhumita Roy from Architecture Department Jadavpur University, Golgota, India:

If this is continued, enough to destruct the earth: exploitation of earth resources and energy and also global warming. And could be worse when architects only considering their design ambition, not caring the environment.

That’s why, exploration to the architecture designing based on Green Architecture concept, now not only become an alternative but also a demand to professional architects in this era.
Green Architecture concept which is the final purpose is saving energy on building, now become an answer to these energy problems, and become a challenge in architecture design.

Palembang City Library in its design process approach not only fulfills its room needs but also explores its site form, building existing, and building positioning to respond its area which 60-70% of it is a permanent swamp.

This condition covered by stage concept and suspended floor. Combination of active and passive green architecture concepts applied to depress the energy consumption, like optimizing its structure and façade to natural lighting and circulation.

The design process of this building is definitely a challenge to its architect creativity.

**THEORY**

**Green Architecture**

The term green architecture means ‘building and structure design philosophy that aims at minimal use of non-renewable and/or polluting materials and resources in construction and use of a facility’. This philosophy of architecture advocates sustainable energy sources, the conservation of energy, the reuse and safety of building materials, and the siting of a building with consideration of its impact on the environment (Wines, 1989).

This term also means architecture in which the design is focused on making a building energy-efficient, so as to reduce its energy consumption, water consumption, operating costs, and environmental impact. Such efficiencies include the maximal use of natural lighting, low-e glass, solar electric systems, energy-efficient lighting systems, and energy-efficient ventilation systems including the use of the chimney effect, and newer sustainable materials and techniques that minimize heat loss in buildings (Hill, 2003).

Also, definition of green architecture by Jackie Craven (2003) said that green architecture or green design is an approach to building that minimizes harmful effects on human health and the environment. The "green" architect or designer attempts to safeguard air, water, and earth by choosing eco-friendly building materials and construction practices. Green Architecture or green design is also can be defined as an approach to a building that reduces waste of energy, water and materials used during construction.

**Green Architecture in Summary**

Green architecture in principal is an architecture that prefers utilizing renewable materials—which are able to be ‘reused, reduced, and recycled’—from nature to using non-renewable ones.
Green architecture also noted on its design process that calculating site management, waste management, building orientation to environment and sunlight timing management, and wind circulation management. More importantly, green architecture also considering social, culture, environment, and user aspects. Green architecture is a challenge to more creative, innovative, and efficient designing.

**PUBLIC LIBRARY**

**Definition in Architecture Context**

Public libraries are function to serve the needs of information of a diverse service population including small children, students, professionals, and the elderly.

Some design criteria should meet these needs i.e. are easy access into the building, adequate lighting, large-print media, etc. Else yet important is factors for keeping the library collections safe like one stated in *HVAC Design Criteria for Museum & Library*. These criteria of course, need a lot of energy.

**HVAC Design Criteria for Museum & Library**

HVAC design is a specialized control to the environment in which museum and library collections are stored. Factors that can affect stored collections and typical museum/library refer to HVAC design guidelines follow:

1) **Temperature**
   When temperature rises to approximately 14°F, the chance of deterioration rate of organic products in museum & library environments get doubled. Then temperature should be maintained between 65° and 75° F throughout the year; seasonal fluctuations between the two extremes are allowed, but daily fluctuations should be ±5° F.

2) **Humidity**
   We know that humidity usually associated with an increased of mold growth and other forms of biodeterioration. Besides that the effects are furniture joints loosen, paint-to-chip cause, degradative chemical reactions promotion, metals corrode, dyes and inks fade, and even glass and mineral collections damage. Based on HVAC, Relative Humidity (RH) levels should be maintained between 40% and 55% throughout the year; seasonal fluctuations allowance between the two extremes; and daily fluctuations held to ±3% (Carrow, 1995).
PALEMBANG CITY LIBRARY

Palembang City Library is one in same level with Regional Library. It is only the ownership and management that different it from Regional, which is in City/Province government. This library located on intersection of Jl. Demang Lebar Daun and Jl. Ogan:

![Location Map](image1)

*Figure 3. The Palembang City Library Location*
*Source: Palembang Google Map, 2013*

This design was used as a case study to energy-efficient building. More as preliminary study or pre-research that hopefully could be generated as inspiration and source to other public libraries in South Sumatera (BAPPEDA, 2005).

![Library Image](image2)

*Figure 4. The Palembang City Library*
*Source: BAPPEDA, 2005*
This library planned to be 6-floors building, with approximately 11,000 square meters, 40% KDB, and 100 meter GSB. Existing site approximately 25,000 square meters, wet land topography which 50–60% of it is permanent swamp.

Climatology analysis: highest-temperature in 33 Celsius degree, lowest-temperature in 23 Celsius degree, wind speed in 30 kilometers per hour to south-east, and humidity at 52–96% (BMKG, 2008).

Table below is J.S. Mandeep (2011) research entitled ‘Cumulative Distribution of Rainfall Data for Tropical Countries, which is taking cities all over the world as a sample, and one of it is Palembang. This information—along with sun light cycle in area information data— used for analyzing building positioning, form, and orientation of Palembang City Library.

Figure 5. The Palembang City Library Existing
Source: Google Earth, 2013
While ‘Sunpath Diagram’ see sundial and latitude position of the library. And help giving a better graph of climate around.

Source: Mandeep, 2011

<table>
<thead>
<tr>
<th>Country</th>
<th>Regions</th>
<th>State</th>
<th>Climate</th>
<th>Latitude (°)</th>
<th>Longitude (°)</th>
<th>Average Annual Rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaysia</td>
<td>North Peninsular</td>
<td>Alor Star</td>
<td>Tropical</td>
<td>6.2</td>
<td>100.4</td>
<td>1990.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beers</td>
<td>Tropical</td>
<td>5.7</td>
<td>100.9</td>
<td>2183.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Langkawi</td>
<td>Tropical</td>
<td>6.23</td>
<td>98.74</td>
<td>2427.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Penang</td>
<td>Tropical</td>
<td>5</td>
<td>100</td>
<td>2485.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ipoh</td>
<td>Tropical</td>
<td>4.57</td>
<td>101.1</td>
<td>2427.9</td>
</tr>
<tr>
<td>Nigeria</td>
<td>South West</td>
<td>Lagos</td>
<td>Tropical Wet</td>
<td>6.58</td>
<td>3.3</td>
<td>1530</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Benin</td>
<td>Tropical Wet</td>
<td>6.22</td>
<td>5.39</td>
<td>1948</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ilu Ilefe</td>
<td>Tropical Wet</td>
<td>7.42</td>
<td>4.31</td>
<td>1245</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Warri</td>
<td>Tropical Wet</td>
<td>5.52</td>
<td>5.7</td>
<td>2776.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ibadan</td>
<td>Tropical Wet</td>
<td>7.21</td>
<td>4.01</td>
<td>1286</td>
</tr>
<tr>
<td>Kenya</td>
<td>West Province</td>
<td>Eldoret</td>
<td>Sub Tropical</td>
<td>0.53</td>
<td>35.2</td>
<td>1062</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kisumu</td>
<td>Tropical Wet</td>
<td>0.10S</td>
<td>34.7</td>
<td>1388</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nairobi</td>
<td>Sub Tropical</td>
<td>1.32S</td>
<td>36.73</td>
<td>1043.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kitale</td>
<td>Tropical Wet</td>
<td>1.02</td>
<td>35</td>
<td>1185.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kericho</td>
<td>Tropical Wet</td>
<td>0.37S</td>
<td>35.29</td>
<td>1751.8</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Peninsular Sumatera</td>
<td>Medan</td>
<td>Tropical</td>
<td>3.57</td>
<td>98.6</td>
<td>2263</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Padang</td>
<td>Tropical</td>
<td>0.68S</td>
<td>100.3</td>
<td>4305.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bandar Aceh</td>
<td>Tropical</td>
<td>5.52</td>
<td>95.4</td>
<td>3620.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Riau</td>
<td>Tropical</td>
<td>1.05S</td>
<td>103.4</td>
<td>2344</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Palembang</td>
<td>Tropical</td>
<td>2.90S</td>
<td>104.7</td>
<td>2474.6</td>
</tr>
<tr>
<td>PNG</td>
<td>North Region</td>
<td>Lee</td>
<td>Tropical Wet</td>
<td>6.73S</td>
<td>147</td>
<td>4579.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Madang</td>
<td>Tropical Wet</td>
<td>5.22S</td>
<td>145.8</td>
<td>3496.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kavieng</td>
<td>Tropical Wet</td>
<td>2.69</td>
<td>150.29</td>
<td>2984.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vanimo</td>
<td>Tropical Wet</td>
<td>2.27S</td>
<td>141.7</td>
<td>2782.3</td>
</tr>
</tbody>
</table>

Source: Mandeep, 2011
**Figure 6 and 7.** The Palembang City Library Sundial Position  
Source: Brown & DeKay, 2001

**Figure 8.** The Palembang City Library Climate Based on Sundial & Latitude Position  
Source: Brown & DeKay, 2001
GREEN ARCHITECTURE: PASSIVE AND ACTIVE SOLAR BUILDING DESIGN

Passive-Solar Building Design

The spontaneous warming effect resulting from the absorption of solar radiation is called ‘Passive-Solar Heating’. When temperature rises, this induces heat flow from the affected surface to other surface and indoor air, as well as to processes of heat storage within the building structure.

This heat storage modulates the excess and deficit in solar gain over the daily cycle, and is a critical design consideration. Passive solar heating relies on the design of windows, clerestories, rooflights, glazed walls and roofs.

‘Passive-Solar Cooling’ is the dissipation of excess heat by natural process. This depends on two conditions: the availability of a heat sink which is at a lower temperature than indoor air, and the promotion of heat transfer towards the sink (Krishan et. Al., 2001).


In passive solar building design context, windows, walls, and floors are made to collect, store, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer. This is knowingly called climatic design. Because unlike active solar heating systems, it doesn't involve the use of mechanical and electrical devices at all (Wikipedia, cited 2013).

There are no additional mechanical or electrical devices to deliver heat or electrical energy, no additional fuel or utility costs, and no added environmental impacts in passive-solar building design. For this reason, many people think that passive solar technology is superior to active solar technology (Greenlivingtoday, cited 2013).

Active-Solar Building Design

Meanwhile, active solar technologies are contributed to convert solar energy into another more useful form of energy. This could be a conversion to heat or electrical energy. In the building this energy would be used for heating, cooling, or off-setting other energy use or costs. Active-solar usually uses electrical or mechanical equipment for this conversion (Wikipedia, cited 2013).

In summary, active-solar systems use external sources of energy to power blowers, pumps, and other types of equipment to collect, store and then convert solar energy. Once energy from the sun is absorbed, it stored for later use. Small systems are ones that used to furnish electricity for heating and cooling systems in homes and other buildings, while large systems can furnish power for entire communities (Urza, 2013).

Active-solar system uses the sun’s irradiance or radiation (the sun’s rays) then converts it to electricity to power systems in your home (Allcot, 2011).
RESEARCH and METHODOLOGY

Method used in this research is desk evaluation to two areas: design analysis and HVAC analysis.


Each of these basic principles used as analyzing form respond to climate and environment: site, orientation to sunlight cycle, wind direction and shading, and also ornaments and materials choosing relevant to heat absorption reflection level and heat reduction.

This design analysis only concentrated to the building design output, not the analytical calculation.

For HVAC (Heating, Ventilation, and Air Conditioning), analysis was done by evaluating it from passive and active-solar design principles. It’s focused on form—the site as well as the façade—that responsive to climate.

Hypothetically, this refer to green architecture concept building design process will generate the architect creativity.

RESULT AND DISCUSSION

DESIGN ANALYSIS BASED ON BRENDA & ROBERT VALE GREEN ARCHITECTURE THEORY

Conserving Energy & Working with Climate

This theory said that design creativity seen on how architect is able to modify the building structure and form so it’s adjusted to climate and environment; not in contrary.

The pressure point is on nature resources itself, how far it could be optimized to reduce the electricity or artificial energy use.

As an example, optimize the solar potency as energy resource, or explore the building form by means its circulations working best so air conditioner no longer needed. This could be done by applying passive-solar or active-solar concept, or both:

1. Building Form and Orientation to Solar Cycle
   - In case to optimize solar exposure, this Palembang City Library was designed in curve form and ‘mirror’ on most of it.
   - This dynamic curve mass form gives benefit a dynamic solar-receiving-area as well: the inside curve to minimize midday-solar exposure, and the outside curve to maximize the early and late day-solar exposure.
   - While the mirror reflects the solar back and minimize the unwanted heats (fiu.edu, cited 2013).
This dynamic form also gives a best-working circulation, so the heats automatically reduced.

**Figure 9.** The Palembang City Library Form & Orientation to Solar Cycle  
Source: Hanum, 2005

**Figure 10.** The Palembang City Library Circulation System  
Source: Hanum, 2005
Besides the form, dynamic floor construction, vegetation—like roof garden, and water areas—retention pool in ground floor gives contribution to the circulation as well.

Figure 11. The Palembang City Library Dynamic Floor Construction
Source: Hanum, 2005

2. Hybrid Design: Integrated Passive-Active Design

Beside the passive-concepts application above, this library also uses active-solar design. First, it uses ‘Photovoltaic’ or more popular as solar cells above the roof floor to gain the thermal resource for electricity and ornament at once.

Figure 12. The Palembang City Library Photovoltaic
Source: Hanum, 2005

Second, it’s finished with ‘sunscreen’ and ‘sunshade.’ Sunscreen on windows functioned as automatic-light intensity-controller; guarantee the rooms get enough natural lighting and heat. While sunshade contributes on protecting
building skin from over-heating. It also helps diffusing the natural lights, so could be used as day-lighting and minimize the use of artificial lights.

![Sunshade Diagram](image)

**Figure 13. The Palembang City Library Sunscreen & Sunshade**
*Source: Hanum, 2005*

**Respect for Site & Respect for User**

Besides the building form and orientation, this library structure also responds to site topography that almost of it is swamp. These respect-for-site implementations are:

1. Hold about 40% parts of the swamp areas for retentions and green-opened-areas;

![Site Plan](image)

**Figure 14. The Palembang City Library Existing**
*Source: Hanum, 2005*
2. Its mass that thin and vertical unified to environment and climate;
3. Its floor structure that ‘suspended’ not ‘slap-on-ground,’ so it supports ‘the stage-concept’ and accommodates the lowland site.

Respect-for-user implementations could be done by exploring local identity. This library adopted ‘stage’ concept or local Palembang identity, ‘rumah limas.’ This concept of course, respects the social-culture of Palembang.

Limiting New Resources

This effort would be achieved by:
1. Optimizing already-in-stock materials and minimize the new ones;
2. Using biodegraded and reused materials;
3. Reducing non-renewable natural resources and energy use;
4. Recycling the possible materials.

Holistic

As seen above, all of these green architecture principles cannot be applied separately, but supports one-another (Vale & Vale, 1991).
# Table 2. The Study Result

<table>
<thead>
<tr>
<th>METHODS OF ANALYSIS</th>
<th>PASSIVE SOLAR DESIGN</th>
<th>ACTIVE SOLAR DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conserving Energy</td>
<td>• Latitude, sun path, and <em>insolation</em> (sunshine)</td>
<td>• Photovoltaic on the Roof Floor</td>
</tr>
<tr>
<td></td>
<td>• Seasonal variations in solar gain, heating degree days, solar insolation, humidity</td>
<td>• Roof Garden Concept</td>
</tr>
<tr>
<td></td>
<td>• Obstructions / Over-shadowing - to solar gain or local cross-winds</td>
<td></td>
</tr>
<tr>
<td>Working with Climate</td>
<td>• Micro-climate details related to humidity,</td>
<td>• Flexible Sun Shade</td>
</tr>
<tr>
<td></td>
<td>• Orientation Of Building, Slim of Form, Building Coverage, Floor Area Ratio,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Potitioning with Climate, Vegetation and land contour</td>
<td></td>
</tr>
<tr>
<td>Respect for Site</td>
<td>Explore the Palembang local identity with its ‘stage’ or ‘Rumah Panggung’ concept</td>
<td></td>
</tr>
<tr>
<td>Respect for User</td>
<td>Reuse, reduce and recycle principles</td>
<td></td>
</tr>
<tr>
<td>Limiting New</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RECYCLE</td>
<td>Reuse gray water, rainwater, treat sewage to high degree,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduce</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heat Buildings Effect</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Recycle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control sources for retention swamp water, to native landscaping requires less</td>
<td></td>
</tr>
<tr>
<td></td>
<td>irrigation, find</td>
<td></td>
</tr>
</tbody>
</table>

Source: Hanum, 2005
A variety of guidelines for sensitive climatic building design were developed including the use of shaded space and sun control, passive cooling through cross ventilation and the use of lightweight exterior construction of low thermal capacity to avoid the accumulation and re-radiation of heat. A key objective of the Master Plan was that all new buildings comply with the north east/south west orientation and be “designed to produce comfortable interior environments with minimal interference from artificial climate controls”

As a result of the increased interest in green building concepts and practices, a number of organizations have developed standards, codes and rating systems that let government regulators, building professionals and consumers embrace green building with confidence. In some cases, codes are written so local governments can adopt them as bylaws to reduce the local environmental impact of buildings

As these demands and challenges come around, there is no way that architects could run away. The only way left is to face these ‘limitation.’ And the only way to work well on limitation is by being ‘creative.’ The technologies are now provided to help the concept realized. There were already so many examples. One of it is Palembang City Library.

Drove by a challenge that almost of its existing site were swamps and a will to embrace it well in to uniquely-local identity-reflection public space, the architect applied green architecture concept creatively. It contents shaded space and sun control, passive and active cooling design ventilation, and the use of lightweight exterior construction as architectural ornament.

It combined passive-active architecture concept very well, along with respect to Mother Nature, as these are all the holistic components of green architecture by Brenda and Robert Vale. It considers respect for environments with minimal interference from artificial climate controls and efficiency energy basic concept by means, orientation of building, its slim form, building coverage, floor area ratio, and its positioning just adjusting the climate, vegetation, land contour, and solar energy exposure.

Obviously nature is the truly inspiring teacher. It derives architecture in to the next level. Like concluded by Wines (2008: 148): the aesthetic and green design that ensemble of real goods has to successfully achieve the client’s objectives; the site plan should maximize elements of beauty, serenity, and spirituality; this should be a sanctuary and a testament to sustainable building practice, energy systems, living, agriculture, and community

REFERENCES

Editorial Books:


**Books with multiple authors:**

**Paper for Conference and Symposium Proceeding:**

**Reports:**

**Downloads:**

BMKG, [http://meteo.bmkg.go.id/prakiraan/propinsi/08](http://meteo.bmkg.go.id/prakiraan/propinsi/08)


INTERNATIONAL CONFERENCE
GREEN CONCEPT IN ARCHITECTURE AND ENVIRONMENT


Richard Carrow (Danforth Air Filtration & Air Purification, Buffalo, NY).
https://www.danforthfilters.com/secure/store/Air-Filters-Museum-1.asp diunduh tgl 21 Agustus 2013, jam 07.05


http://www.eere.energy.gov/de/passive_solar_design.html
EFFECTIVITY WIND CATCHER AT HOUSING IN LIMITED AREAS IN HOT-HUMID TROPICAL CLIMATE

Yuswinda Febrina*, Sri Nastiti N Ekasiwi**, I.G. Ngurah Antaryama***
*)Department of Architecture, University of Lambung Mangkurat, Indonesia
  e-mail: yf_winda@yahoo.co.id
**)Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
  e-mail: nastiti@arch.its.ac.id
***)Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
  e-mail: antaryama@arch.its.ac.id

ABSTRACT

The function of cross ventilation for removing accumulated heat inside houses for hot-humid tropical climate is difficult to cope, as the house has very limited house areas. This study discusses the effectiveness of wind catcher on housing in a limited areas in the hot-humid tropics, due to the use of cross ventilation is not possible, this research tries weeks to use the opening in the roof of the principle of wind driven ventilation is wind catcher. By measuring the real condition in the existing houses, the study aimed to investigate the thermal performance inside the houses. Furthermore simulation is conducted to improve the thermal condition. Wind catcher is introduced in the house. The simulation process primarily utilizes the CFD software: Fluent version 6.2 to explore wind-driven ventilation method. The results show that 3 and 4 meter-height, 0.7x0.7m cross-section and 0.5x0.5 opening hole of wind catcher is effective in improving indoor thermal condition. The effectiveness is demonstrated in increasing airflow velocity from 0.15 m/sec to 0.82 m/sec and reducing temperature of 5.3°C.

Keywords: wind catcher, natural ventilation, hot-humid tropical climate.

INTRODUCTION

Nowadays, land scarcity in urban area has forced inhabitants of housing estate to make use the remaining land. The Addition of space is an example of how the inhabitant of housing develop their house to accomodate new activities. Such an addition of space unfortunately often ends up with make the home environment discharged enclosed by building. In the context of hot humid tropical climate, these conditions are less favorable to optimize the use of cross ventilation to help releasing heat from the building. As a consequence, utilisation of fan and air
conditioning is increasing. This condition subsequently raises amount of energy consumption of the building.

Results of previous studies that modest house built by a developer mostly not notice the placement, dimensions, and type of window based on direction of the wind. This is because limited cost modest house construction which led to the building is designed with a simple detail, including the design window. So mostly heat conditions inside the house and the house as a residence to be eligible health and comfort are not met anymore (Febrita, 2009).

Because the use of cross ventilation is not possible, then the ventilation system with the use of the openings at the top that allow to air change that is the stack effect and wind driven ventilation one of which is wind catcher. Air movement created by the stack effect is usually not sufficient to achieve physiological cooling, because fewer than the recommended air velocity for cooling from 0.15 to 1.5 m/s in a tropical climate (Satwiko, 1994). Ekaswi (2003) doing research on Eco House building ITS to observe the effectiveness of stack effect The results of these studies explain that the movement of air resulting from a chimney is less effective than cross ventilation (horizontal) is more dominant.

Because the use of cross ventilation in the housing on limited plot and does not allow a stack effect is applied in the hot humid tropical climate, so in this study to apply the opening of the roof of adding a chimney with an opening facing the wind flow to enter the air from outside into the house with the basic principles of wind driven ventilation. And because research on the wind catcher is still mostly done in the dry tropics, so in this study apply to wind catcher in the housing on limited plot that have been increased in hot-humid tropical climate.

Several studies related to the wind catcher is Badran (2003), Montazeri (2008) researching wind catcher in the dry tropics. Wind catcher is used to cool the air and creating comfortable conditions for occupants in a dense urban area in the desert.

**NATURAL VENTILATION**

Ventilation system is a strategy to achieve the air quality in the space is the basis for providing fresh air in the space and to minimize the concentration of pollution in space, the number of ventilation openings required to maintain the air quality depends on the dominance of natural conditions and pollution sources in space (Allard, 1998). Natural ventilation is used not only to supply fresh air to the needs of residents and to maintain the needs of air quality level, but also for cooling (Santamouris, 1996).

The use of natural ventilation during the day has three benefits, namely: cooling the air inside the building along the outside temperature is lower than the temperature in the building, cooling the building structure, direct cooling effect on the human body through convection and evaporation (Santamouris, 1996).

In the hot-humid tropics the humidity reaches 80% and the temperature outside above the thermal comfort conditions. To reach the condition of thermal comfort, passive cooling strategies with the ventilation system is the most optimal
strategy. This passive cooling system has two principles, namely: for the elimination of heat and for physiological cooling.

Component of natural ventilation based on Moore (1993), Santamouris (1996) and Allard (1998). Ventilation components basically divided into two types namely:
1. Components that function as natural ventilation driving force of the wind or the air temperature outside the room.
2. Building and site planning are:
   a. Type of surface roughness building site environment, this type of surface roughness affects the wind speed around buildings.
   b. Building orientation related to the wind direction coming.
   c. Height of the building and roof geometry.
   d. Geometry of the building.
   e. Openings area, height and type of openings.

Wind catcher is another name for the tower of wind (Wind Tower), but here it means specifically by a wind-driven ventilation. Wind catcher on the roof to catch the wind and lead directly down into the building. Wind catcher is designed to work with the openings and the air flow mainly influenced by wind speed and direction outside the building, the temperature difference between the outdoor and indoor environment. Wind catcher using other openings such as windows to remove the air from inside the building (Badran, 2003).

When there is wind all day, the level of air circulation increase. The cold air can be circulated through the space in the building by the appropriate setting of the openings in the tower and the room. If there is no wind throughout the day, the circulation of air down through the tower and into the building and the tower began to operate like a chimney. Operation of the tower are not fixed in a day-to-day: the cooling effect and duration of each stage of the operation changes according to fluctuations of the tower air temperature, intensity of solar radiation, wind speed and so on (Bahadori, 2009).

Research conducted Badran (2003), using a wind catcher to cool the air and creating comfortable conditions for residents in areas such as the desert climate in the Jordan valley (Ghor) and Aqaba. The main driving force air on wind catcher is the air density difference between inside and outside the tower. When the air inside is cooler than outside, the higher density and the density differences that affect the chimney behind. These effects bring the cold air flow throughout the tower for the conditioned space. The results of the study, a high tower with a cross-section 4m and 0.57m X 0.57m airflow rate can result in the building 0.3 m/s and the lower temperature of 36°C to 25°C where the airflow velocity outside the building is assumed (5, 10 and 15 m/s) (Badran, 2009).

The results of research conducted shows that Montazeri wind catcher with openings on one side has the potential as an effective ventilation design for urban areas. Corner of the intake of air, wind catcher and the placement of the wind direction affect the coefficient of pressure, level and direction of air flow ventilation (Montazeri, 2008).
Research conducted in Elmualim and Awbi Montazeri, using CFD simulations to evaluate the achievement of the wind catcher with squares and circles. The results showed that the efficiency of the wind catcher with four sides is much higher than the circle with the same airflow velocity, related to the angle of the square that creates a flow and higher pressure differences (Montazeri, 2008).

The effectiveness of wind catcher refers to two of the three roles that have natural ventilation, namely: maintaining air quality by allowing sufficient air turnover, and in terms of passive cooling system (passive cooling), ventilation to create comfortable conditions for building occupants. Associated with comfort, airflow distribution and airflow velocity in the room used as a benchmark of success for natural ventilation able to blowing sweat on the skin surface, so the physiological cooling is achieved. The airflow velocity requirements for thermal comfort in a room graph defined by Mc. Farlene. According to Ansley number of air changes (ACH) are recommended for the family room is 45m³/hour (Aynsley, 1977). According Santosa (1993), temperatures that meet the thermal comfort of building occupants in the humid tropics of 25.4°C-28.9°C.

**RESEARCH METHODS**

This study uses the simulation with program CFD fluent v.6.2. Modest house types that will be examined is limited to the Type 45. Object selected case is housing type 45 in East Surabaya, Jl. Sutorejo, Sutorejo Village, District Mulyorejo. Taken modests house type 45 with 112.5 to 135 m² area which has been expanded with the addition of the remaining land space fulfill before.

![Image of houses facing different directions](image1)

**Figure 1.** Figure fourth object of study  
Source: field survey, 2012

Building orientation, aperture type, pattern lid openings and wind direction outside of the building is very influential on the temperature, humidity and wind speed into the building needed to remove heat and cooling fisologis occurring in the building. Seeing from the phenomenon of temperature and wind speed that occurred in the fourth sample objects in the living room, it is recommended placement wind catcher in the living room because the reality on the ground is getting away from the opening of the lower wind speeds otherwise undetectable even further away from the opening temperature of the the higher temperature. Expected by adding wind...
catcher capable of adding wind speeds so that the greater the value of air change according to the conditions necessary thermal comfort and able to eliminate heat and create physiological cooling.

Based on the working principle of wind catcher; when the air temperature inside the chamber is lower than outside air temperature, the air moves in through openings in the top hole and out through openings that position is lower, so the wind catcher as a function of the inlet hole. And if the air temperature in the chamber is higher than the outside air temperature, the air moves in through the hole openings that exist at the bottom and exit at the round opening at the top, so it functions as an outlet hole wind catcher.

The principle of wind catcher and based on the results of field measurements on four samples of the object, the air temperature inside the chamber is lower than outside air temperature occur at any time during the day, the function of wind catcher as inlet holes occur at any time during the day. While the air temperature inside is higher than the outside air temperature occurred on the night, the function of wind catcher as outlet holes occur at night time.

In this study, the independent variable is restricted to high wind catcher, is determined based on previous studies that Badran (2003); tall wind catcher from 4 m to 9 m and wind catcher dimensions 0.7 m x 0.7 m Patterns of airflow (air flow pattern), the acquisition of air change in the building (air change) and wind speed (air velocity) served as the dependent variable is based on several previous studies that the results of research wind catcher ventilation systems can increase the speed of the wind, creating wind flow, cooled temperatures and reduced humidity in the humid tropics (Montazeri, 2008).

Airflow velocity outside the building on this study assumed the same in all models of the objects in the coldest months 1.94 m/s (PM) and 0.8m/s (AM), the hottest months 1.72 m/s (PM) and 1 m/s (AM) according to the wind speed at 3m altitude sub-urban terrain. The design and location wind catcher as shown in Figure 1 as a model input CFD program FLUENT version 6.2.
Figure 2. Figure fourth object of study when applied to wind catcher
Source: author, 2013
Simulation used in this study were simulated with CFD programs fluent version 6.2 by making the object of study as a model before and after the wind catcher applied to obtain data of airflow velocity, airflow patterns and temperature and air changes in the building to be analyzed. After the measurement and simulation results obtained, and then carried out to obtain verification of the height of effective wind catcher.

RESULT AND DISCUSSION

Table 1. Simulation Result of Existing Condition before The Wind Catcher Applied

<table>
<thead>
<tr>
<th>Object</th>
<th>Coldest month Siang</th>
<th>Night</th>
<th>Hottest month Siang</th>
<th>Malam</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To °C</td>
<td>Ti °C</td>
<td>Vo m/s</td>
<td>Vi m/s</td>
</tr>
<tr>
<td>1</td>
<td>31</td>
<td>31</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>2</td>
<td>31</td>
<td>27</td>
<td>2.5</td>
<td>1.8</td>
</tr>
<tr>
<td>3</td>
<td>31</td>
<td>27</td>
<td>2.5</td>
<td>2.9</td>
</tr>
<tr>
<td>4</td>
<td>31</td>
<td>27</td>
<td>2.5</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Source: author, 2013
Note: To: temperature outdoor, Ti: temperature indoor, Vo: airflow velocity outdoor, Vi: airflow velocity indoor, Ach: air change.

The highest air temperature in the living room is the object study 1, and the lowest on the object 2. The air change that occur in the house does not meet the physiological comfort. The requirement value of air change in the living room on the fourth object of study in the evening less qualified air changes required for the family room for 45m³/hour (Aynsley, 1977). While the wind speed during the day to meet the required wind speed for the convenience of physiological (physiological comfort).
Table 2. Simulation Results Of Modifications Building

<table>
<thead>
<tr>
<th>Object 1</th>
<th>Object 2</th>
<th>Object 3</th>
<th>Object 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>• wind catcher with a height of 4m have effectively reduce the temperature of 0.3 to 5.3 ° C and add air flow velocity 0.14m/s.</td>
<td>• wind catcher with a height of 4m effectively increase the airflow velocity 0.07 to 0.53m/s, lowering the temperature of 1.1 ° C</td>
<td>• wind catcher with a height of 3m effectively reduce the temperature of 0.6 to 2.3° C, although the airflow velocity lowering 0.06 until 0.13m/s, but air circulation still through the building.</td>
<td>• wind catcher with a height of 3m effectively increase the air flow velocity 0.03 to1.03m/s, reduce the temperature of 1.1 until2.3° C .</td>
</tr>
<tr>
<td>• air flow distribution pattern in the family room becomes more prevalent, than buildings before modification.</td>
<td>• The pattern of air flow distribution more equitable.</td>
<td>• air flow distribution pattern is also more evenly.</td>
<td>• patterns of distribution air flow more evenly.</td>
</tr>
<tr>
<td>• hole function instead turned into the inlet. (Fig. 2)</td>
<td>• Function as an inlet hole in the daytime and at night outlets.</td>
<td>• ventilation system of the original building is a cross ventilation system, if the modification causes the wind speed into the building to be divided into two outlets.</td>
<td>• function as an inlet hole remains in the daytime and at night outlets.</td>
</tr>
</tbody>
</table>

Source: author, 2013

<table>
<thead>
<tr>
<th>Object</th>
<th>Existing Condition</th>
<th>Modifications Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Wind velocity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Air Flow Distribution Pattern
Figure 3. The Example Simulation Result Of Existing Condition and Modification Building Object Study I
Source: Simulation, 2013

Table 3. Temperature, Wind Speed and The Air Change Of Height Effective Wind Catcher

<table>
<thead>
<tr>
<th>Object</th>
<th>To (°C)</th>
<th>Vo (m/s)</th>
<th>Building before modification</th>
<th>Modification Building</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ti (°C)</td>
<td>Vi (m/s)</td>
<td>Q (m³/hour)</td>
<td>Ti (°C)</td>
</tr>
<tr>
<td>1</td>
<td>34.7</td>
<td>1.1</td>
<td>27-34</td>
<td>0.2-0.9</td>
</tr>
<tr>
<td>2</td>
<td>28.7-32.4</td>
<td>0.2-0.93</td>
<td>46</td>
<td>27.6-31.3</td>
</tr>
<tr>
<td>3</td>
<td>28-33</td>
<td>1.39</td>
<td>16</td>
<td>27.4-30.7</td>
</tr>
<tr>
<td>4</td>
<td>26.6-36.3</td>
<td>1.07-1.34</td>
<td>14</td>
<td>25.5-34</td>
</tr>
</tbody>
</table>

Note: To: temperature outdoor, Ti: temperature indoor, Vo: airflow velocity outdoor, Vi: airflow velocity indoor, Ach: air change.

The Air change that occurred in the family room all of objects at a wind catcher height of 3 and 4m qualified air change that must take place in the family room 45m³/jam, then by adding a wind catcher with 3 and 4m high tower already qualified with holes wind catcher function as the inlet. Temperature in the family room on all objects after modified by adding wind catcher with a height of 3 and 4m is effective to meet the thermal comfort of building occupants during the day is 25.4°C - 28.9°C Santosa (1993).

Wind Catcher will be most effective in building ventilation systems that have a one-sided, because the air flow in addition to utilizing the difference of positive and negative air pressure can also occur due to differences in air temperature resulting vertical pressure difference. Effective if the wind catcher as a function of inlet opening hole that is going on during the day. This is due to the wind flow into the large space due to the size of the inlet opening is smaller than the outlet.

Wind catcher is less effective when opening hole functions as an outlet that is at night because of lack of effect on increasing the speed of the wind, even adding the temperature inside the building. This caused a small wind flow into the chamber due to the size of the inlet openings larger than the outlet.
Wind Catcher less effective when applied to buildings that have cross ventilation system, because the air flow towards the outlet is divided into two outlets, so the effect on the value of the difference in air pressure that occurs and the value of the temperature difference resulting vertical pressure difference. When the wind catcher hole serves as an outlet, an increase in temperature in the family room, but the air circulation through the building remains. It is due to air in the building is pulled through the chimney, and the cold air outside is drawn into the building through a door or window. It needs a further study on the application of the design development of optimum wind catcher included material considerations.

CONCLUSIONS

The results on the object of study, wind catcher is used to cool the air and create comfortable conditions for occupants in the hot-humid tropics, high tower is needed to create air flow and reduce temperature. Height of towers 3 and 4m have been effective, dimensions of towers 0.7X0.7m and opening holes for 0.5X0.5m with wind catcher material is brick plaster, can increase wind speeds from 0.15 m/sec to 0.82 m/sec and reducing temperature of 5.3°C.

A bigger role on the wind catcher with the principle of wind driven ventilation is the air pressure in influencing the size of the wind speed in the house instead of stack effect. The principle of wind driven ventilation is the air pressure in influencing the size of the wind speed in the house instead of stack effect. Number of air changes that occur in the family room at all study object after adding wind catcher qualified to function as a family room. The Air flow into the house with the implementation of wind catcher can not be controlled to the maximum, so that when the wind speed is not adequate then the air can not flow properly and less effect on the thermal reduction. Conversely, if high winds, the thermal conditions in the room will go down. Although air quality is difficult to control, but the wind catcher can be used for flow of fresh air from the outside into the room. The height of wind catcher role in changing wind speed and temperature in the room. Wind velocity outside the home and wide inlet and outlet openings are also very important role in increasing the wind velocity and the lower the temperature in the room. Placement of wind catcher effect on wind speed distribution in the room. System of opening and closing windows or doors also affect the effectiveness of the wind catcher.

REFERENCES

Books:

Givoni, B. (1975), Laboratory Study of the Effect of Window Size and Location on Indoor Air Motion, Building Research Station Technion, Israel Institute of Technology, Haifa.


Journal:


Paper for Conference and Symposium Proceeding:
Febrita, Yuswinda, Ekasiwi, Antaryama. (2009), Performance of Ventilation at Housing in Limited Area in Humid Tropics Region, Proceeding of National Seminar 1st APTECS, Surabaya.


Santosa, Mas. (1986), Energy Conservation through Urban Settlement Pattern, World Planning and Housing Congres Adelaide Australia.

Thesis:

This page intentionally left blank
OPTIMIZING URBAN OPEN SPACE AS STUDENTS
FAVORITE PLACES FOR RESTORATION
CASE STUDY OF UNIVERSITY STUDENTS IN BANDUNG

Astri Anindya Sari*, Shirleyana**
*) Lecturer, Department of Architecture, Widya Kartika University, Surabaya, Indonesia
**) Lecturer, Department of Architecture, Widya Kartika University, Surabaya, Indonesia
e-mail: anindyasari@gmail.com

ABSTRACT

Results of previous studies suggest that the natural elements of urban open space has a restoration or emotion-regulation function which can reduce the mind tension due to daily activities. Related to this function, proper planning for urban open space is required to support community activities in the city. Bandung City with its natural potentials is also supposed to have a good quality of urban open space. Unfortunately, the existence of open space in the city is still considered minor both in terms of quantity and quality.

Bandung is a city of education. Hence the students contribute a significant number in amount of people. This study explores the preferences of students for the city open space. Qualitative research was conducted to determine physical and spatial factors that make the students chose an open space as a favorite place for restoration purposes and doing activities.

It was found that urban open space has a great potential to become a favorite restorative place for students. It was also retrieved that restorative effects for students can be derived not only from the natural elements, but also from non-natural elements such as activities and social interactions.

Keywords: Bandung, preferences, students, restoration, urban open space

INTRODUCTION

Open space is an important element of the city which also determines the identity of the city. Lerner (2003) argued that the existence of good quality of public open space can improve the quality of the urban environment and quality of life in society. This is related to the function of public green open space as a means for the community activity as a whole and its role as lungs of the city. These benefits reinforce the importance of open space provision in the city.

Studies suggested that the presence of natural element such as plants and
water is an important factor that encourages people to come to the open space the city. This happens because of the presence of the natural element can provide restorative effects that can reduce the stress due to day-to-day activities (Korpela, 2003; Hartig & Staats, 2005; Korpela et al, 2011).

Indonesia in general and Bandung in particular are located in the tropical climate and have beautiful scenery a year-round. This potential should be optimized to create qualified public green space. Unfortunately, the availability of green space for community activities in the city is still lacking (Pikiran Rakyat, 2013), whereas the existence of public green space is essential for improving the quality of urban living.

Sari, et al (2012) in the study of students favorite places in Bandung found out that open space is the second most favorite place for relaxation purpose, while the first favorite place goes to shopping malls. This condition is certainly ironic, seeing the potential nature of Bandung which should be optimized to create qualified green space as an alternative destination for people to relax and spend their leisure time. This tendency of choosing mall compares to green space can also be the impact of the rapid development of shopping malls in recent years. In the perspective of students, this circumstance is the implication of inattentive behavior of the city government to the provision of public green open space. In fact, shopping malls are the result of the western culture influence, which is closely related to the negative ways of consumerism. Students as young people are still easily influenced. Therefore, it is important to note that the provision of public green open space is needed to increase student preference towards open space instead of the malls.

This paper aims to explore the attractive factors for the students in the public open space. The results are expected to provide input on how open space should be designed to meet the needs and preferences in accordance with the students.

**RESEARCH METHOD**

This study is an exploratory study that aims to map out the push factors which enforce student to choose an open space as a favorite place for recreational activities and spend leisure time. Data collection and analysis methods used are qualitative methods with open-ended questions as the data collection instrument. The purpose is to provide an opportunity for researchers to get a variety of possible answers of the respondents, so the research results are expected to be more affluent (Creswell, 2002).

Respondents in the study came from higher education institutions in Bandung at the Tamansari - Dago include Unisba, Unpas, ITB, Unikom, and Padjadjaran Dipatiukur University. The number of samples is determined proportionally based on the ratio of students each institution (proportional sampling). The respondents at each campus are selected randomly (random / quota sampling) with the criteria of undergraduate students more than 1 year. This criterion is determined based on the consideration that the second year undergraduate students have a level of age,
psychological maturation, and the need for equal complexity. In addition, they are assumed to have had a cognitive map of the city of Bandung.

The primary data used is collected to explore students’ favorite places in town. Results show that the open space is selected in the second place as a favorite place to be visited when the students feel bored with college activities. Of the 303 students who participated as respondents, 67 of them (22%) chose open space as a favorite place. The factors that influence students were further studied using the available data. Content analysis was done to re-group the answers of the respondents into some variables like physical characteristics, spatial characteristics, activities, emotional response, and cognitive factor. The results of the analysis will at the end shows some qualities of public open spaces which are preferred by students, as well as their activities in those spaces.

RESULTS AND DISCUSSION

Students Preference towards Green Open Space

As mentioned earlier, the data in this study use the data 67 respondents who chose open space as his favorite place, comprise of 27 female respondents, and 40 male respondents male.

Frequency of visit with particular group of companion (alone, friends, special friends, and family) is shown in Figure 1. It can be seen that more students frequently visited open space with friends. This result is consistent with Hurlock, 1996, who acknowledged that the students have the adolescent behavior that is characterized by the presence of important relationships with peers. This occurs because the education experiences they have at the age of 18-25 years include their teenage peers.

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very often</td>
<td>5</td>
</tr>
<tr>
<td>Often</td>
<td>4</td>
</tr>
<tr>
<td>Sometimes</td>
<td>3</td>
</tr>
<tr>
<td>Seldom</td>
<td>2</td>
</tr>
<tr>
<td>Very seldom</td>
<td>1</td>
</tr>
</tbody>
</table>

**Figure 1.** Frequency of Visit with Particular Group of Companion

Source: Authors Analysis, 2011

Based on its location, open space favored by the respondents can be categorized into two: a rural open space located in the suburbs, and urban open space located in the city center. Rural open space is selected by 85% of the
respondents (57 students), while the remaining 15% (10 students) selected urban open space. Both of these open spaces are selected referring to their characteristics.

Rural Open Space

Rural open space is selected by the respondents for its categories of location: hills/high places, nature/outbound places, natural landscape, and plantations. Among the four categories, hill / high places is the favorite place for 60% respondents (34 students) who choose rural open space.

![Rural Open Space](image)

Hills or high places selected as a favorite place for relaxation include: Punclut, Caringin Tilu (cartil), Bukit Bintang (Dago), and Puncak Lembang. These places are chosen primarily because of its location is higher than the surrounding, hence city views can be seen clearly from the place. Places in the nature / outbound places category are considered as natural tourism spot and have been well managed and optimized with built facilities. These places include: Ciater, Tahura, Maribaya, and other outbound places. The natural landscape is mountainous area and camp sites. Those places offer direct interaction with pure wilderness.

![Outbound Activities in Maribaya, Tahura, and Manglayang Mountain](image)

Figure 3. Outbound Activities in Maribaya, Tahura, and Manglayang Mountain
Source: Respondents documentation and Authors (2011)

Figure 4 shows the push factors that drive the respondents to choose the rural open space as a favorite place for rest or a tive function. The chart in the figure...
presents that natural element is the main attractive physical character of rural open space. With the nature character, most of the respondents can enjoy the beautiful scenery of the city and its surrounding, feeling calm, and be able to feel the benefits of restorative function (refreshing). Natural characteristics perceived in the rural open space are not easily found in the city, thus even though it was far from the campus and residential areas, rural open space will remain be searched.

Spatial characteristic where the push factor found is the high places. This is connected with the need of the respondents to see the scenery more freely. Other positive thing about the rural open space is its quiet location, away from the bustle of the city, as well as the fresh and clean air quality is make this place considered appropriate as places of contemplation and interaction, to feel different from daily atmosphere.

<table>
<thead>
<tr>
<th>PHYSICAL &amp; SPATIAL</th>
<th>EMOTIONAL &amp; COGNITIVE</th>
<th>ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tempat tinggi</td>
<td>Refreshing</td>
<td>Enjoying the scenery</td>
</tr>
<tr>
<td>High places</td>
<td>Beautiful scenery</td>
<td>Breathing the fresh air</td>
</tr>
<tr>
<td>Natural element</td>
<td>Serenity/calm</td>
<td>Contemplation</td>
</tr>
<tr>
<td>Fresh air</td>
<td>Different atmosphere</td>
<td>Interaction</td>
</tr>
<tr>
<td>Water element</td>
<td>Comfortable</td>
<td>Camping, outbond</td>
</tr>
</tbody>
</table>

Figure 4. Push Factors in Choosing Rural Open Space
Source: Authors’ Analysis, 2011

Figure 5 represents the usually visited places in the rural open space. These places include scenic spot located on high altitude, eating places with interesting view,
water elements, such as lakes, waterfalls, or ponds, places of worship, as well as outbound places. The existence of these elements needs attention in the planning and design of open space in order to be a favorite place.

![PLACES TO GO IN RURAL OPEN SPACE](image)

**Figure 5. Places to Go in Rural Open Space**
Source: Authors’ Analysis, 2011

![Source: Authors’ Photograph, 2011](image)

**Figure 6. Scenic Spot and Eating Place in Puncclut**
Source: Authors’ Photograph, 2011

**Urban Open Space**

Urban open space is selected by the 15% minority (10 respondents) of the total 67 respondents who chose open space. Types of urban open space selected are roadways (car free day, roadside around campus, and main street in central Bandung), selected by 5 respondents and city parks (Cikapayang Park, City Hall Park, garden of UPI, and MPRJB), also selected by 5 respondents.

Figure 7 shows the push factors in choosing urban open space. In physical and spatial factor, urban open space is chosen because it is cool, calm, and beautiful, just like the rural open space. In addition, urban open space is preferred since it is close to campus thus make it easily accessed. There are also many places for snacks at affordable prices.
The difference with rural open space is this open space is not used for contemplation but rather the interaction activities, sightseeing, and exposing themselves to other teenage peers. Furthermore, while in the rural open space people enjoy the panoramic beauty of nature, in the urban open space the main attraction is the crowd and people activities.

**Figure 7.** Push Factors in Choosing Urban Open Space  
Source: Authors’ Analysis, 2011

**Figure 8.** Activities in Urban Open Spaces  
Source: Authors’ Documentation, 2011

**Frequency of Visits to the Open Space**

Figure 9 shows the frequency or intensity of respondents’ visits to rural and urban open space. The result indicates that urban open spaces (streets and city parks) tend to be more frequently visited while rural open space is less frequently visited.
This is most likely related to the accessibility factor. Location of urban open space in the middle of the city, close to campus, can be easily reached by students, and much cheaper, hence it can be visited at anytime. While the rural open space despite its natural quality that cannot be found in the city is relatively more difficult to access and need specially allocated times such as weekends or holidays to visit. This makes the rural open space rarely visited compared with the urban open space.

Results of this study demonstrate the important roles of location and accessibility to the frequency of visits to a place. Places in the city center with good accessibility have great potentials to be developed as public green open space that can be visited easily at any time when needed. Provision of natural environment such as: plants and water must be considered in the planning for public green open space. This is in accordance with the public preference and has restorative functions.

**DISCUSSIONS – DESIGN CRITERIA FOR OPTIMIZATION OF OPEN SPACE IN ACCORDANCE WITH STUDENTS PREFERENCES**

From the analysis results, it is found out that Bandung has lots of potential to develop public open space into students’ favorite places which have restorative effects. The Municipality of Bandung has neglected the condition of the existing open space has resulted in unpopular open space as alternative leisure place in the city. Therefore, one way to increase the preferences toward open space is to improve the planning, design, and management system in order to meet the needs of students.

Natural qualities of rural open space that cannot be found in the city influence the respondents to choose rural rather than urban open spaces. This confirms the research results of Korpela (2003) which states that the natural environment is preferred as a favorite place for the purpose of restorative or relaxation. Hence, the existence of natural factors such as vegetation and water elements is an absolute thing that must be considered in the planning of open space for the community.
On the other hand, urban open space has advantages in terms of accessibility. Ease of access makes urban open space more often visited than rural open space. The development of potentials of the existing urban open spaces can be done by improving existing designs and incorporate elements of the natural and treated water elements designed to appeal so as to increase the preference of the general public as well as part of the student community. Efforts to increase the frequency of visits to the rural open space can be done by improving accessibility, such as road improvements, also the provision of public transport lines to reach the community. Thus the rural open space will be more easily accessible whenever needed.

Most of the students visited a public open space with their friends. It should be accommodated in the planning of public open, providing facilities that can be used for group activities, and preparing the seating configuration that facilitates group interaction, and so forth.

Results of this study also indicate that the hill or high altitude place is the most preferred for relaxation purposes. This provides inputs for the Municipality to consider places in the city which is favored by the public community. The urban open space is also preferred because of the existing crowd that makes it a comfortable place to hang out. Design of urban open space using different altitude levels and the provision of viewing towers at some point will make an urban open space becomes more attractive.

Moreover, results of this study also suggest the presence of eating places is to support the activities of students in public open space. Whyte (1980) also acknowledged that the presence of food vendors is a factor that can encourage someone to come to the public open space. Location of eating places should be carefully designed, well planned and cleanly maintained. It is often became a problem when they are accommodated by the street vendors which are not well managed and occupying whole places. This disrupts the activities of visitors who want to enjoy the public space.

**CONCLUSIONS**

This study finds that open space has a great potential to become a favorite restorative place for students. It was also retrieved that restorative effects for students can be derived not only from the natural elements, but also from non-natural elements. The result shows the tendencies to choose nature open space because of its natural qualities. The built environment or built open spaces are selected because of the ease of accessibility. The local government of Bandung should pay attention to this when planning for public open space provision and improving the present condition.
ACKNOWLEDGMENT

Authors would like to thank to DR. Eng. Hanson Endra Kusuma for the sharing and discussion during the research process.

REFERENCES

Lerner, J,(2003), Urban Acupuncture,Record, Rio de Janeiro.
DO PUBLIC PARKS CREATE A GREEN ENVIRONMENT?
CASE STUDY: TAMAN FLORA SURABAYA

Himasari Hanan*, Rakryan Khrisnaramya**
*) School of Architecture, Planning and Policy Development, Institut Teknologi Bandung, Indonesia
**) Master Student, Study Program Urban Design, Institut Teknologi Bandung, Indonesia
hanan@ar.itb.ac.id, ryankhrisnaramya@yahoo.com

ABSTRACT

The government of Surabaya plays a strong role in improving the quality of public parks. The physical transformation of existing parks in the city showed the strong political will in enhancing the city image and the development progress. The local government so far has been highly appreciated for the revitalization program of public parks, in that Surabaya residents are now keen to spend time outdoor and to experience green spaces. However, the program has not been evaluated yet how these public parks have improved the social life of the people and the park design for climatic reason. This paper is written based upon empirical research on public parks in Surabaya, which review the spatial design and its correlation to the making of a green environment and public place. The research observes people’s activities inside Taman Flora for three months to identify the uses of spaces and the interaction among people that have taken place. The qualitative evaluation is focused on the environmental function of Taman Flora as a public park in which it promotes the social interaction among residents and creates a green environment. The field survey includes mapping people’s activities, visual observation on spatial configuration and landscape elements, and interviewing visitor and user. The paper discusses the interpersonal and climatic factors that are in correlation to the environmental design. The discussion in this paper indicates the negative impact of rational design approach and the absence of ecological approach in the design of a green public place. So far, the public park has been designed and operated on physical functionalities and formalities basis and has not yet been managed to encourage its social and ecological function.

Keywords: green environment, public park, social interaction, Surabaya

INTRODUCTION

Over the last decade, many scholars and practitioners in urban development have researched how to improve people’s quality of life by increasing social interaction among people living in large cities (Carmona, 2003). Many scholars are in the
opinion that social capital of a nation contributed by social interaction gives an impact of raising Gross Domestic Production, education rate, health condition, and reducing criminal rate (Carmona, Magalhaes, & Hammond, 2008). There is a growing recognition that outdoor activities and natural environment can promote social cohesion, mental well-being, and overcome the feeling of isolation (Forsyth, A, 2005).

The rapid economic and population growth in large cities of Indonesia has caused many problems in resident’s physical and psychological health. The absence of social interaction affects to the augmentation of individualism, egocentrism, intolerant people and friction between groups of people. Urban dwellers are hesitant to undertake outdoor social activities because of, among others, the insufficiency of green open space and the hectic of urban life.

Taman Flora is selected as a case study for evaluating the impact of a public park to people’s social life and environmental issues. The analysis covers the utilization of the open space and the impact of its spatial design for the creation of green environment. In this research, green environment will be evaluated on its support for interpersonal relationship and urban greening through the impact of dominant factors to the spatial design.

Taman Flora is a public park in the middle of Surabaya, with an area of 2.4 Ha and open to public from 5.30 in the morning until 17.30 in the afternoon. Its surrounding is residential and commercial areas, and its location is circa 200 meter from the public transportation terminal Bratang. At the northern side, the park is bordered by Ngagel Jaya Selatan street, which is a major street for commercial activities and tertiary functions. At the eastern border is the Manyar street where educational buildings dominate the streetscape. The southern part of the park is bordered by commercial facilities in the 1-2 story buildings where the Flower Market and traditional market Bratang are remarkable. At the western side of the park are commercial buildings of 3 story high with the typology of shop houses and retail shops.

The local government originally founded Taman Flora in 1990 as a garden for plants seeding and nurseries, but later in 2007 the garden was revitalized and transformed to a public park for recreational and educational purposes. The park is afterwards popular for school excursion where younger people could learn and play with nature while enjoying recreation activities. As the government realized that the future of a recreational park to survive needs a professional management, in 2010 a private company PT Surya Inti Permata was assigned to develop Taman Flora as a green open space. Nowadays, Taman Flora is often called by the residents as an urban forest for the greenery has reached hundreds of trees, and the park has sheltered protected wildlife species.

Taman Flora is one of the most wide ranging public parks in Surabaya. It has facilities of children playground, mini zoo, outbound area, library, and it is furnished with WIFI connections and a classroom for Information Technology training. There is no doubt that many elementary students are fond of camping and undertaking outbound activities in this park. On holidays, visitors are not limited from Surabaya areas, but further away from neighboring cities such as Sidoarjo and Gresik. Special
occasions, as well as exhibition, seminar, and competition for children regularly take place in the park.

![Figure 1. Location of Taman Flora, Surabaya](source: Khrisnaramya, 2012)

**THEORY/ RESEARCH METHODS**

The research is started by literature review on the historical evolution and functional role of a public park. Studies of precedents indicate that public parks might be differentiated to three main categories in its role to the city and residents, namely for 1) ecological purposes, 2) social function, and 3) economic value. To its size and elements, public parks can be identified to 6 types, namely 1) Pocket Park, 2) Neighbourhood Park, 3) Community Park, 4) District Park, 5) Regional Park, and 6) National Park. Following the studies on public parks, the research converges to the issue of social interaction and environmental design as it is significantly neglected in the development of a green public place.

The discipline of environmental psychology indicates that personal and social factor, as well as physical factor, may contribute significantly to the promotion of social interaction in green open spaces. Research on personal space (Hall, 1992) has led to the issue of proxemics (the convenient distance between individuals who interacts each other) and the presence of personal bubble. During interpersonal interaction, this personal bubble regulates the distance as a mechanism for adaption to local conditions. Social space comes into being when individuals meet each other for a temporary interaction in a physical distance of 4-12 feet. Public space comes about when individuals meet each other without visual and communication contact in a physical distance of 12-25 feet. Proximity becomes a critical issue in the public park design for social interaction (Fischer et al, 1997, Marcus, C, 1998; Gehl, 2001).
The physical distance between individuals can be structured with the aim of enhancing social interaction among visitors in a green open space.

Another important factor for engaging people to interact in a green environment is the territoriality in human relations. Similar to personal bubble, territoriality is a human reaction in spatial dimension when an individual is invaded by others. A human being will intuitively defend his/her territory for self-expression, feeling secured, indicating his/her identity, or demonstrating ownership (Altman, 1975). Territory is also defined for self-actualization and maintenance of relationship with others. In general, a territory can be characterized with 1) spatial dimension, 2) individual/group control, 3) physically or symbolically signified, 4) motivation, 5) defensible.

The research is undertaken through case study method, and data are collected from primary and secondary resources. Physical elements in Taman Flora are observed and redrawn in plan drawings, and visual characteristic are documented in pictures and videos, whereas non-physical aspects are recorded from questioners and interviews to visitors. Previous studies on other public parks in Surabaya are referred for comparison. Primary and secondary data gained from the field observation and literature review are then analysed to retrieve the correlation of social interaction, physical design and green quality. The analysis is to explicate the characteristics and intensity of social interaction taking place in Taman Flora, and the impact of greenery and environmental design to social interaction in a green environment. The activities and ambience in Taman Flora is recorded in four different times, in the morning between 7.00-8.00, at noon between 12.00-13.00, and in the afternoon between 16.00-17.00. The field survey is carried out in three consecutive months in the year 2012, and questioners are spread out to 100 respondents.

RESULTS AND DISCUSSION

Facility Programming

![Diagram of Taman Flora (a)]
The people’s activities in Taman Flora are spread out in three (3) different zones (Fig. 2a):

1. **The Recreation Zone** at the north side. In this area stand the mini zoo (Fig. 3a) with a collection of rusa tutul, rusa Bawean and birds, and the outbound facilities with the equipment of flying fox and other games. The area covers 30% of the public park.

2. **The Education Zone** in the middle covers 28% of the public park. This zone represents the image of Techno-park, of which Taman Flora is known among Surabaya residents. This zone facilitates activities that are intended to educate people in using information technology. In this area people may enter to the Broadband Learning Center (Fig. 4a) and do browsing the internet and reading on Information Technology, and to Green House for learning about the nursery and plant seeds. The area is equipped with WIFI network in that people are free to access internet. Adjacent to this learning center is a spacious pavilion (pendopo) (Fig. 4b) where people undertake individual and group activities and enjoy being in the park and having leisure. Many people use this pavilion for social gathering and large group activities.

![Figure 2](image1.png)

**Figure 2.** (a) Zoning of Activities, (b) Site Plan
Source: Khrisnaramya, 2012

![Figure 3](image2.png)

**Figure 3.** (a) The mini Zoo, (b) The Birdcage, (c) The Children Playground
Source: Khrisnaramya, 2012
3. **The Playground zone** at the southern part of the park is dedicated to children playground and relaxation activities (Fig. 3c, 5a, 5b). There are tracks for jogging and a water feature as the focal point for relaxation activities in this area. The area covers 42% of the public park.

The facilities for services such as toilet, pavilion, and management office are centrally located in the middle of the park so that they are accessible from any direction. The landscape features fish pond and water fountain are spread out at the periphery of the park, whereas the built up area are concentrated in the middle zone. The open space for outdoor activities is allocated along the site in longitudinal from the north to the south in that people may wander crossing all zones easily in various spatial experiences. The layout of the facilities and Site Plan of the park is indicated in Figure 2b.

**Movement Design**

People enter the park from the entrance at the western and eastern side and move along the main ways straight to the recreation or education zone. To the visitor, the recreation zone is the most attractive place since the bird cage (Fig. 3b) and fish pond catch people’s attention at the first sight. After visiting the mini zoo, people tend to go for a walk to the education zone where plenty of park furniture is available, and then stay in the pavilion to shade and to leisure. After visiting the pavilion, people hesitate to walk further to the playground zone because of the
walking distance. The playground is quite away from the entrance and the pedestrian ways heading to it is rather discreet and does not invite people to walk. The polygonal pattern of the pedestrian ways concealed people’s access behind the trees, which make people discourage to walk through greenery (Fig. 6a) and stay longer to rest in the education zone.

In the playground zone, the water feature and greenery creates serene and green environment, nevertheless people come rarely to this area because of the unfriendly pattern of pedestrian ways between greenery. These hidden ways are, therefore, occupied only by the young couples in private interaction or people who are passing by for jogging. The greenery area has become a semi-private zone in the park and, ironically the greenest part is the least occupied area in the park. The attractive and tranquil water feature at the end of the park is concealed by the intricate ways and is not much appreciated and enjoyed by the visitor (Fig. 6b, 6c).

**Figure 6.** (a) Greenery, (b) Intricate ways, (c) Concealed water feature
Source: Khrisnaramya, 2012

**Greenery**

Taman Flora accommodates at least 1000 trees and plants within which around 100 species are tropical plants (Fig. 7a). They have been cultivated since it was initiated as a nursery. The greenery consists of large trees with a large canopy that is occasionally scattered in the area and forms an urban oasis for passerby and school children. *Samanea Saman* (Trembesi) and *Delonix Regia* (Flamboyan) are the common species to be found at both end of the park. They are in average 15 meter high and have a canopy with a diameter of 18 meter. Other trees with a large canopy are *Pterocarpus Indicus Willd* (Angsana), *Canangium Odoratum* (kenanga), and *Ficus Benyamina* (Beringin).

**Figure 7.** (a) Green oasis, (b) Vegetation as orientation
Source: Khrisnaramya, 2012

In the education zone, most vegetation is placed in adjacent to the pedestrian ways to create a green and visually pleasing environment. The trees here are in
average 2-3 meter high and charming when they are blooming, among others are: *Clerodendron Squamatum Vahl* (Bunga Pagoda), *Cerbera Manghas* (Bintaro), *Maniltoa Grandiflora* (Bunga Sapu tangan). The monumental Palm trees with average height of 5 meter: *Roystonea Regia*(Palem Raja), *Wodyetia Bifurcate* (Palem Ekor Tupai), *Veitchia Merillii* (Palem Putri) are planted as orientation for the pedestrian (Fig. 7b).

**Seating place**

In several places, young people and children are keen to sit on benches with comical figures, and most people enjoy making pictures of it (Fig. 8b). In the middle of the pedestrian route, long benches with greenery on top are installed and many people make use of it to rest after wandering (Fig. 8a). Its popularity as seating place is underlined by its size that accommodates many possibilities of sitting position and behavior of the young, children and adults. In the middle of the park, polygonal form of benches accommodates different uses of the place, in particular for chatting in groups (Fig. 8c). The inward looking form of the bench encourages people to have visual and verbal contact to each other. In the early morning, variety of people sit on the bench which is long enough to seats individuals with different interest and behavior without interfering one to another.

![Figure 8](source.jpg)

*Figure 8.* (a) The long bench, (b) The bench with comical figure, (c) The polygonal bench

*Source: Khrisnaramya, 2012*

The young people and children often use pedestrian ways as seating place when they have activities in groups. They sit on the paving area in sideways where nobody is passing through, and the area is shadowy. The adults usually use the main pedestrian ways as seating place during festivals or special occasions taking place in the pavilion area. Surface materials of the pedestrian ways determine the way people choose the sitting area; smooth materials such as ceramic tiles are favorable, whereas hard surface of concrete is consequently covered with mats or newspaper (Fig. 10c).

**Social Interaction**

During weekdays and holidays, people visiting the public park intensifies at noon as people come for having a break and to leisure, or the children on a school excursion. 68% of the visitors are low-income people from the city of Surabaya and they come
regularly to the park every week to meet friends, to wander and to play around. The other 30% are people from East Java region, and 2% are from outside East Java. 30% of the visitor comes 2-5 times a month to this park, and 42% of the visitor spends 2-3 hours on each visit. Most of the visitors (58%) come with friends and do activities that involved 3-5 persons. On holidays, activities with higher interaction rate occur in the morning when people do sports and children play at the playground, outbound area and in the pavilion. During weekdays, intensive activities take place at noon, and the most interactive activities are chatting with friends.

In the area of the bird cage, reindeer stalls (Fig. 9a) and fish pond (Fig. 9b) a lot of people stay longer to watch and feed the animal, to watch passer-by, and to have conversation to others. During weekdays, many people come to the park individually, while on holidays, they come with their families and close friends. Although the recreation zone is relatively small in size compared to the playground, most people are interested to visit this area because living creature and social activities are developed as public attraction. The outbound activities during weekdays are attended by a large group of school children between 6-10 years old, while on holidays, member of extended family or close friends are the participants (Fig. 9c). The activities over there are favorably interactive and dynamic, and succeed to involve a large number of individuals to interact in a group.

![Figure 9](image_url)

Figure 9. (a) Mini Zoo, (b) Fish pond, (c) Outbound area
Source: Khrisnaramya, 2012

The free access for WIFI attracts many young people to gather together and keep themselves busy with their laptop in the education zone. The IT facilities reinforced people to undertake passive activities and did not encourage people’s interaction. Dynamic activities, on the other hand, occur inside the pavilion where groups of children doing collaborative work such as drawing and attending lecture. The adults during the day use this pavilion for having a rest and taking a nap.

In the playground zone at noon, children of 5-10 years are playing around accompanied by their mother. While waiting for their children, the ladies sit on benches and have verbal communication to each other. The interaction between children and between mothers is influenced by the playground equipment, in which outdoor play set encourages higher social interaction than individual swings. Usually, the mothers respond spontaneously to the local situation and initiate to set up interactive social behavior. This situation is captured by the street vendors by which all of them settle down their business in the near of playground area. The
street vendors perceptively recognize that children and mothers are a regular visitor with the longest stay and great willingness to buy.

Besides the social interaction, Taman Flora has unintentionally provided places for intimate interaction, especially in the playground zone where empty pedestrian ways are covered with greenery. People, who look for intimacy, serenity and peacefulness, visit the park usually in the afternoon. They prefer to occupy pedestrian ways of which the surface material impressed as a pleasant and clean place for activities (Fig. 10a). The pavilion with its white ceramic floor impresses people also as a pleasant place for group activities (Fig. 10b).

Children visitors are dominated by children from kindergarten and elementary schools. They usually come during the day on school excursion and utilize educational facilities and outdoor areas for learning and playing around (Fig. 11b, 11c). The diverse collections of plants in the park ascertain its legacy as a natural laboratory complementary to formal education. The young people are represented by students of 20-23 years who come mostly in the afternoon to meet friends for discussion or chatting, and to date after college. They occupy places with WIFI connection and pedestrian ways for a period of up to two hours. On holidays, most of this young people come for dating in secluded and uninterrupted area. The adults of 30-35 years are predominantly parents who bring their children to play. The other adults are some people who come for leisure and take a rest or to meet friends (Fig. 11a). On holidays, besides the parents, there are only a small number of adults who come to the park for jogging with the family.
Environmental design

Personal factors have a strong influence to the uses of Taman Flora as a green open space. The majority of visitors are low-income Surabaya residents who live in high density residential areas. Their motive to come to a public park is for outdoor activities that are complementary to crowded domestic life, namely for relaxation, sports, enjoyment, playing and fresh air. The children are the utmost beneficiaries of the public park since most of the facilities are dedicated to children. The needs of the young and old people are not yet well anticipated since privacy and thermal comfort are not considered as important issues in the spatial design. Therefore, the young people occupy areas not in the way as it was designated. Secluded and shadowy areas and small units of sitting area are preserved by them for more personal and intimate interactions.

The differentiation of areas in the park is established to age differences, which subsequently has generated pattern of territoriality in social interaction. The children have activities in the playground zone, the Youngs establish private area for personal interaction on pedestrian ways, and the adults set up temporary territory in which commodities exchange may take place. The greenery is manipulated to define spatial grouping and territorial boundaries. Hence, the revitalization of Taman Flora has indeed led to the improvement of a public park for social function in which residents come over to green open space and interact with other people. Nevertheless, it has not been designed as a public place with a consideration on climatic reason and ecological function. The facility programming has matched people’s need for leisure and playground, yet the spatial design has not responded to environmental issues and climatic reason.

Informal social relations among visitors are crucial in generating people’s activities in open space. 94% of the visitors of Taman Flora come to the park for interactive activities with friends and relatives. It appears that the public park is just a functional place for activities among people who previously have been engaged in a relationship. People do not come to a public park for the better quality of environment, but for the needs of a meeting place out of the scarcity of space in their neighbourhood. The interaction with friends is the prime motive, whereas environmental condition of the place and its attractiveness as greenery are just secondary. The visitors can comfortably sit on the floor or pedestrian ways or steps, as far as people could gather together and have chitchat generously in their group. Therefore, greenery, thermal comfort, visually pleasing objects and quality in spatial design is not highly appreciated by the visitors.

The surroundings of the park play a great role in making the liveliness of the place. Diverse activities next to the park influence the various people coming over and the way people utilize the open space. The visibility of spaces in the park determines the interest among visitors. People favor for flowing pattern of movement, wide angle view to places and open multifunctional space where people may walk around while watching the activities taking place.

The seats and vegetation are as well critical for locating interactive activities, especially during the day in the tropical climate. Seating arrangement in circular form that accommodate group sitting is liked since it creates an enclosing space and
encourages conversation. Landscape features such as a stage, children playset, water elements, a plaza and street vendors attract people to come over, watch the scene, stay over for a while and then set up conversation with adjacent people. People like to stop, have a rest, and gather together under the shadow of the trees.

CONCLUSIONS

The great number of population in Surabaya has exceeded the capacity of public services that are accessible to low-income people. The lack of these services has made local government operate green open spaces as public facilities for education, sports, and amenities which are usually accommodated indoor. The high demand of space for people’s activities has turned the green open space into a multi-functional space that subjugates its ecological purposes. The green environment is overwhelmed with hard scape material for circulation and functional buildings. The trees are not planted to create a natural environment and to improve a better climate, yet, they are organized to fill up open spaces between geometrical patterns of ways. Functionalities and formalities have overruled the existential and experiential green environment. The spatial design does not promote the contribution of green open space for the livelihood of the people and the biodiversity.

The local government has succeeded to build up Taman Flora as a public park out of a nursery through the revitalization program responding the needs of the society. The public park is well visited and utilized by the residents, and vivid throughout the day and the week; nevertheless it has not accommodated the variety of people’s need to be in green environment. The activities of each group are isolated one from the other, and the designed spaces predominantly accommodate children activities. Privacy and thermal comfort for people are less anticipated than recreational facilities. The provision of functional space for group activities, on one hand, brings liveliness in the open space, but, on the other hand, it does not increase people’s participation to social life and ecological awareness. The rigid and enclosed boundaries of the zone in Taman Flora have hampered visual contact among people and discourage people’s movement inside the park. The visitors tend to walk straight away to the targeted area in the park with no guidance or direction for alternative experience being in a green environment.

The interactive activities in the park occurred among people who had known each other before they came to the park or due to the related interest and background. The activities taking place are comforted by personal and social relationship and not by the environmental design of the park. Nevertheless, landscape elements might intensify social interaction when seating arrangement is to create an enclosure, the layout of natural features attracts people to gather, and an open space promotes performances and people watching.
REFERENCES


ABSTRACT

According to the Asian Development Bank (ADB) in 2009 sustainable development is not possible without sustainable urbanization. Sustainable development has been defined as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs". Decision making for sustainable development, particularly in the field of planning or design, requires a framework within which to structure the problem. The proposed framework aims at guiding designers and planners, official public developers and decision makers through the process of understanding and evaluating sustainable development in planning and design on the basis of a new holistic structure that acts as a prompt and a checklist. Sustainable urbanization is a significant component and the key to sustainable growth and it’s strategies should be "green" with a strong emphasis on energy efficiency, public transport, and sound urban planning and construction. Furthermore urban sustainability indicators are important instruments for assessing the performance of cities, including environmental, economic and social indicators. Urban sustainability Indicators and their appropriative selection undoubtedly play an important role in successfully attaining urban sustainability. It is appreciated that the use of indicators for assessing urban sustainability performance is an important tool and has been widely adopted. This study use a descriptive methode to analyse the applied existing frameworks to evaluation the sustainability with the consideration for instance of it’s holistically approach. Urban sustainability Performance Indicators and the selection are very important tool in achieving the urban sustainability. The multi- modality aspects are appropriate approach as framework because it consist of not only technical assessment but also ecologically oriented assessment, understanding the historical and cultural significance of the planning asset and its social desirability, which is the key question according to this methode can be developed in Surabaya based on the issue of built environment.

Keywords: sustainable urbanization, surabaya, urban sustainability performance indicators, stakeholders
INTRODUCTION

The Importance and Necessity of the Key Issues: Sustainable Development and – Urbanization

According to the Asian Development Bank (ADB) in 2009 sustainable development is not possible without sustainable urbanization. Sustainable development has been defined as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987) and is a broad subject, within which today’s topic – sustainable urbanization – is a significant component. Sustainable Urbanization is the key to sustainable growth. Moreover, in his speech to the Regional Workshop on Sustainable Urbanization, Klaus Gerhaeusser, Director General of ADB’s East Asia Department, said rapid urbanization presents significant challenges for ADB’s developing member countries. Urbanization strategies should be “green” with a strong emphasis on energy efficiency, public transport, and sound urban planning and construction (Gerhaeusser, K, 2009). The UN Habitat said there can be no sustainable development without sustainable land. (http://www.unhabitat.org/downloads/docs/AMCHUD3.pdf) as follows:

“Governments should strengthen their capacities to respond to the pressures caused by rapid urbanization . . . . Particular attention should be paid to land management in order to ensure economical land use, protect fragile ecosystems and facilitate the access of the poor to land in both urban and rural areas”

According to Michael J. Paul and Judy L. Meyer (2001) Urbanization is a pervasive and rapidly growing form of land use change. More than 75% of the U. S. population lives in urban areas, and it is expected that more than 60% of the world’s population will live in urban areas by the year 2030, much of this growth occurring in developing nations (UN Population Division 1997, US Census Bureau 2001).

Massive urbanization programs are under way in many parts of the world, often in regions where the available land and resources are limited relative to the size of the population (International Conference on Sustainable Urbanization, PolyU, 2010). While urbanization is a natural consequence of economic development and industrialization, it does lead to many challenges. Such challenges include the provision of effective urban infrastructures (e.g. transport systems), adequate housing, sufficient energy and water supplies, a clean environment, and caring community support systems in a sustainable manner. These challenges are amplified by the severe problems already faced by the world, including climate changes and limited energy and water supplies.

In other hand the role of stakeholders in the city in dealing with the implementation of sustainable urbanization is very important. City authorities are particularly key to sustainable urbanization progress because of the coordinating role in the policies and the power in implementing them. Although the sustainable
city recently has become a new paradigm of urban development in the world and is a social, economic and political construct, but the sustainable cities are not equally sustainable for all social and ecological interests, not generic, planned objects, uniformly implemented throughout the world. They are individually constituted phenomena, produced within specific geographical scales and spaces and are not simply business as usual for capitalized urbanization, but involve the active repackaging or humanisation of neo-liberal projects in urban areas, through new discursive regimes and new economic practice (Whitehead, M, 2003).

The Role of Urban Planning, - Form and - Landscape in Sustainable Urbanization

The infrastructure systems are an integral part of urban planning and development which is its decisions contribute the urban form and the spatial distribution of people and economic activities, including services, people and goods. Therefore infrastructure has not only an immediate on the daily lives but also long-term environmental impacts. Tibajuka, A (2009) wrote that while the building of infrastructure can be disruptive of the local eco-system and often requires intensive use of physical resources and energy, the infrastructure locks cities and especially metropolitan areas into consumption and production patterns for decades to come. If there is a lacking in attention to environmental and social aspects in infrastructure development it can be reduce the profitability of investments and negatively influence competitiveness of urban areas and support the livability of a city as well as the attractiveness for investment.

Regarding the role of urban landscape in sustainable urbanization Turner, Tom (2009) has definition which is used by a large UK landscape practice: “a sustainable urban landscape achieves the correct balance between environmental, economic and social needs”. Moreover urban landscapes are described as socioecological systems where natural and social processes go together with the ecosystems (Andersson, E, 2006) and urban landscapes can be explored in respect of how cities developed over time and their relation to nature ( Sherwood, R.). Nowadays, urbanization no longer applies to the growth of cities and towns only but it also influences the processes in the rural countryside. The actual changes of landscapes are induced by urbanization processes such as residential and industrial land development and new communication infrastructures. The Construction Industry plays an important role in realization of sustainable urbanization and expected to contribute by executing its works in a sustainable way and the Role of city’s stakeholders in dealing with the implementation of sustainable urbanization is very important

Urban Sustainability Indicators in Evaluating Sustainable Development In the Field of Planning or Design.

Urban sustainability indicators are important instruments for assessing the performance of cities which is consist of environmental, economic and social indicators. Based on the Charter of European Sustainable Cities and Towns, cities
have worked with specific sets of urban sustainability indicators which enable them to measure their success in attaining their targets and to communicate the results of initiatives undertaken to their citizens. In other hand the definition of indicators is a complex procedure which will have to be checked and updated whenever required. The degree of complexity increases with the creation of a unique sustainability index, as indicators have to be weighted by their contribution to urban sustainability levels. The method suggested for defining a unique urban sustainability index is based on a survey measuring the theoretical degree of interest shown by the citizens of a given city. The theoretical degree of interest is the individual's true value, true probability of accepting an offer and true ranking of alternatives (Mega, V, et al, J,1998).

Urbanization is defined by the UN as movement of people from rural to urban areas (2004). In line with the promotion of sustainable urbanization, international institutions and governments at different levels are seeking the optimum urban sustainability value. It is important for a better urban sustainability performance to develop set of indicators by making target setting, performance reviews and facilitating communication among the policy makers, experts and public. A wide range of urban sustainability indicators is therefore in use across diversity of different cities and regions, which according to their particular needs and goals. Urban sustainability Indicators and their appropriative selection are very important tool in achieving the attainment of urban sustainability and the use of indicators for assessing urban sustainability performance. The various indicators have been applied in different ways for attaining urban sustainability and due to the differences between individual practices, the selection of indicators should be done with the clear understanding of the needs where these are going to be applied (Shen, L-Y, et, al., 2006). Whilst there are various lists of urban sustainability indicators there is no single set of indicators that suits equally to all cities of communities.

Objective and Aim of the Study

a. To explore the importance given to the issue of sustainable urbanization.
b. To review the framework proposed in relation to sustainability performance indicators used by European and Asian Cities and the specific ones unique to Surabaya as casestudy.

THE EXISTING FRAMEWORKS IN EVALUATING URBAN SUSTAINABILITY

Multi-Modal Aspects

A framework in decision making for sustainable planning or design, should overcome the problem and be a new approach in integrating the all elements of urban system holistically. This new holistic structure consist of 15 modal aspects/relevant issues and are needed in evaluating the sustainability which is used as a checklist by the important stakeholders like designers and planners, official public
developers and decisionmaker as shown by the following (Lombardi, P, Brandon, S, P, 2005):

a. A technical assessment of the construction under development with regard to dimension, space function, accessibility etc
b. An ecologically oriented assessment of the project illustrating the environmental compatibility of this development within the existing contact
c. An understanding of the historical and cultural significance of the planning asset and its social desirability
d. An analysis of the financial and economic feasibility
e. A check of the visual appeal of this new (re) development and of its flexibility or adaptability which may allow it to meet some future user needs
f. An assessment of the institutional sustainability of the project, based on analysis of the juridical and procedural issues
g. An understanding of what interest or concern there is in the local agenda of the city and its strategic plan.

Table 1: Proposed framework for sustainable development decision making particularly in the field of planning or design

<table>
<thead>
<tr>
<th>First level aspects</th>
<th>Second level aspects</th>
<th>Multi-modal aspects (modalities)</th>
<th>Issues of the built environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical environmental capital</td>
<td>Urban and infrastructural development</td>
<td>1. The numerical modality</td>
<td>Numerical accounting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. The spatial modality</td>
<td>Spaces, shape and extension (e.g. urban density)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. The kinematics modality</td>
<td>Transport and mobility (e.g. environmental quality level)</td>
</tr>
<tr>
<td>Human Cultural capital</td>
<td>Environmental and physical quality</td>
<td>4. The physical modality</td>
<td>Physical environment, mass and energy</td>
</tr>
<tr>
<td></td>
<td>Education and scientific development</td>
<td>5. The biological modality</td>
<td>Health, biodiversity and eco-protection (e.g. greenery)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. The sensitive modality</td>
<td>People’s perception towards the environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. The analytical modality</td>
<td>Analysis and formal knowledge (e.g. university reputation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8. The historical modality (Formative)</td>
<td>Creativity and cultural development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9. The</td>
<td>Communications and</td>
</tr>
</tbody>
</table>
Therefore the multi-modal structure as a key resource and holistic approach to decision-makers in this problem area which provides a means to assist the selection of assessment techniques in sustainable urban development issues in a pragmatic and integrated manner. This means that the most significant elements and linkages in the system are addressed, and the “technical” aspects, and the “soft “ institutional systems that direct and respond to them, evolve together. This method is appropriate to be used in a city to overcome many problems regarding physical, ecological, economical as well as social by making the performances as a list of questioner to the important stakeholders.

**Sustainable Urban Development Policies**

This method concentrated in producing sustainable urban development policies at its practice level by measuring and assessing the sustainability performance with urban sustainability indicators which is used to aid policy making (Dur, F. et al, 2010) and had a depth approach in dynamic and static built environment, as follows:

<table>
<thead>
<tr>
<th>Table 2 : Urban sustainability indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category</strong></td>
</tr>
<tr>
<td>Dynamic Built Environment</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
### The Six C’s of Sustainable Urbanization

Sustainable Urbanization or Sustainable urban Living is delivered according to the formula of "The Six C's of Sustainable Urbanization" is by Gary Pivo, who is the Chair of the Department of Urban Design and Planning at the University of Washington. He said that only in recent years has the concept of sustainable development begun to be applied to the field of urban planning as follows

**Table 3.** The Six C's of Sustainable Urbanization

<table>
<thead>
<tr>
<th>Factors</th>
<th>Built Environment and Planning aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Compactness</td>
<td>• The first principle is that more compact, densely developed cities are less auto dependent, less expensive to serve with infrastructure, and put less pressure on nearby farm, forest, and environmentally sensitive areas.</td>
</tr>
<tr>
<td></td>
<td>• Spatial, density, environment, nature</td>
</tr>
</tbody>
</table>

2. Completeness
- Communities should be made more complete. A complete community is one in which the segregation of urban activities has been reduced.
- Social aspect: Community

3. Conservation
- A third principle of sustainable urbanization — conservation — involves the use of a number of tools (in addition to development regulations) to protect environmentally sensitive areas.
- Environmental aspect: tax

4. Comfort
- Comfort takes note of the fact that it is important to create public spaces and routes that are pleasant for pedestrians and for non-auto users, such as bicyclists.
- Environmental aspect: Public spaces

5. Coordination
- Coordination involves joint planning by numerous jurisdictions. One example is creating a land use and transportation plan for Oregon's Willamette Valley from Portland to Eugene.
- Land Use, Transportation

6. Collaboration
- Partnership for the Willamette Valley's Future is bringing together Oregon community leaders from many interest sectors in order to establish ongoing dialogue about issues of common concern in the Willamette Valley.
- Partnership

Source: [http://cogeneration.net/sustainable-urbanization](http://cogeneration.net/sustainable-urbanization)

**International Urban Sustainability Indicators List (IUSIL)**

The List IUSIL is used to assist in conducting comparative analysis between available cases. (Shen, L-Y, et al., 2006). Due to the fact that indicators can be described or measured in different ways, therefore for the purpose of proper analysis the description and units of measurement for the indicators included in IUSIL must be clear and distinct indicators in order to avoid repetitions and netter classification.

**Table 4. IUSIL Indicators**

<table>
<thead>
<tr>
<th>Category</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENVIRONMENTAL-</td>
<td></td>
</tr>
<tr>
<td>En1 Geographically balanced settlement</td>
<td>En1-1 Population growth En1-2 Planned settlements</td>
</tr>
<tr>
<td>En2 Freshwater</td>
<td>En2-1 Proportion of total water resources used En2-2 Water use intensity by economic activity En2-3 Presence of faecal coliforms in freshwater En2-4 Biochemical oxygen demand in water bodies</td>
</tr>
<tr>
<td>En3 Wastewater</td>
<td>En3-1 Percentage of city population served by wastewater collection</td>
</tr>
<tr>
<td>En4 Quality of ambient air and atmosphere</td>
<td>En3-2 Percentage of wastewater receiving no/primary/secondary/tertiary treatment</td>
</tr>
<tr>
<td>En4-1 Number of times the limit values for selected air pollutants are exceeded</td>
<td></td>
</tr>
<tr>
<td>En4-2 Existence and level of implementation of air quality management plan</td>
<td></td>
</tr>
<tr>
<td>En4-3 Emissions of greenhouse gases</td>
<td></td>
</tr>
<tr>
<td>En4-4 Consumption of ozone depleting substances</td>
<td></td>
</tr>
<tr>
<td>En5 Noise pollution</td>
<td>En5-1 Share of population exposed to long-term high level of environmental noise</td>
</tr>
<tr>
<td>En5-2 Noise levels in selected areas</td>
<td></td>
</tr>
<tr>
<td>En5-3 Existence and level of implementation of a noise action plan</td>
<td></td>
</tr>
<tr>
<td>En6 Sustainable land use</td>
<td>En6-1 Artificial surfaces as a percentage of the total municipal area.</td>
</tr>
<tr>
<td>En6-2 Extent of derelict and contaminated land</td>
<td></td>
</tr>
<tr>
<td>En6-3 Number of inhabitants per Km2</td>
<td></td>
</tr>
<tr>
<td>En6-4 Quota of new edification taking place on virgin area and quota taking place on derelict and contaminated land in % per year.</td>
<td></td>
</tr>
<tr>
<td>En6-5 Restoration of urban land</td>
<td></td>
</tr>
<tr>
<td>a) Renovation, conversion of derelict buildings</td>
<td></td>
</tr>
<tr>
<td>b) Redevelopment of derelict land for new urban uses</td>
<td></td>
</tr>
<tr>
<td>c) Cleansing of contaminated land</td>
<td></td>
</tr>
<tr>
<td>En6-6 Protected areas as a percentage of total municipal area</td>
<td></td>
</tr>
<tr>
<td>En6-7 Land affected by desertification</td>
<td></td>
</tr>
<tr>
<td>En6-8 Area under organic farming</td>
<td></td>
</tr>
<tr>
<td>En6-9 Proportion of land area covered by forests</td>
<td></td>
</tr>
<tr>
<td>En7 Waste generation and management</td>
<td>En7-1 Percentage of city population with regular solid waste collection</td>
</tr>
<tr>
<td>En7-2 Percentage of solid waste disposed to sanitary landfill/incinerated and burned openly/disposed to open dump/recycled/other</td>
<td></td>
</tr>
<tr>
<td>En7-3 Total solid waste generation per capita</td>
<td></td>
</tr>
<tr>
<td>En7-4 Generation of hazardous waste</td>
<td></td>
</tr>
<tr>
<td>En7-5 Waste treatment and disposal</td>
<td></td>
</tr>
<tr>
<td>En7-6 Management of radioactive waste</td>
<td></td>
</tr>
<tr>
<td>En8 Effective and environmentally sound transportation systems</td>
<td>En8-1 Travel time</td>
</tr>
<tr>
<td>En8-2 Transport modes</td>
<td></td>
</tr>
<tr>
<td>En8-3 Energy intensity of transport</td>
<td></td>
</tr>
<tr>
<td>En9 Mechanisms to</td>
<td>En9-1 Local environmental plans</td>
</tr>
<tr>
<td>En9-2 Latest approval date of Master Plan</td>
<td></td>
</tr>
<tr>
<td>PREPARE AND IMPLEMENT ENVIRONMENTAL PLANS</td>
<td>En10 Biodiversity</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>En10-1 Proportion of terrestrial area protected</td>
<td></td>
</tr>
<tr>
<td>En10-2 Management effectiveness of protected areas</td>
<td></td>
</tr>
<tr>
<td>En10-3 Area of selected key ecosystems</td>
<td></td>
</tr>
<tr>
<td>En10-4 Fragmentation of habitats</td>
<td></td>
</tr>
<tr>
<td>En10-5 Change in threat status of species</td>
<td></td>
</tr>
<tr>
<td>En10-6 Abundance of selected key species</td>
<td></td>
</tr>
<tr>
<td>En10-7 Abundance of invasive alien species</td>
<td></td>
</tr>
</tbody>
</table>

| ECONOMIC | Ec1 Consumption and production patterns |
|-------------------------------------------------|
| Ec1-1 Material consumption |
| Ec1-2 Material intensity of the economy |
| Ec1-3 Domestic material consumption |
| Ec1-4 Annual energy consumption, total and by main user category |
| Ec1-5 Share of renewable energy sources in total energy use |
| Ec1-6 Intensity of energy use, total and by economic activity |

<table>
<thead>
<tr>
<th>Ec2 Economic development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ec2-1 Macroeconomic performance</td>
</tr>
<tr>
<td>a) Gross domestic product (GDP) per capita</td>
</tr>
<tr>
<td>b) Gross saving</td>
</tr>
<tr>
<td>c) Investment share in GDP</td>
</tr>
<tr>
<td>d) Adjusted net savings as percentage of gross national income (GNI)</td>
</tr>
<tr>
<td>e) Inflation rate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ec2-2 Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Employment-population ratio</td>
</tr>
<tr>
<td>b) Vulnerable employment</td>
</tr>
<tr>
<td>c) Labor productivity and unit labor costs</td>
</tr>
<tr>
<td>d) Share of women in wage employment in the non-agricultural sector</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ec2-3 Information and communication technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Internet users per 100 population</td>
</tr>
<tr>
<td>b) Fixed telephone lines per 100 population</td>
</tr>
<tr>
<td>c) Mobile cellular telephone subscribers per 100 population</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ec2-4 Research and development</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Gross domestic expenditure on Research and Development as a percent of GDP</td>
</tr>
<tr>
<td>Ec2-5 Tourism</td>
</tr>
<tr>
<td>a) Tourism contribution to GDP</td>
</tr>
</tbody>
</table>

| Ec3-1 Debt service ratio |
| Ec3-2 Tax service ratio |
| Tax collected as percentage of tax billed |
| Ec3 Finance          | Ec3-3 Own-source revenue as a percent of total revenues  
|                     | Ec3-4 Capital spending as percentage of total expenditures  
|                     | Ec4-1 Price of water  
|                     | Ec4-2 Domestic water consumption per capita  
| Ec4 Water           | Ec5-1 Informal employment  
| Ec5 Strengthen small and microenterprises |  
| SOCIAL:            | So1 Energy Access  
|                     | So1-1 Percentage of city population with authorized electrical service  
|                     | So1-2 Total electrical use per capita  
|                     | So1-3 Number and duration of electrical interruptions per year per customer  
|                     | So2-1 Percentage of city population with potable water supply service  
|                     | So2-2 Number of interruptions in water service  
|                     | So3-1 Percentage of children completing primary and secondary education  
|                     | So3-2 Percentage of school aged children enrolled in schools (by gender)  
|                     | So3-3 Student/teacher ratio  
| So3 Education       | So4-1 Mortality  
|                     | a) Under-five  
|                     | b) Mortality rate  
|                     | c) Life expectancy at birth  
|                     | d) Healthy life expectancy at birth  
|                     | So4-2 Health care delivery  
|                     | a) Percent of population with access to primary health care facilities  
|                     | b) Contraceptive prevalence rate  
|                     | c) Immunization against infectious childhood diseases  
|                     | So4-3 Nutritional status  
|                     | a) Nutritional status of children  
|                     | So4-4 Health status and risks  
|                     | a) Morbidity of major diseases such as HIV/AIDS, malaria, tuberculosis  
|                     | b) Prevalence of tobacco use  
|                     | c) Suicide rate  
| So4 Health          | So5-1 Number of homicides per 100,000 population  
|                     | So5-2 Number of sworn police officers per 100,000  

<table>
<thead>
<tr>
<th>So5 Safety</th>
<th>population</th>
</tr>
</thead>
<tbody>
<tr>
<td>So5-3 Violent crime rate per 100,000 population</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>So6 Fire &amp; Emergency Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>So6-1 Number of firefighters per 100,000 population</td>
</tr>
<tr>
<td>So6-2 Number of fire related deaths per 100,000 population</td>
</tr>
<tr>
<td>So6-3 Response time for fire department from initial call</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>So7 Poverty</th>
</tr>
</thead>
<tbody>
<tr>
<td>So7-1 Income poverty</td>
</tr>
<tr>
<td>a) Proportion of population living below national poverty line</td>
</tr>
<tr>
<td>b) Proportion of population below $1 a day</td>
</tr>
<tr>
<td>So7-2 Income inequality</td>
</tr>
<tr>
<td>a) Ratio of share in national income of highest to lowest quintile</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>So8 Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td>So8-1 Km of transportation system per 100,000 population</td>
</tr>
<tr>
<td>So8-2 Annual number of public transit trips per capita</td>
</tr>
<tr>
<td>So8-3 Commercial Air Connectivity</td>
</tr>
<tr>
<td>So8-4 Average travel speed on primary thoroughfares during peak hours</td>
</tr>
<tr>
<td>So8-5 Transportation fatalities per 100,000 population</td>
</tr>
<tr>
<td>So8-6 Number of daily trips and time taken per capita by type of trip and by mode of transport</td>
</tr>
<tr>
<td>So8-7 Total average daily distance covered per capita by type of trip and by mode of transport</td>
</tr>
<tr>
<td>So8-8 Mode of transportation used by children to travel between home and school</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>So9 Natural hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>So9-1 Percentage of population living in hazard prone areas</td>
</tr>
<tr>
<td>So9-2 Human and economic loss due to natural disasters</td>
</tr>
<tr>
<td>So9-3 Disaster prevention and mitigation instruments</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>So10 Adequate housing</th>
</tr>
</thead>
<tbody>
<tr>
<td>So10-1 Durable structures</td>
</tr>
<tr>
<td>So10-2 Overcrowding</td>
</tr>
<tr>
<td>So10-3 Right to adequate housing</td>
</tr>
<tr>
<td>So10-4 Housing price and rent-to-income</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>So11 Shelter</th>
</tr>
</thead>
<tbody>
<tr>
<td>So11-1 Percentage of city population living in slums</td>
</tr>
<tr>
<td>So11-2 Area size of informal settlements as a percent of city area and population</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>So12 Secure tenure</th>
</tr>
</thead>
<tbody>
<tr>
<td>So12-2 Authorized housing</td>
</tr>
<tr>
<td>So12-3 Evictions</td>
</tr>
<tr>
<td>Category</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td><strong>So12 Security of Tenure</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>So13 Access to credit</strong></td>
</tr>
<tr>
<td><strong>So14 Access to land</strong></td>
</tr>
<tr>
<td><strong>So15 Promote social integration and support disadvantaged groups</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>So16 Culture</strong></td>
</tr>
<tr>
<td><strong>So17 Recreation</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Go1 Participation and civic engagement</strong></td>
</tr>
<tr>
<td><strong>Go2 Transparent, accountable and efficient governance</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Go3 Government</strong></td>
</tr>
</tbody>
</table>
| **Go4 Sustainable management of the authorities and businesses** | The International Urban Sustainability Indicators List (IUSIL) is such a holistic and very detailed framework as shown by the long list and could be implemented in the...
city that has completed and availability of data. This list is more a quantitative approach and almost all the data should be measured.

RESULT AND DISCUSSION

Review the framework of sustainability performance indicators

The selected frameworks from different point of view has some specific methods and main aspects which is important to be reviewed in describing the holistically approach, as shown at table 5.

<table>
<thead>
<tr>
<th>Method</th>
<th>Main Aspect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-Modal Aspects</td>
<td>1. Physical environmental capital. 2. Human Cultural capital 3. Financial institutional capital 4. Governance</td>
<td>1. This multi modal method is one of the key requirements to be considered in the development of frameworks/ models and processed to address the evaluation of sustainability 2. It is a more holistic frameworks used as a checklist by the important stakeholders such as designers, planners, official public developers and decision makers which is consist of not only technical assessment of the construction but also ecologically oriented assessment, understanding the historical and cultural significance of the planning asset and its social desirability. Moreover the checklist consist of analyse the financial and economic feasibility, the visual appeal of this new (re) development and of its flexibility or adaptability as well as the institusional sustainability of the project as well as analysis of the juridical and procedural issues as well as what interest or concern there is in the local agenda of the city and its strategic plan.</td>
</tr>
<tr>
<td>Sustainable Urban Development Policies</td>
<td>1. Dynamic and static Built Environment</td>
<td>1. This method produce sustainable urban development policies at its practice level by measuring and assessing the sustainability performance with urban sustainability indicators which is used to aid policy making 2. The themen are acessibility and affordability, environmental externalities, resource consumption, travel pattern, location, urban density, urban form and</td>
</tr>
</tbody>
</table>
The Six C's of Sustainable Urbanization

<table>
<thead>
<tr>
<th>Design</th>
<th>The unique formula in developing sustainable urbanization or sustainable urban living is to be applied to the field of urban planning</th>
</tr>
</thead>
</table>

1. Compactness, completeness, conservation, comfort, coordination and collaboration

International Urban Sustainability Indicators List (IUSIL)

<table>
<thead>
<tr>
<th>Design</th>
<th>The indicators for measurements are very detail and indicate variables to be measured. This variables can be measured in different ways, therefore for the purpose of proper analysis the description and units of in order to avoid repetitions</th>
</tr>
</thead>
</table>

1. Environmental Economy, Social and Government

The Implementation of Urban Sustainability Performance in a Case Study

This paper discuss also the implementation of the urban sustainability performance as framework for evaluating the city in a case study and Surabaya would be selected by considering the holistic problems not only in physical but also ecological, historical and cultural as well as social. The development of Surabaya (340 km², 3.2 Mill) is rush recently into big settlements, industries and services which have brought positive impact economically. Ecologically Surabaya has still problem in achieving the green open space which is shown by the lacking in the awareness of districts in following the city regulation for green open space which is indicated by the changing of green landuse into settlement and industries. Although the quality of green open space which is managed by the government has already increased but the lacking in quantity is still exist and should be planned carefully. For the year 2009-2029 the Goverment will plan 6.610 ha (66,10 km²) and it is not sufficient enough for the whole Surabaya which needs approximately 102 km²/340 km². Moreover with a population of more than 3 million and as a center of business, commerce, industry, and education in Eastern Indonesia Surabaya has strong urban attraction, providing an increasing number of residents each year. The study shows that by using the Maximum Likelihood method and with GIS technology overlaying for the years 1990-2009, vegetation and mangrove between the years 1990-2009 in Surabaya shrank very rapidly, from 48% in 1990 to just 10.9% in 2009 (Wahid Hasyim, A et al, 2011) as shown by the figure 1.
The Analyse of Key Question in developing of Urban Sustainability Performance with Case Study Surabaya

The selected method of Urban Sustainability Performance will be used for assessing urban sustainability performance with creating the list as quisionaire to the selected stakeholders. This set of performance indicators will be asked in form of semi structured discussion with the academic, policy makers and experts as well as public. To develop the method the first step is to analyze those areas where urban sustainability performance grading particularly poor by qualitative investigation based on semi-structured discussion with different stakeholders and experts. The preparation for making quisionaire should be made with the development of key question from each group of main aspect (Physical environmental capital, Human Cultural capital, Financial institutional capital and Governance) which is the key question according to this method can be developed in Surabaya based on the issue of built environment such as:

<table>
<thead>
<tr>
<th>Multi Modal Aspect</th>
<th>Key Questions for Case Study Surabaya</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In order to be sustainable City the following questions should be answered</td>
</tr>
<tr>
<td>1. The numerical modality</td>
<td>a) How long takes the development process?</td>
</tr>
<tr>
<td></td>
<td>b) How much the cost of the development of existing (renewable and unrenewable) natural resource?</td>
</tr>
<tr>
<td></td>
<td>c) How long it takes to gather the community Surabaya in collecting their aspiration in the making of the spatial planning and regulation</td>
</tr>
<tr>
<td></td>
<td>d) How much the redistribution of wealthy by this scheme is.</td>
</tr>
<tr>
<td>Multi Modal Aspect</td>
<td>Key Questions for Case Study Surabaya</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td><strong>Multi Modal Aspect</strong></td>
<td><strong>Key Questions for Case Study Surabaya</strong></td>
</tr>
<tr>
<td><strong>In order to be sustainable City the following questions should be answered</strong></td>
<td></td>
</tr>
</tbody>
</table>
| **2. The spatial modality** | a) How is the density of the city Surabaya currently?  
b) Is the density and the urban form suitable for the stakeholder as well as environment friendly?  
c) Is the development flexible enough to be considered in the next development? Will the urban form be kept for along time? Could the existing development be implemented?  
d) How is the role of stakeholders in the decision of the form/pattern of building and it’s regulation? |
| **3. The kinematics modality** | a) How is the transportation system in Surabaya recently? Do the system affect the mobility in the longterm?  
b) Do each stakeholders get easy access with public transportation and as a part of transportation system development?  
c) Is the planned transportation system environmental friendly and increasing the quality of air? |
| **4. The physical modality** | a) How is the involvement of local community in the process of environment planning and developing?  
b) How big is the awareness of the people in managing the building intensity (zoning, building mass arrangement, FAR, BC, ROW etc)?  
c) Does the implementation of development depend on and consider more in not renewable and renewable and even on local resources? How is the implementation?  
d) Have the implementation already consider the efficient as well as alternative energy? |
| **5. The biological modality** | a) How is the role of local community in Surabaya responding the issue of local environment?  
b) How is the strategy in balancing the development process with the community’s health? Do the fulfillment of healthy infrastructure as a part of consideration in the development?  
c) How is the applied development strategy in increasing the quality of air, water and groundwater as well as saving of ecological environment? How is the impact of this strategy to the healthy environment?  
d) How is the role of local natural resources in the implementation of development? |
<table>
<thead>
<tr>
<th>Multi Modal Aspect</th>
<th>Key Questions for Case Study Surabaya</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6. The sensitive modality</strong></td>
<td>In order to be sustainable City the following questions should be answered</td>
</tr>
<tr>
<td>a) Does the local government have the long term safety and is the planning addressed to overcome the criminality issue and violence? Do all the stakeholders feel comfortable and secure in the local planning/design? Does the design consider also the aspect of the children as the users?</td>
<td></td>
</tr>
<tr>
<td>b) Can the existing planning overcome the problems of noise as well as affect the existing visual aspect?</td>
<td></td>
</tr>
<tr>
<td>c) Do all stakeholders (including passive stakeholders) become as consideration in the planning? Is the local community also fight for the children rights and involved in decision making?</td>
<td></td>
</tr>
<tr>
<td><strong>7. The analytical Modality</strong></td>
<td></td>
</tr>
<tr>
<td>a) Is there any academic analysis in making the policy? Have the academic analysis already made to overcome the problem including consider the long term perspective? How is the role of academic and practitioner in decision or policy making?</td>
<td></td>
</tr>
<tr>
<td>b) Could the financial of the city support all the solutions in long term?</td>
<td></td>
</tr>
<tr>
<td>c) Is there any education planning for the people and education programm which attached with the environment for the community?</td>
<td></td>
</tr>
<tr>
<td>d) Can the analysis be accessed and approved by the majority of stakeholders?</td>
<td></td>
</tr>
<tr>
<td><strong>8. The historical modality</strong></td>
<td></td>
</tr>
<tr>
<td>a) Do the planning and design of the city Surabaya (as the historical city) include the restoration program in conserving the conservation or historical area? Do the innovation based on the local value?</td>
<td></td>
</tr>
<tr>
<td>b) How is the role of the people participation or community in the heritage or conservation program?</td>
<td></td>
</tr>
<tr>
<td>c) Could the planning increase the life standard and culture aspiration from middle low and disadvantaged community?</td>
<td></td>
</tr>
<tr>
<td>d) Is the technology used in conservation environmental friendly?</td>
<td></td>
</tr>
<tr>
<td>e) Does the city possess and make good consultation processes? Have this process already done connected with it’s proposal?</td>
<td></td>
</tr>
<tr>
<td><strong>9. The communicative modality</strong></td>
<td></td>
</tr>
<tr>
<td>a) Is the monitoring system already prepared in the planning?</td>
<td></td>
</tr>
<tr>
<td>b) Will the communicative infrastructure be increased not only in the recent but also in the next time?</td>
<td></td>
</tr>
<tr>
<td>c) Is there any long term programm for urban sign?</td>
<td></td>
</tr>
<tr>
<td>d) Does the planning increase the accessibility in communication facility for the whole community, include middle low and disadvantaged?</td>
<td></td>
</tr>
<tr>
<td>e) Does the planning include environmental impact?</td>
<td></td>
</tr>
</tbody>
</table>
### Multi Modal Aspect

<table>
<thead>
<tr>
<th>Key Questions for Case Study Surabaya</th>
</tr>
</thead>
<tbody>
<tr>
<td>In order to be sustainable City the following questions should be answered</td>
</tr>
<tr>
<td>assessment? Is the environmental oriented advertising already available and the information regarding development planning accessible for stakeholders?</td>
</tr>
<tr>
<td>f) Can the community involve in the discussion, argumentation as well as evaluation in planning? Do all the parties communicate with the same “language”?</td>
</tr>
</tbody>
</table>

### 10. The social modality

| a) | Does the development planning consider the social aspect? (either from the potential of social or from social impact appeared) |
| b) | Is there any effort in involving the people in the development planning? |

### 11. The economical modality

| a) | Is there any longterm financial evaluation? How is the scheme of the financing in the development plan? |
| b) | Is there any local worker in the construction or development? |
| c) | Is there any efficient management in the scheme of the development? Any recycling programme which give the profit for the government? |
| a) | Who are the stakeholders which involved and have more attention on the economy and finance? |

### 12. The aesthetical modality

| a) | Has the city in the scheme of development considered the availability as well as the artistic character of building and settlement in the certain time? |
| b) | Does the built environment increase the visual attraction? |
| c) | Do you feel satisfied as one of decision maker with the scheme of city development? How is the response from others of the “aesthetic intervention”? |
| d) | Have the physical development already considered the natural environment? Will that scheme change the existing natural form? |

### 13. The juridicial modality

| a) | Have the rights and obligations from the developers, owners and users already be paid attention in the longterm? |
| b) | Do the scheme identify who takes the profit and who should pay from the development? |
| c) | How far the people can change their environment with or without their elected representatives? |
| d) | Have “Environmental Assessment” which fulfilled the technical standard regarding environment protection already done? Which community involved in the decision making? |
### Multi Modal Aspect

<table>
<thead>
<tr>
<th><strong>Key Questions for Case Study Surabaya</strong></th>
<th><strong>In order to be sustainable City the following questions should be answered</strong></th>
</tr>
</thead>
</table>
| **14. The ethical Modality**             | a) Has the programm of development already anticipate the social and economical impact in the community in the future and how can be handled?  
   b) Can all the people take benefit from the outcome from the development programm  
   c) Do the programm has already “Assessment of Environmental “document”?  
   d) Are the programm care- taker involved in the decision making for development programm? |
| **15. The credal Modality**              | a) What kind of government policies are valid in the area of development programm?  
   b) What are the constrains in implementing the programm design?  
   c) Do the steps and points of design pay attention to the aspect of regional spatial planning? Is there any consideration regarding environmental impact from these programm as well as any financial planning to overcome it?  
   d) From what kind of resources comes the financial development?  
   e) Who is responsible for the design programm and What kind of responsibilities and roles in these development programm? |

### CONCLUSION

a. The importance given to the issue of sustainable urbanization are for a better sustainable urban living. Urban sustainability Performance Indicators and the selection are very important tool in achieving the urban sustainability.

b. The use of performance indicators for assessing urban sustainability performance is an important tool and has been adopted by many countries. The multi-modality aspects are appropriate approach as frameworks proposed in relation to other similar sustainability performance indicators because of it’s holistically in assessing indicator.

c. The selected method of Urban Sustainability Performance will be used for assessing urban sustainability performance with creating the list as quisionaire to the selected stakeholders. This set of performance indicators will be asked in form of semi structured discussion with the academic, policy makers and experts as well as public. To develop the method the first step is to analyze those area where urban sustainability performance grading particularly poor by qualitative investigation based on semi structured discussion with different stakeholders and experts.
The preparation for making quisionaire should be made with the development of key question from each group or main aspect (Physical environmental capital, Human Cultural capital, Financial institutional capital and Governance) based on the issue of built environment.

ACKNOWLEDGMENT

The Author would like to thanks Prof. Anson dan Prof. L-Y Shen from the Department of Building and Real Estate Polytechnic University Hong Kong for the depth discussion regarding the urban sustainability as well as the students of Post Graduate Study Department of Architecture ITS in discussing the key questions.

REFERENCES

Shen, L-Y, et, al. Key Assessment Indicators for the Sustainability of Infrastructure Projects. Journal of Construction Engineering and Management ©ASCE/June 2011/441
The Faculty of Construction and Land Use (FCLU) of the Hong Kong Polytechnic University (PolyU). The First International Conference on Sustainable Urbanization (ICSU) on 15-17 December 2010 in Hong Kong
Materu, J, Sietchiping: Geoinformation for Sustainable Urbanization UN-Habitat
The Goal of "Sustainable Urbanization" or Sustainable Urban Living URL (http://cogeneration.net/sustainable-urbanization/)

Pivo, G (1997). The Six C’s of Sustainable Urbanization. URL: http://www.u.arizona.edu/~gpivo


Tibaijuka, Anna (2009). Forum on Sustaiable urbanization in The Information Age. Role of Infrastructure in Metropolitan Development

Tang, Thomas S.K. For a sustainable world, start at the city Level.

APPROACHING VERTICAL GREENERY AS PUBLIC ART:
A REVIEW ON POTENTIALS IN URBAN MALAYSIA

Nur Izzah Abu Bakar*, Mazlina Mansor **, and Nor Zalina Harun **.

*) Master candidate, Department of Landscape Architecture, Kulliyyah of Architecture and Environmental Design (KAED), International Islamic University Malaysia (IIUM), Jalan Gombak, P.O. Box 10, 50728 Kuala Lumpur, Malaysia.
**) Lecturer, Dept. of Landscape Architecture, KAED, IIUM, Malaysia.
Email : izzah1987@gmail.com

ABSTRACT

When landscape becomes the work of art, it is becoming more significant to the community. However, finding practical and effective ways in which public art could present an environmental cause is yet to be fully explored. Therefore, one way to approach this issue is by increasing the Vertical Greenery technology’s application, especially at the wall of building in the city. Vertical Greenery (VG) varies in term of definition, but all in all, it can be interpreted as the growing of plants in, up, or against the facade of a building. On the other hand, public art can be referred as an artwork that is located in public space, which welcomes public interactions. Thus, in order to further study the potential of VG implementation as public art, this paper reviews 25 selected real life projects in urban Malaysia as reference studies, which include Kuala Lumpur, Selangor Johor and Penang that applied VG in their development. It explored whether the VG’s implemented is, for public art. Based on the study, the researcher found that VG is implemented for its’ environmental, economic and aesthetic value. The researcher also noted that all VG that has been implemented at the developments in some ways portray the basic idea of public art which is an artistic expression that is positioned in a freely accessed public space for the public to use, but not just any art placed outside yet still carries the basic concept of art, which to beautify spaces. Hence, the result had shown significant potentials for VG to be introduced as a new form of sustainable public art in urban Malaysia.

Keywords: Aesthetic value, environmental value, potentials, public art, Vertical Greenery (VG).

INTRODUCTION

Art is usually associated with privatization. The audience is commonly from the elite groups, and it is normally placed in a gallery. On the other hand, public art,
according to Bach (2001), is an artistic expression that is positioned in a freely accessed public space for the public to use and for everyone to enjoy. Nevertheless, Bostwick (2008) mentioned that artists and arts advocates are consistently trying to make a case for the arts by addressing economic and social aspects. Nonetheless, she then argued whether the artist also tackled the environmental aspects of public art. She asserted that there are a few studies conducted to explore the ways in which public art could provide an environmental purpose. Thus, one way to engage public art in environmental aspect is by increasing the Vertical Greenery (VG) technology applications on the walls of our buildings whereby a plain wall can be turned into a luscious plant-filled art vision. VG can become a work of art that is alive. For example, growing and choosing plants over the typical granite or marble finish allows one to make a strong green statement, in other word means ‘greener art’ (G TOWER-Rebuilding the green concept 2012).

Thus, in order to further study the potential of VG implementation as public art, this paper reviews 25 selected real life projects in urban Malaysia as reference studies which include Kuala Lumpur, Selangor and Johor that have applied VG in their development. It explores the current practice of VG in buildings development in urban Malaysia; identify the purpose and objective of the VG application in the building development and determine whether VG has the potential to become a new form of public art. Thus, this exploratory study is hoped to help architects, landscape architects or promoters of VG technology in further understanding the benefits of VG so that later, encourage wide and rapid implementation of VG in our urban developments in Malaysia.

Public Art: An Overview

The term ‘public art’ is subject to a variety of interpretations. It is relevant to everything from subway graffiti to government-funded monumental sculpture. It has been employed as a touchstone to describe any art that is not housed in formal museums or galleries. Public art, says painter-educator Jolly Koh (see Shunmugam, 2010) is any work of ornamentation or art that is in public places such as parks and street corners, and on buildings. However, public art as mentioned by Sharp et. al. (2005) is not just any art placed outside.

Hunting (2005) explained that public art exists in a matrix defined by two important functions; in terms of the physical space that it occupies and secondly in terms of the origin of its existence, simplified in three-by-three grid format (Table 1.)

<table>
<thead>
<tr>
<th>Private Placement</th>
<th>Partial Placement</th>
<th>Public Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Origin</td>
<td>Art purchased by individuals or corporations and placed inside office buildings, etc.</td>
<td>‘Corporate art’ displayed outside or in common areas such as shopping malls.</td>
</tr>
</tbody>
</table>
Private Placement  |  Partial Placement  |  Public Placement  
---|---|---
Partial Public Origin  |  Works sponsored by non-profit and charitable organizations on private property.  |  Small memorials in street medians and low-traffic areas.  |  Public/private partnerships at athletic venues, etc.  
Fully Public Origin  |  Government funded artwork placed in government offices not generally accessible to the public.  |  Government funded artwork placed inside libraries or neighborhood parks.  |  Full government funding and prominent, highly visible locations  

Source: Hunting 2005  
Note: Public art is defined by its placement and origin for easy understanding  

All in all, the operational definition of public art used in this paper is an artistic expression that is positioned in a freely accessed public space for the public to use, but not simply any art placed outside yet still carries the basic notion of art which is to beautify spaces.  

Based on the studies done, there are various types of public art found. However, this study differentiates the types based on explanation by The Hamilton Public Art Master Plan (2009) which are summarized into Table 2.  

**Table 2. Different types of public art**  

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Supporting images</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated Art</td>
<td>Art that is integrated physically attached to or exists as an aspect of the infrastructure. It may be integrated with landscape feature such as walls, railing/fencing or paving.</td>
<td><img src="image" alt="Public art being integrated with a free standing wall" /></td>
</tr>
<tr>
<td>Environment Art</td>
<td>Focus on interrelationships between humans and nature and may use natural materials and landscape to convey meaning.</td>
<td><img src="image" alt="Public art as ecological stone" /></td>
</tr>
</tbody>
</table>
Public art plays brings benefits to both the community and the environment. In a study by Ramlan (2009), among the roles and value of public art are; aesthetical value, promoting the sense of community, celebrating the sense of place, addressing community needs, social implication and educational value. This view is also supported by Muhizam (2009) and a report by the Urban Redevelopment Authority of Pittsburgh (2010) and many other authors claimed that public art also contributes to the environment in terms of place making and publicity, promotes a clear sense of community pride and identity, reflects cultural heritage, improves and enhances the built environment, contributes to a safer community, enhances tourism and economic growth as well as promotes community engagement and collaboration in public development.

Public Art In Malaysian Context

Public art has an important role to play in transforming the public sphere and contributing to the urban renaissance. The arts are animators; they can inspire and rejuvenate (Harvest, 2004). Public art does not belong exclusively to the gallery and it can be an effective way of changing the way people think about their environment. Thus, in order for the art to benefits people, it means that our public art should be brought outside and be appreciated by the public. However, in Malaysian context, the situation differs from the way it should be. In a study by Mohd Fabian et. al. (2012), they reported that the understanding of public art among the community and related professions in Malaysia is still low. Among the issues that contributed to this problem are insufficient art educations, placement of the public art, low art quality, lack of community’s participation and collaboration, as well as inadequate pertinent memories and identity in the public art. Piyadasa (see Shunmugam 2010), asserted that public art should not be any construction just to fill and decorate a space but something that gives the country a sense of pride; a well thought art. Referring to Muhizam Mustafa (2009), to help understand the ways in which public art practices in Malaysia, two main communication systems; authoritarian and paternalistic are highlighted. Authoritarian refers to a system of communication whereby a ruling
group controls the society of the ruled (Williams see Muhizam Mustafa 2009). This method defines what is happening today in Malaysia whereby public art was installed by the administration without consulting the public despite the artworks were placed in the public realm. In contrast, the paternalistic mode of communication is an authoritarian form of communication with a conscience; it claims to have the benefit of the society in mind. Thus, it can be concluded that the government with the help of art experts, can provide such informative and experiences to its people in order for the public to benefit from the presence of great art in their surrounding (Kwon, 2002).

**Vertical Greenery: An Overview**

The idea of having plants on the wall was not a new idea whereas the most famous VG systems in ancient history would most likely belong to the Hanging Gardens of Babylon. However, the modern version was initiated by Stanley Hart White, a Professor of Landscape Architecture. VG became popular after only in the 1980s, when Dr. Patrick Blanc, a French botanist and researcher, popularized the theory and approach to grow vertical gardens (Sia 2011). Additionally in Europe, during the 1980s, a growing interest in environmental issues conceived the hope of bringing nature into cities. However, in explaining why the green initiatives are only recently seen an upsurge, Daniels (2008) noted that it is because city leaders are recognizing that a cleaner environment is needed both to provide residents with good quality of life and to compete in the global economy.

Vertical greenery is a broad term referring to any ways in which plants can be grown on, up, or against the wall of a building such as a vine, as part of a window shade, as a balcony garden, or in a vertical hydroponic system. Various definitions of vertical greenery can be concluded in Table 3.

**Table 3. Different definitions of vertical greenery (Badrulzaman et al. 2011) Bass and Baskaran (2003) and Peck et al. (1999)**

<table>
<thead>
<tr>
<th>Terminology</th>
<th>Supporting Images</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Garden/Wall</td>
<td>![Vertical wall on Jean Nouvel’s Musée du quai Branly](source: Hart, K. (2001))</td>
</tr>
<tr>
<td>- Refer to all forms of plant surface of the wall; used to determine the growing plants, up, or on the façade of buildings.</td>
<td></td>
</tr>
</tbody>
</table>
Green façade
- Climbing plants or cascading groundcover trained to cover specially designed supporting structures. Rooted at the base of these structures, in the ground, in intermediate planters or even on rooftops, the plants typically take 3-5 years to achieve full coverage.

![Green façade at First Avenue, Bandar Utama](Source: Author’s archive (2013))

Green Wall
- All forms of vegetation surface. This technology can be divided into two main categories; green facades and living walls.

![Citi Data Center in Frankfurt features a green wall featuring plants that are irrigated with recycled water.](Source: http://www.datacenterknowledge.com/leed-platinum-data-centers/)

Living Wall
- Consists of pre-vegetated panels, vertical modules or planted blankets that are fixed vertically to a structural wall or structure. These panels can be made of plastic, expanded polystyrene, synthetic fabric, clay, metal, and concrete.

![Living wall in front of Intermark building’s porte cochere](Source: Author’s archive (2013))

Green space wall
- An ecosphere that doubles as an exterior wall or mixed interior/exterior spaces in new development. These walls can create multiple, synergistic uses of space.

![Example of new building using a Green Space Wall](Source: Birkeland (2008))
The benefits of infusing a city with greenery varied but the most obvious benefit would be visual. It would create an appealing atmosphere that provides relief from the congested urban surroundings. The second advantage is environmental. This is because plants improve air quality, absorb storm water and slow the formation of ground level-ozone (Bonham and Smith, 2008). Thus, VG is seen as one form to introduce more green to the city. It helps to improve the overall environmental quality and serves as a solution to increase our connection with nature. Table 4 categorized benefits of vertical greenery into three categories, namely aesthetic, environment and economic.
Table 4. Different benefits of VG

<table>
<thead>
<tr>
<th>Category</th>
<th>Supporting Images</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aesthetic</strong></td>
<td>Symbiotic green wall to improve conventional construction wall.</td>
</tr>
<tr>
<td>1. Greener skyline and visual relief from urban environment</td>
<td>Source: inhabitat.com (2009)</td>
</tr>
<tr>
<td>2. Enhance architectural designs, create iconic landmarks</td>
<td>Lush walls create a positive perception for prospective property purchasers</td>
</tr>
<tr>
<td>4. Enhancing public spaces</td>
<td>VG has potential to increase necessary green mass in cities for vegetation.</td>
</tr>
<tr>
<td>5. Limiting the negative psychological effects associated with property demarcation.</td>
<td>Source: Interface (2013)</td>
</tr>
<tr>
<td><strong>Economic</strong></td>
<td></td>
</tr>
<tr>
<td>1. Reduction of cooling loads through better insulation and shading</td>
<td></td>
</tr>
<tr>
<td>2. Improving acoustic insulation</td>
<td></td>
</tr>
<tr>
<td>3. Increasing property values</td>
<td></td>
</tr>
<tr>
<td>4. Protection of building facade</td>
<td></td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td></td>
</tr>
<tr>
<td>1. Reduction of the UHI effect and regulation of the microclimate</td>
<td></td>
</tr>
<tr>
<td>2. Improving the air quality</td>
<td></td>
</tr>
<tr>
<td>3. Enhancement of biodiversity by adding natural habitats in the city</td>
<td></td>
</tr>
<tr>
<td>4. Improving rain water retention and onsite wastewater treatment</td>
<td></td>
</tr>
<tr>
<td>5. Therapeutic effects of plants and landscape</td>
<td></td>
</tr>
<tr>
<td>6. Sound Insulator</td>
<td></td>
</tr>
<tr>
<td>7. Improved Energy Efficiency</td>
<td></td>
</tr>
<tr>
<td>8. Building Structure Protection</td>
<td></td>
</tr>
</tbody>
</table>

VG is characterised by its system in which it is constructed on site. A considerable amount of literature has been published on VG system. Badrulzaman et al. (2011), Afrin (2009), as well as Hodson-Walker (2009) reported that the two main types of VG are modular trellis/carrier systems and cable and rope wire/support systems (Figure 1.). The carrier system which consist of rigid lightweight panels, are installed vertically as either wall-mounted or freestanding systems. It is designed in such a way to hold the planting media vertically. They can be used on tall buildings in conjunction with intermediate planters or on rooftops. These planters may be required where the growth of climbing plants is physically restricted. They are able to support bigger selection of plants, for instance shrubs, ferns, groundcovers, grasses, sedges and even mosses.
Conversely, cable and rope wire/support system (Figure 2.) contains a kit of parts that includes wire trellises, high-tensile anchors, steel cables, spacers, and supplementary equipment. It helps to guide plants up on the vertical surface. Vertical and horizontal wires can be attached through cross clamps to create a flexible trellis system in various sizes and patterns. Other than that, stainless steel wire-rope nets can be supported on flexible or rigid frames to cover large areas. It allows cascading groundcovers as well as climbing plants to grow up the façade on specially designed support structures. However, apart from these two systems, Skyrise Greenery (2012) added another method which is the planter system (Figure 3.). The planter system consists of planter boxes mounted at regular intervals onto a structure or frame. Stacked on top on another, they create extensive green wall coverage. Nevertheless, the system is similar to carrier system in terms of its ability to support a greater diversity of plants as compared to support systems.

In terms of application, VG has been actively applied in various countries such as France, Great Britain, USA, Japan and Singapore. Example of the VG’s implementation methods is shown in Table 5.

**Table 5. Various Implementation of VG around the world**

<table>
<thead>
<tr>
<th>Location</th>
<th>Application</th>
<th>Location</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>Bio-Lung</td>
<td>USA</td>
<td>Living Wall</td>
</tr>
</tbody>
</table>


PNC Living wall with logo as a bold commitment statement from PNC towards the environment Source: Meinhold (2009)
<table>
<thead>
<tr>
<th>Location</th>
<th>Implementation</th>
<th>Details</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>Outdoor Sculpture</td>
<td>Whole Foods Living Wall for Agriculture planted with edible vegetables</td>
<td>Living Walls: 15 More Vertically Vegetated Buildings (n.d.)</td>
</tr>
<tr>
<td>USA</td>
<td>Living Wall for Agriculture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>Greenery Curtains</td>
<td>Greenery curtains, Anjo City of Aichi Prefecture</td>
<td>Japan for Sustainability 2008</td>
</tr>
<tr>
<td>London,</td>
<td>Environmental Graffiti</td>
<td>Van-Gogh’s “Wheat Field with Cypresses” as a living painting at the National-Gallery Trafalgar Square, London</td>
<td>Collet 2011</td>
</tr>
<tr>
<td>Britain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>Living Paintings</td>
<td>Living Walls at Edmonton International Airport</td>
<td>Poiraud 2012</td>
</tr>
<tr>
<td>Changi</td>
<td>Indoor Vertical Garden</td>
<td>Indoor Vertical Greenery, at Changi Airport, Singapore</td>
<td>Living Walls: 15 More Vertically Vegetated Buildings (n.d.)</td>
</tr>
<tr>
<td>Airport,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singapore</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Various implementation of VG around the world, indoor and outdoor
VERTICAL GREENERY AS PUBLIC ART

Rubin (2008) then explains that successful urban greening projects will not only be worthwhile in the long term to the health of the community but essentially rewarding to the participants. Most urban greening endeavours grow out of the passionate pursuit of professional and single-issue advocates with the managerial expertise to execute murals and other public art. Without that kind of deep issue specific experience and uncompromising attention over several years; most of the greening initiatives and projects would never be realized. Urban greening projects can become key components to a successful projects, creating the environment in which more people are comfortable shopping, working or living, and in which they think their community’s character is expressed. Public art becomes one of the main ways by which the local history, character and richness of the neighbourhood and its residents are reflected in the new properties.

However, finding practical and effective way to exercise sustainable developments in our cities through public art strategy is yet to be fully explored. In further understanding this issue, Kate Maddison (Chrysalis arts n.d.) from Chrysalis Arts commented that even though artistic considerations are vital in creating public art, art creator could also implement sustainable principles as long as they were supported through the funding and commissioning process. Despite putting upfront people’s involvement, collaboration with key partners and promotion of local, public artist frequently touched upon environmental considerations but typically fall short of encouraging best practice in promoting low impact and non-polluting methods of implementation. What is required is a particular approach to innovation encompassing environmental, social, economic, management and practical issues and equally applied by both artists and commissioners.

Thus, one way to create a public art that is environmentally sound is through an increase of vertical greenery technologies on the walls of our buildings (Peck & Kuhn 1999). By combining aesthetics with environmental principles, vertical gardens are certainly rewriting conventional rules of gardening as more recent green walls are often showing beautiful patterns, it is becoming a new urban art (Séguin 2012). This idea was well supported by a study conducted by Wong et al. (2010) whereby they have carried out studies on perception of vertical systems Greenery in Singapore to provide aesthetic value as a parameter study. Their findings showed that all respondents were from the developer, consultant, government agencies and the resident agrees to the use of VG to enhance visual appeal. Furthermore, green walls are a good option to consider if space being the constraints, but yet greenery is still needed around the area which definitely adds to the aesthetic value. In an interview with him by Chin Mui Yoon (2010), Blanc talks about this matter, “Over half of the world’s population now live in cities; I think it’s very important to combine nature with cities instead of separating both from one another.”. The walls are works of arts, indeed; and in a concrete jungle, a splash of living green is always refreshing and also beyond aesthetics.

Institute of Landscape Architects Malaysia (ILAM 2009) in their bulletin has conducted two interviews to further explored VG’s potential to be developed in Malaysia, especially in the urban realm. One prominent Landscape Architect,
Hodson-Walker believes there are great potentials to be developed in Malaysia. According to him, VG’s application and design are surely going through a period of refinement and further development, yet with continuing environmental pressure and government policy, green walls will certainly become an important part of modern urban design. Furthermore Mr. Pua, another prominent feature of Malaysian landscape architectural field also agrees that VG may be built as a work of art for its beauty but in vertical garden design. Yet, we must continue to explore all available options and expand our creativity beyond our imagination. The essential knowledge is within all Landscape Architects, yet the functionality and practicality of these designs have to work hand-in-hand with the artistry and creativity of the product, in order to develop effective, beautiful and functional living wall art. Additionally, Patrick Blanc also mention about this potential in his an interview with Patrick Blanc by Chin Mui Yoon (2010) when elaborated that Kuala Lumpur has much potential for Vertical Greenery since out of the identified 8,000 plant species in Malaysia, some 2,500 grow without any soil.

METHODOLOGY

In order to further study the potential integration of VG and public art, this paper studies and reviews 25 selected real life projects in urban Malaysia which include Kuala Lumpur, Selangor, Johor and Penang that have applied vertical greenery in their development. Firstly, literature reviews were carried out to obtain information on the projects and their relationship to VG application. Next, out of the 25 projects, six projects were selected to obtain more information through site observation. Last but not least, interview method was also carried out for another four projects. For literature review, information on the projects was obtained from multiple sources such as company brochures, websites and company’s collection and this method contributed 15 projects. Site observation method managed to gather six projects while personal interview with the contractors contributed another four projects. This finding shows that different parties were involved and show strong commitment to implement VG in urban Malaysia.

The first dimension of the study was the placement of VG that was then divided into three categories; public, partial public and private. This dimension was chosen in relation to a study by Hunting (2005), whereby he divided PA’s placement into the same notion. The second dimension was the name of and various parties involved in the projects. This is important in identifying all the projects that applied VG in their development and parties involved. The third category is the objective of VG application. This aspect is important in order to recognize the objective of VG application, be it aesthetic, economic or environment, and was comparable to Table 3. Next, type and system of VG was also identified. The identification was based on the information obtained from reviews of the literature shown in Table 1.0 and Figure 1.0, Figure 2. and Figure 3. Other than that, the location of the vertical greenery also was noted, based on Table1. Next, the types of public art that the VG fall were also highlighted. This aspect was based on types of public art mentioned in Table 2; integrated, environmental and stands alone. This dimension is the most
crucial as it will eventually prove the interrelation of public art and VG. The last measurement is the relationship of that particular VG with public art. The dimension was based on the operational definition of PA used for this paper which is an artistic expression that is positioned in a freely accessed public space for the public to use, but not just any art placed outside yet still carries the basic idea of art which is to enhance spaces. Thus, any VG projects that agree with the operational description will be considered relevant as a public art. Then, the data gained were presented in a table format according to the above dimensions for easy referencing and discussion.

FINDINGS AND DISCUSSION

Table 6.0 summarizes the findings of the 25 projects derived from the data collected for easy referencing and discussion. In the dimension of VG’s placement, nine projects placed the VG in a public space whereby the public can directly see and interact with the VG for example, Lot 10 Roof Top, Bukit Bintang (Figure 6.). In contrast, four projects fall into the partial public category. Finally, twelve projects positioned the VG at private placement whereas the only people with access to the area can experience the VG for instance Sime Darby Property Head Quarters (Figure 9.0). This result demonstrated that VG shared the same aspect of public art in terms of its placement. VG is not only can be placed but also at an outdoor realm thus giving enormous opportunity for it to be experienced as a public art by the public.

Among all the projects, eleven projects were identified to implement VG for aesthetic value only (Figure 8.) whilst another five project used VG for its environmental and aesthetic benefits (Figure 7.). Alternatively, only one project was intended to utilize VG as environmental and economic purpose (Figure 10.0). On the other hand, five projects were recognized to employ VG for all its objectives; aesthetic, environmental and economic. Other than that, 18 projects fall into the category of green wall (Figure 11.) while only two projects utilized Vertical Greenery System or Living Wall. However, there are also four developments that utilize Green facade / Bio-facade wall. Lastly there is only one project used both Green facade and Vertical Greenery System. It was also noted that among the 25 selected real life projects in urban Malaysia studied, twenty of them apply carrier system only (Figure 14.) and another four used support system while the remains were identified to combine both carrier and support system.

Referring to the location dimension, 17 VGs were placed outdoors; and another one was located at a semi indoor area. Similarly, only one project located the VG both indoor and outdoor whilst the rest was positioned in an indoor environment. For example, referring to Figure 14.0, Platinum Sentral which was developed by Malaysian Resources Corporation Bhd. (MRCB) is located in an outdoor space while G Tower’s VG is located at both indoor and outdoor (Figure 15.0 and Figure 16.). The analysis of the findings of a relationship of VG with public art, all projects are coherent with the operational definition of public art. Thus, it can be concluded that VG has a strong potential to be implemented as a public art. Referring to the location dimension, 17 VGs were placed outdoors; and another one was located at a semi indoor area (Figure 13.). Similarly, only one
project located the VG both indoor and outdoor whilst the rest was positioned in an indoor environment. For example, referring to Figure 16.0, Platinum Sentral is located in an outdoor space while G Tower’s VG is located at both indoor and outdoor (Figure 15. and Figure 17.).

Based on the types of public art aspect, it was identified that all of the 25 projects falls into the category of environmental art. However, nine of the projects were also categorized as standalone art while the rest of 16 projects fall under integrated art. Last but not least, from the analysis of the findings of a relationship of VG with public art, all projects are consistent with the operational definition of public art. Thus, it can be concluded that VG has a strong potential to be implemented as a public art.
Figure 12. Internmark Integra Tower
Source: Author’s archive (2013)

Figure 14. Digi Technology Operation Centre apply carrier system
Source: Author’s archive (2013)

Figure 16. Platinum Central’s VG located at outdoor area
Source: Author’s archive (2013)

Figure 13. Desa Park City’s Club House Green facade
Source: ILAM, (2009)

Figure 15. G Tower’s VG located at indoor area
Source: Author’s archive (2013)

Figure 17. G Tower’s seven-storey outdoor VG
Source: Author’s archive (2013)
### Table 6. Collected data according to respective dimensions for easy referencing and discussion

<table>
<thead>
<tr>
<th>No</th>
<th>Name, Party Involved</th>
<th>Objective of VG Application</th>
<th>VG System &amp; Location</th>
<th>Data Collection Method</th>
<th>Types of public art</th>
<th>Relation with public art</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Sage Community Centre, Kuala Lumpur (Earthiagreen)</td>
<td>Environment</td>
<td>Green Wall Carrier Semi indoor</td>
<td>Literature review</td>
<td>Integrated art Environmental art</td>
<td>✓</td>
</tr>
<tr>
<td>2</td>
<td>Platinum Sentral, Kuala Lumpur (Malaysian Resources Corporation Bhd.)</td>
<td>Environment</td>
<td>Green Wall Carrier Outdoor</td>
<td>Literature review Site observation</td>
<td>Integrated art Environmental art</td>
<td>✓</td>
</tr>
<tr>
<td>3</td>
<td>Intermark Integra Tower, Ampang, Kuala Lumpur (MGPA Asia Developments)</td>
<td>Environment Aesthetic Economic</td>
<td>VG System / Living Wall Outdoor</td>
<td>Literature review</td>
<td>Stand alone art Environmental art</td>
<td>✓</td>
</tr>
<tr>
<td>4</td>
<td>G Tower, Ampang, Kuala Lumpur (Earthiagreen)</td>
<td>Environment Aesthetic Economic</td>
<td>Green Wall Carrier Outdoor</td>
<td>Literature review</td>
<td>Integrated art Stand alone art Environmental art</td>
<td>✓</td>
</tr>
<tr>
<td>5</td>
<td>Lot 10 Roof Top, Bukit Bintang, Kuala Lumpur (Sek San Design)</td>
<td>Environment Aesthetic Economic</td>
<td>Green Wall Carrier Outdoor</td>
<td>Literature review</td>
<td>Stand alone art Environmental art</td>
<td>✓</td>
</tr>
<tr>
<td>6</td>
<td>DBKL - KL Heritage Trail Green Wall, Kuala Lumpur, (Lian Shun Technology)</td>
<td>Environment Aesthetic Economic</td>
<td>Green Wall Carrier Outdoor</td>
<td>Literature review Site observation Interview</td>
<td>Integrated art Environmental art Stand alone art Environmental art</td>
<td>✓</td>
</tr>
<tr>
<td>7</td>
<td>Veo Melawati Sales Gallery, Selangor (Pembinaan Muzqi (M) SB)</td>
<td>Aesthetic</td>
<td>Green facade Planter Outdoor</td>
<td>Literature review Site observation</td>
<td>Stand alone art Environmental art</td>
<td>✓</td>
</tr>
<tr>
<td>8</td>
<td>Saujana Resort Entry Green Wall, Selangor (Artisat SB)</td>
<td>Aesthetic</td>
<td>Green Wall Carrier Outdoor</td>
<td>Literature review Site observation Interview</td>
<td>Integrated art Environmental art Stand alone art Environmental art</td>
<td>✓</td>
</tr>
<tr>
<td>9</td>
<td>Qaseh Entry Green Wall, Kinrara, Selangor (Whola SB)</td>
<td>Aesthetic</td>
<td>Green facade / Bio-facade wall Support Outdoor</td>
<td>Literature review Site observation Interview</td>
<td>Integrated art Environmental art Stand alone art Environmental art</td>
<td>✓</td>
</tr>
<tr>
<td>10</td>
<td>Blu-MED@Mid Valley Megamall, KL (Lian Shun Technology)</td>
<td>Aesthetic Economic</td>
<td>Green Wall Carrier Indoor</td>
<td>Literature review</td>
<td>Stand alone art Environmental art</td>
<td>✓</td>
</tr>
<tr>
<td>11</td>
<td>Best Western Hotel Dua</td>
<td>Aesthetic</td>
<td>Green Wall Carrier Outdoor Interview</td>
<td>Literature review</td>
<td>Integrated art</td>
<td>✓</td>
</tr>
<tr>
<td>Private Placement</td>
<td>No</td>
<td>Name, Party Involved</td>
<td>Objective of VG Application</td>
<td>VG Type &amp; System</td>
<td>Location</td>
<td>Data Collection Method</td>
</tr>
<tr>
<td>-------------------</td>
<td>----</td>
<td>----------------------</td>
<td>----------------------------</td>
<td>-----------------</td>
<td>----------</td>
<td>----------------------</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
<td>First Avenue , Bandar Utama, Petaling Jaya (Hoy Chan SB Group)</td>
<td>Environment, Economic</td>
<td>Green facade, Support</td>
<td>Outdoor</td>
<td>Literature review, Site observation</td>
</tr>
<tr>
<td>13</td>
<td>13</td>
<td>Digi Technology Operation Centre, Shah Alam, Selangor (TR Hamzah &amp; Yeang SB.)</td>
<td>Environment</td>
<td>VG System, Carrier</td>
<td>Outdoor</td>
<td>Literature review</td>
</tr>
<tr>
<td>14</td>
<td>14</td>
<td>Sime Darby Property Head Quarters, Ara Damansara, Selangor (Earthia green)</td>
<td>Environment, Aesthetic, Economic</td>
<td>Green Wall, Carrier</td>
<td>Indoor</td>
<td>Literature review</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
<td>Pavillion Executive Office, Kuala Lumpur (Earthia green)</td>
<td>Environment, Aesthetic</td>
<td>Green Wall, Carrier</td>
<td>Indoor</td>
<td>Literature review</td>
</tr>
<tr>
<td>16</td>
<td>16</td>
<td>Private residence, Jalan Pudina , Bangsar, KL (Artisat SB)</td>
<td>Aesthetic</td>
<td>Green Wall, Carrier</td>
<td>Indoor</td>
<td>Literature review</td>
</tr>
<tr>
<td>17</td>
<td>17</td>
<td>Private residence, Damansara Heights, Kuala Lumpur (Artisat SB)</td>
<td>Aesthetic</td>
<td>Green Wall, Carrier</td>
<td>Indoor</td>
<td>Literature review</td>
</tr>
<tr>
<td>18</td>
<td>18</td>
<td>Desa Park City's Club House, Kuala Lumpur (Earthia green)</td>
<td>Aesthetic</td>
<td>Green facade / Bio-facade wall, Support</td>
<td>Outdoor</td>
<td>Literature review</td>
</tr>
<tr>
<td>19</td>
<td>19</td>
<td>Subang Olive Residences, Subang, Selangor (Eurodeck SB)</td>
<td>Aesthetic</td>
<td>Green facade &amp; VG System, Planter &amp; Carrier</td>
<td>Outdoor</td>
<td>Interview</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
<td>Dataran Prima, Petaling Jaya, Selangor (Eco Innovation SB.)</td>
<td>Environment, Aesthetic</td>
<td>Green Wall, Carrier</td>
<td>Outdoor</td>
<td>Interview</td>
</tr>
<tr>
<td>21</td>
<td>21</td>
<td>Setia Eco Gardens, Johor SP Setia Bhd. Group</td>
<td>Environment, Aesthetic</td>
<td>Green Wall, Carrier</td>
<td>Outdoor</td>
<td>Literature review</td>
</tr>
</tbody>
</table>

**DEPARTMENT OF ARCHITECTURE ITS SURABAYA**

*September 26, 2013*
<table>
<thead>
<tr>
<th>No</th>
<th>Name, Party Involved</th>
<th>Objective of VG Application</th>
<th>VG Type &amp; System</th>
<th>Placement</th>
<th>Location</th>
<th>Data Collection Method</th>
<th>Collection</th>
<th>Types of public art</th>
<th>Relation with public art</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>G Hotel, Penang (LandArt Sdn. Bhd.)</td>
<td>● Economic ● Environment ● Aesthetic ● Economic</td>
<td>Green Wall Planter</td>
<td>Outdoor</td>
<td>Literature review</td>
<td>● Stand alone art ● Environmental art</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Mr. Yong’s Residence, Penang (LandArt Sdn. Bhd.)</td>
<td>● Aesthetic</td>
<td>Green Wall Planter</td>
<td>Outdoor</td>
<td>Literature review</td>
<td>● Stand alone art</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>11 @ Mont Kiara, Kuala Lumpur (Earthigreen)</td>
<td>● Aesthetic</td>
<td>Green Wall Carrier</td>
<td>Outdoor</td>
<td>Literature review</td>
<td>● Integrated art ● Environmental art</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Private residence, Sri Hartamas, Kuala Lumpur</td>
<td>● Aesthetic</td>
<td>Green Wall Carrier</td>
<td>Indoor</td>
<td>Literature review</td>
<td>● Integrated art ● Environmental art</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Results shown great potential for VG to be implemented as public art.
CONCLUSION

In summary, both public art and VG can contribute to the quality of life as they complement each other in terms of its aesthetic, environmental and economic quality. This study has found the combination of both will not only create a public art that is high in aesthetic quality but also environmentally sound. This paper has also proven that VG has a strong potential to be implemented as public art and it may be built as a work of art for its beauty. Nevertheless, we must continue to explore all available options and expand our creativity beyond our imagination. The basic knowledge is within people that are involved in the built environment, yet the functionality and practicality of these designs have to work hand-in-hand with the artistry and creativity of the product, in order to create a beautiful and functional living wall art. Hence, more attention should be given on developing creative, innovative and quality environment that will eventually encourage further research on integrating VG as public art in the urban landscape. Therefore, it is hoped that this exploratory study will be useful in upgrading the functions, ideas and strategies in approaching VG and public art and will also be the launch pad for the public art to go much further, especially in Malaysian urban landscapes.

REFERENCES

Afrin, S., (2009), Green Skyscraper: Integration of Plants into Skyscrapers Green Skyscraper: Integration of Plants into Skyscrapers. Kungliga Tekniska högskolan.


Chrysalis Arts, Public Art Sustainability Assessment.


This page intentionally left blank
International Conference
Green Concept in Architecture and Environment

Sub Theme:
Management and Urban Planning

Department of Architecture ITS Surabaya, September 2013
GREEN URBAN WATERFRONT MANAGEMENT
Case of Solo, Indonesia

Arif Kusumawanto*, Zulaikha Budi Astuti
*) Department of Architecture and Planning, Faculty of Engineering, University of Gadjah Mada
Indonesia
e-mail: arifk@ugm.ac.id, zulaikhabudiastuti@yahoo.com

ABSTRACT

Solo is a city located in Central Java, Indonesia with 501,650 inhabitants in 2011. It hosted in 2010 the Asia Pacific Ministerial Conference on Housing & Urban Development (APMCHUD) as big events for this city. Besides APMCHUD is an award for Solo urban renewed images since 2005 which one of them is urban waterfront revitalization.

Applying the Lourenço meta-analysis for urban growth areas which is specific in urban waterfront management, a better apprehension of the sequence of interdependencies that exist can be addressed to expand the concepts of redevelopment of urban areas. It can be done within a continuum process associated to planning and investment cycles. The applicability of the proposed model is tested by comparing the idealized evolution to the observed urban waterfront in Solo, for a period of eight years, from 2005 to 2013. This enables the discussion of conceptual issues related to the legitimizing of LCA and the present contribution. Although the complete cycle is not yet observable, it is possible to confirm that the relevant nature of this tool allows for an earlier awareness of the cycle progression anomalies and, therefore, a potentially better adjustment between observed and ideal behaviors, if these anomalies are monitored and addressed.

This paper will address Solo profile and planning process, major outcomes due to urban waterfront applicability of LCA models and framework for the sustainable management.

Keywords: Life Cycle Analysis, Green Urban Waterfront Management, Solo

INTRODUCTION

Life cycle analysis (LCA) is a graphical tool to represent a succession of phases in a long period of time. The applicability of LCA urban growth area for urban expansion was introduced by Lourenço in 2003. She developed a meta-analysis for
urban growth areas applied in seven urban areas of Portugal. Presented by three curves of planning, action, and living, it is a bi-dimensional graph which represents the intensity of the cycle and time period dimensions.

Nowadays, some cities compete for the quality of life which represented by green areas. It is very important in urban planning to provide public space for citizens and to get the fresh air. One of the opposite properties of green area is water as a refreshing element of life in green areas and a restraint for urban function (Jormola, 2008). Some cities which are passed by rivers or have surface water resources have already had advantages for providing this element.

Urban waterfront in 20th century became spread all over the world especially in USA and Europe. There are some succeed projects and bring the new urban image for the city, such as in Spain, Italy, and Portugal. Since the remarkable results are noticed, some cities in Asia, try to do so. Unfortunately, in the development phase, some ruptures and neglected projects happened before the optimal profit is fruitful by citizens.

Since waterfront revitalization needs investments, it is important to keep it sustain. This project needs to be well-managed and monitored. An improvement of LCA observation to monitor the urban waterfront projects is proposed. This enables the discussion of conceptual issues related to the legitimizing of LCA and the present contribution. It is also possible to confirm that the relevant nature of this tool allows for an earlier awareness of the cycle progression anomalies.

THEORETICAL FRAMEWORK

Life Cycle Analysis for Urban Development

Life cycle is a graphical tool that represents phases over a long period of time. It is represented in exponential or logistic s-curves, which are slow at the beginning, undergo acceleration, then slowing down and at the end, saturation. Mostly used in biology, industry, production, as well as, in economics and politics which have a strong relation with the welfare of people in terms of spatial and time frames such as environment and urban areas.

Lourenço (2003a) defined the urbanized areas in an analogy with the framework of predictions heuristics of the quasi-model of Holton. She noticed that effectively, Holton broke the attractiveness of mining for gold and the discovery of a new field continuing his analogy with the gold rush. As a result, a utopian model of planning cycles which consists of three curves: planning, action, and living (see figure 1) was proposed by her as an ideal behavior of a plan-process. She noticed that the behavior of the knowledge-based graphic could theoretically explains her model as: base curve of planning represented by the curve of participation in the fundamental knowledge, associated actions represented by logistic curve of fundamental research and living curve represented by applied knowledge curve. This model and the likely evolution of the gold rush were associated with an almost metaphoric mathematical model that relies on a graphical representation with an
explicit visualization. This same scheme was applied to analyze and forecast the race to urbanization.

![Graph](attachment:figure1.png)

**Figure 1.** Ideal Behavior of a Plan-process: Lourenço’s Model
Source: Lourenço, 2003a

Lourenço’s model theoretically considered that during the first ten years there is an intensive planning, which will gradually decrease until reaching a minimum value, after two decades. The intensity level of the actions will increase and present a higher ratio in the second decade, and should reach a peak at the end of this period. Regarding to the intensity of the living, it is considered that the intensity has the same or slower increase ratio than the curve of the actions, requiring forty years to reach its maximum precisely when the measure of the curve reaches its minimum. At the end of the twenty or thirty years, corresponding to sixty or seventy years after the beginning of a planning cycle, the intensity of the living begins to decrease rapidly, while the intensity of planning increases very quickly.

The development of this model for the urban waterfront has been examined by Lourenço (2010) with the case study of Lisbon waterfront area. It was an abundant and polluted area in the waterfront of Lisbon which changed in to new urban image during the short time. The plan process of this area shows the similar behavior plan process with Lourenço’s ideal behavior except the time dimension. She analyzed that the short time needed might be due to the big events.

![Graph](attachment:figure2.png)

**Figure 2.** Behavior of Nation’s Park Plan-Process in Lisbon
Source: Lourenço (2010)

In 2013, Astuti studied the most influenced factors that influence the behavior of urban waterfront plan-process (see figure 3). Through those factors the behavior of urban waterfront can be drawn. This graphic will help the municipality to do
assessment for the urban waterfront project if it is going up or rupture. The benchmarking analysis for the cases study of five cities did in southern European through Life Cycle Analysis for urban development. It found that Bilbao, Genoa and Lisbon are successful cities with the waterfront revitalization projects. The behavior of plan-process happened in very high intensity. It is found that to finish the projects the City Hall combined it with big events or flagship projects. Nowadays the living is still continuing in high intensity concentrate in the waterfront area as the major new urban image of the city. For Porto & Viana, the cycle was completed in high intensity (level III). They were in a same national projects namely POLIS project and has strong connected with city center & major urban renewal. For Aveiro rupture was happened in the beginning (due to the environment focus) although at the end, it shows development (Astuti, 2013).

**Urban Waterfront**

Urban waterfront is an area along river, coast, and lake area. Coastal Zone Management Act (1972) defines the term of urban waterfront as port which consists of any developed area that is densely populated and is being used for, or has been used for: urban residential, recreational, commercial, shipping, or industrial purposes. Since the going up and down situation of the city and urban waterfront, a redevelopment of this area recently in 20th century happened in several cities included medium-sized and small cities.

According to CZMA (1972), waterfront revitalization is a process that begins with the desires of a community to improve its waterfront. That proceeds through a series of planning steps and public review to adoption of a waterfront plan. Implementation of the plan, involves public and private actions, investment decisions, and developments (CZMA, 1972). Its revitalization influenced the urban development which is associated with the degradation of rivers. The new urban waterfront territory nowadays can be identified at least four functional areas: public, natural, working and redeveloping (NYCDCP, 2002 in Jankovska, 2009).

Centre for Cities on Water in Venice conducted ‘The 10 Principles for the Sustainable Development of Urban Waterfronts’. It constructed the strongest elements of the urban waterfront transformation process (Giovinazzi and Morretti, 2009). Those principles are: secure the quality of water and the environment, waterfronts are part of the existing urban fabric, the historic identity gives character, mixed use is a priority, public access is a prerequisite, planning in public private partnerships speeds the process, public participation is an element of sustainability, waterfronts are long term projects, revitalization is an ongoing process, and waterfronts profit from international networking.

Basu (2011) described the urban parameters of public space in relation to the waterfront and relationship between the waterfront public space, water body and the city by case study of Barcelona and Lisbon waterfront revitalization projects through nine parameters. Those are: urban aesthetic and architectonic quality, public amenities, physical connection and barriers, visual connections, water accessibility, safety, uses and functionalities, recreation and leisure, integration.

The planning process of new urban image of green urban waterfront helps the city more sustainable. It is successfully change the face of the city centre of the metropolitan city of Baku. It is an example of an historic city as a medieval town.
which alongside to the waterfront of Caspian Sea. The green core city of Baku nowadays becomes a new city attraction especially for the tourists. Some of cultural events most of the time held to make the waterfront more livable (Huseynov, 2011).

**Green City**

Green City was introduced by Le Corbusier et.al. as the latest urban design trends. It consists of eight components: green planning and design, green open space, green waste, green transportation, green water, green energy, green building and green community.

It is a cross sector relationships between several ministries in Indonesia. Under policy of Indonesian Public Works Ministry, a program of green city development has involved 60 cities and regencies in Indonesia to implements the program. The program promotes implementation of urban park and green areas as part of green open space. This program opens opportunity for flower farmers to contribute in the green city implementation under policy of Indonesian Agricultural Ministry.

Through policy of green city development, the city should provide 30% of green areas in the entire city. The program is part of vision which mentioned in Indonesian Regulation no. 26/2007 about green urban planning and design. It is successfully implemented by Singapore which has 8,000 m² of green open space for 1000 citizens. It is respectively achieved by Indonesian Cities as part of public service programs to provide a high quality of living.

**Sustainable Urban Development**

Sustainable urban development has been written so many times since the Brundtland Report (1987). It consists of three dimensions: economic, social, and environment. It has significant influence on planning and policy at the local level. Afterwards, the communities have adopted sustainability as a goal in comprehensive plans and other planning activities.

Nowadays, sustainable planning and management has diverse definitions ranging from “deep green” ecological fundamentalism to: energy conservation issues, serious principles of social equity (inter, intra-generational, and gender), environmental economics, and economic sustainability. Kammeier (2003) proposed the resume of sustainable development coped with big events management as a pragmatic manner as seriously “green” to some extent, socially equitable (at present and with regard to the near future), and economically prudent. The emphasis is on economic value added, employment effect and ‘city image’.

The regeneration of waterfronts was concluded by Giovinazzi and Moretti (2009), as representing an extraordinary opportunity for cohesion and for stitching the territory together. Water as a collective legacy can play a central role and become the engine for sustainable development through recreating the relationship between spaces, uses, and visions. Afterwards, it will build a dialogue between spatial organization, port, and city functions and their economic and social aspects.
RESEARCH METHODOLOGY

The model consists of three curves: planning, action and living. The factors influence the behaviors are:

1. The intensity of planning is indicated by the presentation of urban strategy, planning frameworks, directives, planning proposals, new bodies, urban development visions which have relation with waterfront projects.
2. The intensity of action is indicated by the number of urban development through infrastructures construction, public participation, mount of investment which has relation with waterfront projects.
3. The intensity of living is indicated by the number of people living in the city and the economic and social activities surround the waterfront area.

Figure 3 shows the flow work of this methodology which is revisited from Lourenço (2003a) and Alvares (2008). The factors will be checked if it is present or not present in order to determine the intensity of each phase (low, medium, high). The graphic portrayed is quasi-dynamic model for urban waterfront planning process.

When the city wants to revitalize its waterfront area, it might be a new approach for the city planning. It might bring a success result, when people can enjoy the waterfront area and get the feel of waterfront city or it might be fail. The hypothesis of this research is stated to achieve the research objective. In order to find the most influence and success key factors for the projects sustain, the hypotheses are: Planning: does the urban waterfront become the focus of the city
planning?, Action: does the project persistence in the design proposal?,
Living: does the urban waterfront touch social, culture and economic of the people activities?

The plan-process framework can be drawn on the figure below.

**Figure 4.** The plan-process framework of LCA Model
Source: Astuti (2013)

**SOLO URBAN WATERFRONT**

Solo is a small-medium sized city on 44 km$^2$ area. It has 501,650 inhabitants in 2011. It is located in Central Java Province Indonesia, 477 km east of the capital city, Jakarta. Officially known as Surakarta, this city has been built since 1745 as an autonomous monarchy. Then, after Indonesia independence in 1945, it was integrated in the Indonesian territory.
The vision of this city is Solo as cultural city based on trading, services, education, tourism, and sports. To empower this mission, Solo has its branding: “Solo, The Spirit of Java”. Since 2005, Solo has done several urban renewals such as: city walk building to provide an environmental friendly pedestrian, heritage buildings conservation, and new open green space areas. Those programs have been intertwined with special big events which can leverage the emerging of Solo sustainable management (Lourenco and Astuti, 2011). To commemorate the success projects of Solo urban development, in 2010, Solo hosted the Asia Pacific Ministerial Conference on Housing and urban Development (APMCHUD).

Geographically, Solo has flowed by several rivers. The big one is Bengawan Solo River. The others are: Kali Jenes, Kali Anyar, Kali Gajah Putih, Kali Pepe Hilir, Kali Wingko, Kali Boro, Kali Pelem Wulung, and Kali Tanggul. Unfortunately those rivers are suffered of slum areas. Solo which attracts people to do urbanize forces them to occupy river banks since it is an abundant land. As the results, the river as the city greenery potency could not be enjoyed by the citizens.

During 2008-2012, after hard working to implement the program, Solo has three urban waterfront areas. Those are Bengawan Solo River in Pucang Sawit called Solo Urban Forest, Kali Anyar, Mojosongo, Jebres, called Taman Sekartaji, and Kali Anyar, Sumber, Banjarsari, called Taman Air Tirtonadi (see figure 6).
Solo Urban Forest

Before 2010, Bengawan Solo river bank in Pucang Sawit was a squatter and slum area. Low-income people from the villages occupied this abundant area. It is about 1,571 inhabitants stayed there and faced yearly flooding.

The river bank is a danger area and supposed to be green as waterway of the flood. Through persuasive approach, the municipality tried to relocate people to the safer areas. The municipality provided a better place and helped them to have their own lands and houses which are very expensive for them. The municipality assisted people by giving soft loan; IDR 12 million (1.300 US$) for land purchasing, IDR 18 million (1.900 US$) for public facilities, and IDR 8,5 million (1.900 US$) for housing. The budget was from national budget and local budget.
After the river bank freed from the slum, it was changed to be an urban forest. It was planned for about three hectares area along 750 m. For the first step, it has been already built for 200 m length and 5-30 m width in 2010 as part of APMCHUD event. This project is called as the first urban forest which needs investment of IDR 290 million (30,500 US$). This green area allows the river bank gets back its natural function for water catchment area. It will be a nice waterfront area where people can enjoy afternoon by doing fishing or leisure outdoor activities. This urban forest projects are continued until four projects. The thirdly first projects had been completed in 2012 and had changed the face of the river bank.

Unfortunately in the beginning of 2013, flood came and destroyed the urban forest. The park was full of mud and need to be recovered. The problem was the municipality did not ready to face this situation. The municipality did not allocate
maintenance budgets. As the results, the condition of the built urban forest got suffered.

![Image](image1.jpg)

**Figure 9.** Solo Urban Forest before and after flood 2013  
Source: Septiyaning, I. (2013)

The idea of the program is to have a green area and to mark the area as the land of the municipality. It is important to make this area live which can avoid an illegal owning by the people. This project is very important to supply public green and open space area. It also leverages Solo to have waterfront area which normally hard to be had by Indonesian municipality.

In the Solo urban planning until 2030, this river bank is the biggest green area which will be tried to be recovered by the municipality. It is part of Solo efforts to implement Indonesian Regulation 26/2007 about urban planning and Ministry Home Affairs Regulation 1/2007 about urban green area.

![Image](image2.jpg)

**Figure 10.** Solo Land-use planning Map 2030  
Source: Surakarta Municipality, 2011
Sekartaji Park

Sekartaji Park is another urban waterfront project in Solo. It is located on the Kali Anyar river bank. Previously, it was illegal buildings built on the river bank. Afterwards, it becomes a new urban image of the city waterfront (see figure 11).

The green open space had been planned to change the face of this area. It is about 1200 m length. The first stage and second stage have been completed for about 700m length. To put more attractions the park has theme as part of Javanese legend, names ‘Timun Emas’. It will give entertaining phase for the people who visit.

The park nowadays can be enjoyed by the citizens through the green area an open jogging track. Nowadays the plants have been grown and make the area fresher.
In 2011, the municipality built small flower market in front of the Taman Sekartaji. It is part of City planning to accommodate informal vendors who previously occupied the land. By serving them a comfortable market, the municipality will get local income beside their commitment to be involved in the maintenance of the park. In 2012, when the Mayor did Mider Praja, means informal inspection in Taman Sekartaji, the Mayor asked the people who stayed in that district to help the municipality to maintain the park. In 2013, the municipality plans to enlarge the park. It has been allocated for about 1,4 billion IDR to build the other side of this area. It is about 186m length in the south side and 132 m in the north side. It will have a stage to hold events or performances. The theme of this side will be adopted from the Javanese legend names ‘Karna Tanding’.

Tirtonadi Water Park

The spot of Kali Anyar which can be enjoyed by people is in Tirtonadi. It closes to the municipality bus station. By having this spot, it will be a welcoming gate for people from around when visit Solo.

The history of this area was a cultural place. In the previous time, people had spontaneous traditional performance art as part of people culture. This situation had changed since illegal buildings occupied this area.

The municipality afterward paid attention to this area and planned to transform it to be a park. The idea is to protect the river bank from illegal owning, have more green area, and give new urban image. The spirit of cultural spot has been accommodated by providing a stage (see figure 14).
In 2011, a performance art by 170 artists was held in this park (see figure 15). Respectively every year there will be a big performance held in this park through people involving. It is important to make the urban waterfront more livable and sustain.

![Figure 15. Art Performance in Taman Air Tirtonadi](image)

**SOLO URBAN WATERFRONT SUSTAINABLE MANAGEMENT**

The management of Solo Urban waterfront faced many problems. Destroyed by the flood and not well maintained park are some of the problems. The people surrounds the park also have not involved in the development of the waterfront. It is a successful project to provide Solo with new urban image and new face for the urban waterfront. However it needs a lot of works.

In 2010, the municipality should allocate 2 billion IDR for green open space program. In 2011 it increased to 2.8 billion IDR (see table 1). In 2012, it becomes 5.4 billion IDR, for about ten percentage of total budget of environment council.

<table>
<thead>
<tr>
<th>No</th>
<th>Bodies</th>
<th>2010 (IDR)</th>
<th>2011 (IDR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Urban Planning Council</td>
<td>400.000.000.00</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Village</td>
<td>115.000.000.00</td>
<td>91.800.000.00</td>
</tr>
<tr>
<td>3</td>
<td>Park and Cleaning Council</td>
<td>1.200.000.000.00</td>
<td>1.935.275.000.00</td>
</tr>
<tr>
<td>4</td>
<td>District</td>
<td>9.000.000.00</td>
<td>374.542.000.00</td>
</tr>
<tr>
<td>5</td>
<td>Environmental Council</td>
<td>325.000.000.00</td>
<td>325.000.000.00</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>2.049.000.000.00</td>
<td>2.726.617.000.00</td>
</tr>
</tbody>
</table>

Since it is a hard work to maintain the urban waterfront, some innovations have been made by the municipality. For instance in 2012, through an event, the Mayor asked the leader of the villages to maintain *Taman Sekartaji* and built flowers...
market in front of the park and asked the vendors to involve in the park maintenance.

To make river as part of the city, since 2011 there were several events held by the municipality. Recorded six events to promote river conservation are held, those are:

1. 27/2/2011 Gunungan Charity Boat Race
2. 19/3/2011 Tirtonadi Festival in the Taman Air Tirtonadi
3. 20/11/2011 Bengawan Solo Gethek Festival
4. 19/2/2012 Gunungan Charity Boat Race
5. 11/11/2012 Bengawan Solo Gethek Festival
6. 24/2/2013 Gunungan Charity Boat Race

Those events not only promote tourism activity for the people but also to attract visitors to come and enjoy the park.

The existence of the urban waterfront creates greenery in the city. It supports the ecological system in the city mainly the river environment which supposed to be free from illegal occupancy. It supports the city to provide a better quality of life for the citizens. In 2012 about 12% green open space has already had by the city including the urban waterfront areas.

Through this program, the municipality not only gets the revitalized park but also helps people to have their own land and formalize the illegal vendors. By having this program, which the objective is to gain welfare for the people and increase the quality of life of the city, the municipality will get more advantages. For instance, urban waterfront area will become a new attraction of the city to be offered to the visitors. When visitors come and enjoy the city, they will spend some money which means local income. The same situation when the municipality formalized the informal vendors in Taman Sekartaji area. It will be a local income for the municipality.

LCA MODEL OF SOLO URBAN WATERFRONT

The behaviour of Solo urban waterfront plan-process will be drawn through those three study cases. The planning stage is influenced by urban strategy, framework, directives, planning proposals, and new bodies. The action stage is influenced by new urban images constructions and amount of investments. The living stage is influenced by inhabitants and visitor number, economic and social opportunity, and environmental recovery.

Table 2. The Resume Data of Solo Urban Waterfront Behavior Plan-process

<table>
<thead>
<tr>
<th>Year</th>
<th>Conditions</th>
<th>Planning</th>
<th>Action</th>
<th>Living</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>Solo Local Regulation 10/2001 about Solo Vision</td>
<td>Urban strategy</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2002</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2003</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2004</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2005</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
From the data above, the condition of urban waterfront in Solo can be drawn on the bi-dimensional graphic of Lourenço’s model. The behaviour can be compared to the Lourenço’s ideal behaviour model. It can be justified whether the cycle mirror the ideal model or not. If the cycle shows going up it means the cycle is in the high intensity of it shows going down it means ruptured or decreasing symptoms that supposed to be the city awareness.

Long term data series is might be the most difficulties part of this analysis. That’s why this analysis can be done through qualitative and quantitative analysis. The justification of the intensity level of each phase can be done if the parameters are presented or not presented. If it presented a progressive phase of the cycle is shown. The quantitative data will empower the analysis when the progression of number is shown or not.

The behaviour of Solo urban waterfront plan-process can be drawn in to the graphic of plan-process showed in the figure 16.
It shows that high intensity of planning happened since 2001 and coped by the Solo Municipality in 2006. It is followed by high intensity of action until today and the living condition. The cycle for today shows progressive process. However incentive monitoring should be done to maintain this achievement.

CONCLUSION

Green city is an approach to push municipalities to be more concern to the city environmental. It is one of sustainable management pillars which believes will bring a better quality of live in the city. Indonesian government requires the cities to have at least 30% green area of total of the city area. Recorded 60 cities joined to the commitment to build the green city included Solo in Central Java.

One of the urban greenery potency in Solo is river. It has for about nine rivers flowed in the city. However, the river banks most of the time become a problem area with social and environmental issues. Since it is a potency of the city to have more green area, the municipality decided to revitalize the river bank areas to become urban waterfront as new urban images for the city. During 2008-2012 recorded that Solo has three urban waterfronts in front of the river. It contributes to the green area in Solo for about 5 ha which has had 12% (529 ha) of green area in 2012.

The behavior plan-process of three Solo urban waterfront areas; those are Solo urban forest for about 3 ha, Taman sekartaji and Taman Air tirtonadi for about 1,5 ha shows that the green planning policy have been started since 2006 and it achieves the higher intensity in 2007 when it became national policy. Intensive action happened in 2008-2012 although some lack of maintenance appeared around those four years. High maintenance cost might be one of the difficulties of keep the
waterfront sustain. However, the municipality always put more efforts every year to achieve the target of the green areas. The management of Solo urban waterfront areas still needs to be monitored. Since the rupture or decline symptoms has not met in the life cycle analysis as the assessment during 2001-2013, the challenges that should be faced by the municipality are more than the expectation.

REFERENCES


Jankovska, I. (2009), The Role of Urban Waterfront in Modern City Land Management, in Panagopoulos, T. [eds], *New Models for Innovative management and Urban Dynamics*, University of Algarve, Faro, Portugal.


Surakarta Municipality. (2011a), Solo Development in Mayor Speech, City Branding Conference, Semarang.

UNDERSTANDING OF LOCAL KNOWLEDGE IN SUSTAINABLE DEVELOPMENT TOWARD GLOBAL PERSPECTIVE (EXPLORATION STUDIES OF JAVANESE CULTURE)

Johannes Adiyanto
Study Program me of Architecture, Engineering Faculty, Sriwijaya University
e-mail: johannesadiyanto@yahoo.com

ABSTRACT

The concept of sustainable emerged around 1970 which was developed to address the critical issue of energy. It is less recognized that this concept need to be developed and industrialized by the countries due to their dependence on fossil fuels in that time. Then, architecture develop it into a green building concept. The latest development of green architecture becomes imperative in the design architecture for the construction of new buildings. That understanding built in global perspective, how about in local perspective – like in Javanese culture – is it the same context or perspective? Furthermore, it is going to be the focus of this paper.

This paper tries to pick sustainable background in the context of Javanese culture as the focus. In Javanese culture, philosophy background can be constructed by performing puppet plays reinterpretation. Lakon Babad Alas Wanamarta can be placed as the cornerstone of sustainable communities’ the philosophy of Java. Theoretical level and indicators for green architecture in the Java community may appoint Primbon.

Research method use Hegel dialogue with architecture critic approach. This working paper is still at the level of exploratory studies to answer unresolved and couldn’t replace sustainable and architectural ideas that have been grown in agrarian people today. But it needs to be examined further as sustainable or green architecture can be developed further from an agrarian society civilized.

Keywords: reinterpretation, sustainability, Javanese Culture

INTRODUCTION

Thinking about sustainable started in 1969, when Rachel Carson published the book with the title “Silent Spring”. This book told about pollution and the effect of the environment. Term of ‘Sustainable Development’ was written on “Our Common Future” (Report, 1987). It ties problems together and, for the first time, gives
some directions for comprehensive global solutions (IISD, 2012). That is history of sustainable in global perspective.

How about local perspective in Javanese culture? Is it the same context? That’s the main question in this paper. After that question, the next question is how about the Javanese culture of sustainable in architecture, both in global and local perspective?

In global perspective, we can called ‘Green building council’ to explained sustainable from architecture perspective, and Indonesia already had ‘green building council’ with ‘Greenship New Building versi 1.1’. How about Javanese architecture, is there any kind ‘greenship’?

METHOD

To find the context of sustainable development in global perspective, this paper uses the interpretive-historical research with narrative and analysis in interpretive-historical research strategy (Groat & Wang, 2002). This method has ability to identification of data, organizing and evaluation (Groat & Wang, 2002). This method can be answered by the global context of sustainable development.

Another side, Javanese Culture, this paper used investigation philosophy method with clarification approach from Wittgenstein (Rapar, 1996 and Stern, 2004). This method with language analytic, make it clarify the language which used in lakon wayang.

The main method in this paper is Hegel’s dialectical method. (Raapana & Friedrich, 2012). This method ‘make a dialogue’ between global perspectives of sustainable development with Javanese perspective.
GLOBAL PERSPECTIVE OF SUSTAINABLE EXCERPT FROM IIISD TIME LINE (IIISD, 2012)

Historical of Sustainable Development

Based on International Institute for Sustainable Development time line (IIISD, 2012), the history of Sustainable Development was started in 1962, when Rachel Carson published Silent Spring. She brought together research on toxicology, ecology and epidemiology to suggested that agricultural pesticides are building to catastrophic levels, linked to damage to animal species and human health. After Carson, Paul Ehrlich, in 1968, talked about population bomb, which connected with resource exploitation and the environment.


World Conservation Strategy released by the International Union for the Conservation of Nature (IUCN) in 1980. The section “Towards Sustainable Development” identifies the main agents of habitat destruction are as poverty, population pressure, social inequity and trading regimes. The report calls for a new international development strategy to redress inequities. In 1982, The UN World Charter for nature, called for an understanding of our dependence on natural resources and the need to control our exploitation of them. Meeting in Austria, in 1985, of The World Meteorological Society, UNEP and The International Council of Scientific Union reported on the build up on carbon dioxide and other ‘greenhouse gases’ in the atmosphere. They predicted about global warming.


Earth Summit held in Rio de Janeiro, in 1992, had an agreement on action plan Agenda 21, the Rio Declaration and non-binding forest principles. In 1994, China sets an international example for national strategies for sustainable development. ISO 14001 is formally adopted as a voluntary international standard for corporate environmental, in 1996.

In 2002, World Summit on Sustainable Development was held in Johannesburg, marking 10 years since UNCED. In a climate of frustration at the lack of government progress, the summit promotes “partnerships” as a non-negotiated approach to sustainability. In 2005 Kyoto Protocol entered into force, legally binding developed country parties to the goals for greenhouse gas emission reductions, and establishing the Clean Development Mechanism for developing countries. Emissions reductions obligations expire at the end of 2012. Green economy ideas entered the mainstream in 2008. In 2009, Scientists introduced the concept of “planetary boundaries”; the concept quantifies our proximity to limits in
nine areas, including biodiversity, chemicals, climate change, oceans acidification, fresh water and others.

The population reaches 7 billion in 2011. In 2012, Trade disputes on solar and wind energy products. China’s expanded manufacturing capacity and low prices make it a leader in global trade on wind turbines. The U.S. contests both solar and wind subsidies in China as unfair trade practices. The outcomes of these disputes may influence the future of clean-tech energy sourcing and adoption. Rio +20 (2012) Fifty years after Silent Spring, 40 years after Stockholm and 20 years after the Earth Summit, the global community reconvenes in an effort to secure agreement on “greening” world economies through a range of smart measures for clean energy, decent jobs and more sustainable and fair use of resources.

Context and Perspective of Sustainable Development

In 1960s, Sustainability was only about toxic’s impact in nature and population bomb warning. It was only talk about nature and human population. In 1970s, the problems increased with the oil crisis. In 1980s, global warming became the main topic. In 1990s and early 2000, sustainable development was containing more complex aspects.

The result of UN conference on Sustainable Development, held at Rio de Janeiro, Brazil in June 20-22, 2012, had 7 critical issues (source http://www.unsced2012.org/7issues.html), such as:
1. Green jobs and social inclusion
2. Sustainable Energy
3. Sustainable Cities
4. Food security and sustainable agriculture
5. Fresh water
6. Clean Oceans
7. Reducing Disaster Risk and Building Resilience

Sustainable development in this day has more complex aspect. It is not just pollution or population, but also about all aspects which related with human activity and human life.

After description above, we can take conclusion that sustainable development in the global context takes the control of the nature for the human life. Otherwise, we can refer Charlotte Perkins Gilman books: “The man-made world” (Gilman, 2009).

Sustainable Development in Architecture

In architecture, we can talk about cities and buildings which have connection with the sustainable development. The sustainable cities become one of critical issues in UN conference in Rio, 2012.

Satterthwaite (1997) said that the greening of cities requires some, or preferably all, of the following:
1. controlling diseases and their health burden;
2. reducing chemical and physical hazards;
3. developing high quality urban environments for all;
4. minimizing transfers of environmental costs to areas outside the city; and
5. ensuring progress towards sustainable consumption

In architecture, there are many terms to call sustainability. The term “green” is one of the most widely used but poorly defined terms in architecture nowadays. While the terms “green,” “sustainable,” and “ecological” are often used interchangeably to describe environmentally responsive architecture, in reality each term has its own history and sociopolitical connotations, as well as its own architectural definition, use, and operation. Green architecture is an umbrella term, which involves a combination of values—environmental, social, political, and technological—and thus seeks to reduce the negative environmental impact of buildings by increasing efficiency and moderation in the utilization (Attmann, 2010). For technical aspects in architecture, we can use the greenship, and Green Building Council Indonesia already has greenship ver. 1.1., in February 2012.

Greenship new building ver. 1.1. Indonesia has 6 aspects (source: [http://www.gbcindonesia.org](http://www.gbcindonesia.org)):

1. Appropriate Site Development, consist of: Basic Green Area, Site Selection, Community Accessibility, Public Transportation, Bicycle, Site Landscaping, Micro Climate, and Storm Water Management
6. Building Environment Management, consist of: Basic Waste Management, GP as a Member of Project Team, Pollution of Construction Activity, Advance Waste Management, Proper Commissioning, Submission GB Implementation Data for Database, Fit Out Agreement and Occupant Survey

JAVANESE PERSPECTIVE OF SUSTAINABLE

Lakon “Babad Alas Wanamarta”

Lakon (the story of Javanese shadow play) Babad Alas Wanamarta is the original of Javanese people, called lakon carangan. This story tells about Pandawa who build
the Palace in ‘Mertani’ forest. Prabu Matswapati gives this forest to Pandawa. Pandawa must ‘destroy’ the forest and build the palace.

The problem is this unusual forest, not native forest. This forest is a kingdom of ‘evil spirit’. This great kingdom has 4 states. Yudhistira is a king of the center of this evil kingdom. And the state lead by:
1. Arya Dandunwacana, a king of Jodipati
2. Arya Dananjaya, a king of Madukara
3. Detya Sapujagad, a king of Sawojajar
4. Detya Sapulebu, a king of Bawenatalun.

Bima, one of Pandawa, with his twin brother – Nakula and Sadewa – directly go to forest and ‘destroy’ it with their strength. Another side, Arjuna goes to Resi (high priest) Wiyasa for his blessing. Resi Wiyasa gives Arjuna minyak (oil) Jayangkaton.

In forest, Bima, Nakula and Sadewa can’t beat the evil spirit, and they are arrested by evil force. Bima, Nakula and Sadewa can be seen by normal people. They disappear. After that, Arjuna came to that forest. He can’t see his brothers. Arjuna using minyak Jayakaton, and after that he can see all of them include the evil king and army. Arjuna fight to release of his brother from evil kings, and he did it. After that, Arjuna gives that oil to his brothers. And Pandawa strive with evil army. Finally, Pandawa won, and the evil spirit manunggal (become ‘one’) in Pandawa body. Arya Dandunwacana gets into Bima’s body; Arya Dananjaya gets into Arjuna; Detya Sapujagad gets into Nakula; and Detya Sapulebu into Sadewa.

**Interpretation of Lakon ‘Babad Alas Wanamarta’**

Scene 1: After Prabu Matswapati gave the Mertani forest to Pandawa, Bima go to this forest directly. With his strenght, he destroys this forest. Arya Dananjaya, one of the evil king, beat down Bima and the twin Nakula-Sadewa. They become captive, and can't be seen with normal eye. The forest can be interpreted as ‘mother nature’, and Pandawa as human being. This situation can be interpreted if we cannot handle the nature with our strengthen. Nature can attach human and imprison us with their strength. What we have to do?

Scene 2: Arjuna chooses another way. He goes to resi Wiyasa (high-priest) and gets minyak (oil) jayangkaton (katon: visible). Arjuna uses this oil before fighting with evil. After he uses that oil, Arjuna can see the evil and release Bima, Nakula and Sadewa. The interpretation of this ‘scene’ is Arjuna used another way. He use a spiritual way. Before war, he went to high priest. Minyak jayakaton is the symbol of ‘spiritual perspective’. We can not only use human force but also ‘spiritual aspect’.

Scene 3: Arjuna gives minyak jayakaton to his brothers (Bima, Nakula and Sadewa). After that, they fight with evil kings, and Pandawa win. The evil kings manunggal (become one) into Pandawa body’s. The interpretation of 3rd scene is Pandawa use their strength and spiritual aspect to build the kingdom. Manunggal between evil spirit and Pandawa can be read that nature (‘evil spirit’) become ‘one’ with man (=Pandawa) strengthen aspect and spiritual.
Context and Perspective of Sustainable Development in Javanese Culture

The interpretation of *lakon babad alas wanamarta* above, shows that Javanese culture has close connection with spiritual aspect. Every action must be blessed by religious leader or spiritual logic. Another perspective form this ‘story’ is between man and nature ‘becomes one’ (manunggal) for build an ideal dwelling.

Based on that explanation above, sustainable development for Javanese culture perspective can be said man and nature is one, hence in the development perspective, we design with nature. Javanese people didn’t control nature, but man and nature ‘together’ built dwelling place. How about ‘technical’ aspect of sustainable development in Javanese culture?

Sustainable Development in Javanese Architecture

Talking about Sustainable Development in Javanese Architecture, we can refer to the 3 old references: *Serat* (=manuscript) Centhini, Primbon Betaljemur Adammakna and Kawruh Griya-Kepatihan.

Centhini, is one of the greatest literary works in new Javanese literature, consist of knowledge and Javanese culture. In Centhini, the knowledge of building talks more about wood aspect. First, describe about history of wooden building, good wood for building and way of fell down. After that, talk about construction element, building type. And finally, talk about *petungan* (calculation) which gives building aim, not only look of building, but also compatibility with fortune and prosperity (Santoso, 1999).

Primbon Betaljemur Adammakna talks about site. There is connection between name of candidate’s inhabitant and name of village. Selecting the Javanese reviewing land slope of the land, the environment, the potential of land and type of land (Roesmanto, 1999). Based on Kawruh Griya-Kepatihan, Javanese believe that teak wood influence for a good or bad with building occupant (Prijotomo, 2006).

Description above showed that 3 manuscripts have same ideas with *lakon wayang* (shadow puppets story). Javanese used organic material – teakwood – and have specific order to cutting down that tree. Those teakwoods have a specific influence for building occupant. Primbon told those sites, where the people plan to build the house, have a connection with the occupant? The site has a specific allocation as well. It means for Javanese, nature cannot ignore or be put into human’s control. Nature and human being have close connection. In design, nature and human being is one aspect, or we can say that human design WITH nature.

DISCUSSION

Between global and Javanese perspective about sustainable development seems have no relation. They ‘walk’ in different direction. In global perspective, sustainable development talks more about ‘controlling’. Human being must ‘wise’ to use natural
resources, and control human activity. Another side, Javanese people is thinking that human being and nature have the same level. Javanese cannot be separated between human and nature, they are one. Human and nature have a close connection.

In Hegel dialectical, we can say that global perspective is a thesis and Javanese perspective is an anti-thesis. This method delivers a synthesis. This paper is focus in Javanese side to ‘read’ the synthesis. We can separate this synthesis into 2 matters:
1. Universality in Javanese perspective of sustainability
2. Locality in Javanese perspective of sustainability

Universality in Javanese perspective of sustainability talks about the global common sense from Javanese perspective. There are always to deal globally, because we are the same human being. We, all of human being in this earth, have the same ‘basic knowledge’. Another side, every ethic has something unique, called locality. In Javanese perspective of sustainability, in terms of thought globally also has special or locally.

Figure 2. Discussion (Dialectic Hegel Model)
Dialogue 1

Thesis: Sustainable Development (Rio +21)

The understanding of sustainable Development is built by pollution, population bombs, energy crisis and climate change. All that aspects are affected by industrial consequences. Now, UN has policy to control all of human activities. This policy must be done for viability of human being in this planet. We only have one planet with limited resources. It’s a basic understanding right now. Context of sustainable development is keep the natural sources in this world. They are control human for used the natural sources, because the limitless of natural sources. Human being must be controlled their behavior because in the past time they destroyed natural sources. It is action-reaction method. Natural sources already broke, that why human being must controll their behavior for using the natural sources.

Anti-thesis: Interpretation of Lakon Babad Alas Wanamarta.

This story told a different background understanding. Pandawa build the Palace in the ‘empty space’, in the ‘native forest’. This story didn’t talk about controlling natural resources, but controlling the behavior and the human perspective on nature. Context this story is about human behavior and their perspective of nature. The story tell that Pandawa facing the 'native forest'. There is no pollution or energy crisis or climate change. Pandawa can 'destroy' all of forest to build the palace, but, the story tell, that a wrong way. Pandawa must control their behavior. The Sustainable understanding based on spiritual aspect, not from action-reaction perspective. Javanese people said that nature is representation of God. This is spiritual perspective.

Synthesis:

Universality

Both of them use a same keyword is controlling. Human activity in nature must be controlled for sustain the nature. The different is how to control and what thing or who in control.

Locality

If global perspective, human take a control of the nature; another perspective, Javanese human and nature take a control in the same time. Or we can say that in global perspective, human being as a leader of sustainable development. But in Javanese perspective, human and nature is a team to do sustainable development. They can be separated.

Dialogue 2

Thesis Greenship New Building ver 1.1.

In Greenship New Building ver 1.1 from Green Building Council Chapter Indonesia, already describe in very detail about ‘green building’ technically. That rules can be divided into 3 groups:
INTERNATIONAL CONFERENCE  
GREEN CONCEPT IN ARCHITECTURE AND ENVIRONMENT


In technical aspect, we are not only control the nature but also take advantage. The Architect use 'Mother Nature' for his ‘green building’ aspect. Natural lighting, natural ventilation, count the micro climate for human indoor comfort, are the examples of USING nature term. The latest architectural term – green architecture, bioclimatic architecture – nature became one of important variables. We can say that technically human being CONTROL and USE the nature for human dwelling.

Anti-thesis: Javanese manuscripts.

This paper use 3 manuscripts: serat Centhini, Primbon Betaljemur Adammakna and kawruh Griya-Kepatihan. They ‘talk’ about Javanese building and land where the building is built. That manuscript can be divided into 3 groups:
1. Material, building type.
2. Connection between human and material.
3. Connection between human and land/site

According to those manuscripts, Javanese people build the house based on wooden material (especially teak wood) and that teak wood has a strong influence in shaping the character of house is expected. A similar thing happened in the selection of land/site for building construction. Every land/site has its own character for inhabited. And those characters have a very close relationship with human who will inhabit. This interpretation shows that Javanese perspective, human being is not as a main character in controlling all of aspects of sustainable development. Nature has a power too. Man and nature have equal footing, mutual controlling. In that understanding, man is NOT USING nature, but man and nature are WORKING together for better future.

Synthesis

Dialectical above shows that there are controlling aspects in relationship between humans and nature. The difference is, in global perspective ‘control’ is only done by human being, passive nature; while in Javanese perspective, human and nature have a same level which is control mutually.

CONCLUSION

This paper showed the similarities (universality) and differences (locality) in the perspective of sustainable development, both from philosophical and theoretical (architectural) level.
In global perspective we can see that the rules on sustainable development organized pragmatically. Improving regulations drafted by the changing condition of this earth. Another side, Javanese perspective is talking about the ideal condition. Javanese perspective is not prepared according the present situation. The story about Pandawa build the palace was compiled as native forests, the same conditions as in writing manuscripts.

This paper based on exploration studies. Javanese perspective of sustainable development provides a global perspective of sustainable development, that human cannot put the nature only to be exploited, but man and nature have a same level. Nature is also able to control human decisions or activities in build something. We must ‘LISTEN’ and ‘READ’ a nature more carefully. How does it possible?

To interpret many ‘local knowledge’ is one of the several ways to understand the ‘mother nature’. We can combine advances technology, technical ability with the ideas which contained in the manuscripts or folklore. We must interpret that manuscripts or folklore first, and ‘drag’ into our conditions right now. Manuscripts or folklore contain ‘local knowledge’, they are compiled based on a long experience of the past.

This paper only show that there is knowledge behind Javanese folklore and manuscripts, talk about sustainable development. Next step is continuing this research to more applied or technical aspect. We have to formulate the rules of green building which is more appropriate to the circumstances in Java/Indonesia as, the example.

REFERENCES


Web Site
http://www.uncsd2012.org/
http://www.gbcindonesia.org

Magazine
THE ASSESMENT OF CONNECTIVITY INDEXES AS ROAD NETWORK’S PARAMETER OF SUSTAINABILITY IN MALANG CITY

Septiana Hariyani*, Endang Titi Sunarti Darjosanjoto**, Haryo Sulistyarso**
*)Student of Architecture Doctorate Program, Faculty of Civil Engineering and Planning, Institute of Technology Sepuluh November, and Lecturer of Regional and Urban Planning Department Faculty of Engineering, Brawijaya University Malang
**) Promotor and Co promotor of Architecture Department, Faculty of Civil Engineering and Planning, Institute of Technology Sepuluh November
e-mail: septianahariyani@ub.ac.id; septianahariyanipwk@yahoo.co.id

ABSTRACT

Malang is a city which has a high variety of urban spatial structure, especially in urban service, land use, settlement patterns, population density and building. The study aims to determine the sustainability network of roads especially in Lowokwaru and Kedungkandang District. The quantitative methods are applied to determine the sustainability of the roads network. The quantitative methods include calculation of quadrant configuration, the value of linkage ratio node, grid pattern, connected node ratio, alpha index, gamma index, intersection density, linkage density, distribution and miu index.

The result shows, in term of road network, the analysis of Lowokwaru’s network connectivity expresses a sustainability level higher than Kedungkandang District. This can be explained that the rate of connectivity in Lowokwaru District are 1.04 for the value of linkage node ratio, 0.92 for connected node ratio, 0.42 for grid pattern, and 0.03 for alpha index. Furthermore, the value of gamma index is 36% and miu index 2.83. Meanwhile, Kedungkandang District has the rate of connectivity value of 0.93 for linkage-node ratio, 0.84 for connected node ratio, 0.41 for grid pattern, and (-0.02) for alpha index. Moreover, the value of gamma index is 33% and miu index is -1.08.

Based on the above result it can be concluded that the value of Lowokwaru District’s linkage ratio node, connected node ratio, grid pattern, alpha index, gamma index, intersection density, and density linkage, is more better than Kedungkandang District’s.

Keywords: sustainability, connectivity indexes, road network
INTRODUCTION

City is formed by elements which form the physical structure of urban space. Branch (1995), Agustin (2012, 2013) suggested that the physical elements of the city consist of: (1) buildings (such as residential units, commercial, industrial, governmental), (2) transportation and utilities, and (3) open space city.

According to Bintarto and Hadisumarno (1991), the performance of space structure is determined by the elements forming it which is a manifestation of activity and physical form. Furthermore, the movement of human and goods from one to another place is always through certain channels which is connected to each other by the circulation or transport networks.

The development of infrastructure is a major driver of economic growth. Infrastructure systems such as road/transport, water supply and sanitation, waste and waste water, and energy forms the backbone of the economy that provide social benefits as well as economic benefits to the community (UN ESCAP/United Nations Economic and Social Commission for Asia and the Pacific, 2009).

The existence of utility networks and infrastructure built with the concentric pattern from the city center to the periphery (fringe areas) will encourage the physical development of the city which is compact and continuous spread to all city regions. This condition will allow for financial efficiency in the provision of urban infrastructure in the future (Dardak, 2004).

Common challenges in urban infrastructure development in the region are strongly associated with road network. This condition requires the appropriate approach in the development of urban infrastructure which is integrated and sustainable (Madiaworo, 2010).

Based on the above considerations, the paper aims to determine the sustainability network of roads especially in Lowokwaru and Kedungkandang district.

METHODOLOGY

Primary survey was conducted by researching and recording the condition of road network systems in Malang. Meanwhile, secondary survey was done by finding the literatures related to the issues discussed. The data was used as an input for the quantifying of road pattern. According to Bintarto (1991), Marshall (2005), and Purnomo (2009), there are some ways to classify the sustainability of the road network. Ten methods was used in this study, namely:

1. Quantifying the pattern of road network.

Quantification in study area was done by conducting some calculations which include the ratio of the node and configuration, connectivity index, and the density of the road network system. There is elements-T ratio, ratio X, ratio-cell, and ratio-cul-de-sac that is used to compile the pattern configuration quadrant.

a) Ratio-X (4-way junction), which is the ratio between the number of nodes intersection of four (indicated as ■) with the total number of vertices
b) Ratio-T (3-way junction), which is the ratio of the number of nodes intersection of three (indicated as ●) with the overall number of vertices

c) Ratio-Cell, is the ratio between the number of cell (indicates as □) and the sum of cell and cul-de-sac (indicates as □+○).

d) Ratio-cul-de-sac, is the ratio between the number of cul-de-Sac (indicated as ○) and the total number of cul-de-sac and cell (indicates as ○ + □)

![Figure 1 Configuration of Road Network](source: Marshall (2005))

The calculation resulted by quantification of the pattern of the road network can be input into quadrant as described in Figure 2. According to Marshall (2005), there are 4 quadrant where quadrant I is an area dominated by the 3-way junction and cells, quadrant II is dominated by 3-way junction and cul-de-sac, quadrant III is dominated by the 4-way junction and cul-de-sac, and quadrant IV is an area with a predominance of 4-way junction and cells.

2. Calculating the Linkage-Node Ratio (LNR)

The ratio between the linkages with the node can indicate the level of connectivity on a regional road network (Dill, 2004). Linkage or chain is a path or line segment that connects two vertices (nodes). In this method, a node can shape intersection or the end of a road (a dead end or cul-de-sac). Node linkage ratio formula is calculated using Eq.1.

\[
LNR = \frac{\text{Linkage (m)}}{\text{Node (t)}}
\]

Eq.1

Where: LNR = Linkage Node Ratio

m = linkage / link

t = point or node

Further interpretation of Node Linkage Ratio (LNR) follows Ewing’s statement, that is, if the value of LNR ≥ 1.2-1.4, the road network is sustainable (Ewing, 1996).
3. Calculating the Connected Node Ratio (CNR)
Many opinions suggest that grid connected road network is more sustainable than road pattern of cul-de-sac or with dead end. Connected node ratio (CNR) is the ratio between the number of nodes connecting road (intersection) and a whole node coupled to an impasse (cul-de-sac).

\[
\text{CNR} = \frac{\text{Intersection Node (t)}}{\text{All node (t + c)}} \quad \text{Eq.2}
\]

Where: CNR = Connected Node Ratio  
\( t \) = point or knot-shaped intersection  
\( c \) = point or knot-shaped cul de sac

The interpretation of Connected node ratio (CNR), then follows Ewing’s statement, that is, if the value of CNR is \( \geq 0.7 \), the road network is sustainable (Ewing, 1996).

4. Assessing the grid pattern of road network
The determination of limit value of the area having an ideal grid pattern has been proposed by Marshall (2005). The suggested value is \( X > 0.5 \) and \( C\text{ell} > 0.5 \). The limit value located in quadrant IV indicates the ideal grid pattern. The value lies in quadrant I indicates that the region has grid pattern classified as good. The values lie in quadrant II is classified as an area with a moderate grid value. The values lies in quadrant III indicate the worst grid pattern.

5. Calculating the Alpha Index
Alpha index is the ratio between the number of existing circuits and the maximum number of circuits that can be formed by the existing node Bintarto (1991), Dill (2004), Marshall (2004), Purnomo (2009). Alpha index formula is calculated using Eq.3.
Where:  
\( m = \text{linkage / link} \)  
\( t = \text{node / node} \)  
\( s = \text{sub-graph} \)

Some authors proposed further interpretation of alpha index where the closer the value to 1, the better is the connectivity (Bintarto, 1991; Dill, 2004; Marshall, 2004; Purnomo, 2009). However, there is no exact limit.

6. Calculating Gamma index

As explained by Bintarto (1991); and Purnomo (2009): Gamma index is the ratio between the number of networks, linkage or chain in a network and the maximum number of networks, linkage or chain that can be formed between the existing nodes. Gamma index is calculated using Eq.4.

\[
\text{Gamma Indeks} = \frac{\text{linkage (m)}}{3 \times (\text{node (t)} - 2)}
\]

Some authors proposed further interpretation of gamma index where the closer the value to 1, the better is the connectivity (Bintarto, 1991; and Purnomo, 2009). However, there is no exact limit.

7. Calculating Miu Index

Miu index or cyclomatic number is a number showing a comparison of road networks in the region. Areas with high cyclomatic numbers indicates denser road network implying a higher level of sustainability Bintarto (1991), Purnomo (2009).

\[
\text{Miu Indeks} = \text{linkage (m)} - \text{node (t)} + \text{subgraph (s)}
\]

Where:  
\( \mu = \text{cyclomatic number} \)  
\( m = \text{eye-chain, a linkage that connects a line or a point where} \)  
\( t = \text{the point or place, shaped knot} \)  
\( s = \text{sub-graph, i.e the number of areas} \)

The closer the value to 1, the better is connectivity. However, there is no exact limit.

8. Calculating Density Intersection

Intersection density is calculated based on the number of the intersection for each unit area. Greater density values indicate more intersection and are assumed as a high level of connectivity (Handy, 1996).

\[
\text{Intersection Density} = \frac{\text{intersection node (t)}}{\text{area s}}
\]

The denser the linkage is, the better is the connectivity. However, there is no exact limit.
9. Calculating Linkage density

Linkage density is the ratio between the amount of linkage and the area. Greater linkage density values indicate the more crucial or road segment in a region.

\[
\text{linkage density} = \frac{\text{linkage (m)}}{\text{area (s)}} 
\]

Eq.7

The denser the linkage is, the better is the connectivity. However, there is no exact limit.

10. Calculating Length of road density

Long road density is the ratio between the length of the road and the area of the region.

\[
\text{Long Road Density} = \frac{\text{the long road}}{\text{area}}
\]

Eq.8

The denser the linkage is, the better is the connectivity. However, there is no exact limit.

RESULTS AND DISCUSSION

Quantification Pattern of Road Network

The quantification of the pattern is done by firstly identifying the composition and configuration of a 3-way junction, 4-way junction, cul-de-sac (dead end), as well as the number of cell. More detail data can be seen in Table 1 and Table 2.

Table 1. Element of Road Network of Each Village in Lowokwaru District

<table>
<thead>
<tr>
<th>No</th>
<th>Village</th>
<th>Node Number</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>▲ (▲) ▼ (■)</td>
<td>▶ (●)</td>
<td>□ (□)</td>
<td>▲+▼ (▲+■)</td>
<td>▶+□ (●+□)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Merjosari</td>
<td>30 28 5</td>
<td>12</td>
<td>60</td>
<td>58</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Dinoyo</td>
<td>44 31 4</td>
<td>14</td>
<td>73</td>
<td>75</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sumbersari</td>
<td>43 29 5</td>
<td>11</td>
<td>81</td>
<td>72</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Ketawanggede</td>
<td>39 26 5</td>
<td>13</td>
<td>78</td>
<td>65</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Jatimulyo</td>
<td>41 28 6</td>
<td>12</td>
<td>74</td>
<td>69</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Lowokwaru</td>
<td>39 31 6</td>
<td>13</td>
<td>73</td>
<td>70</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Tulusrejo</td>
<td>34 27 9</td>
<td>10</td>
<td>67</td>
<td>61</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Mojolangu</td>
<td>42 27 4</td>
<td>13</td>
<td>69</td>
<td>69</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Tunjungsekar</td>
<td>31 24 7</td>
<td>11</td>
<td>66</td>
<td>55</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Tasikmadu</td>
<td>31 23 4</td>
<td>9</td>
<td>59</td>
<td>54</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Tunggul-wulung</td>
<td>29 19 3</td>
<td>12</td>
<td>69</td>
<td>48</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>
The bold numbers describe the type of roads, where:

(3) = 3-Way Junction
(4) = 4-Way Junction
(5) = Cul-de-sac
(6) = Cell Number
(8) = Addition (3) and (4)
(9) = Addition (5) and (6)

Table 2. Element of Road Network of Each Village in Kedungkandang District

<table>
<thead>
<tr>
<th>No</th>
<th>Village</th>
<th>Node Number</th>
<th>Linkage Number</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(▲) (■) (●)</td>
<td>(□) (▲)+■ (●)+□</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Arjowinangun</td>
<td>16 10 4 8</td>
<td>45 26</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Tlogowaru</td>
<td>18 12 3 8</td>
<td>46 30</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>Wonokoyo</td>
<td>14 9 4 6</td>
<td>27 23</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Bumiayu</td>
<td>19 11 4 6</td>
<td>40 30</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Buring</td>
<td>15 12 5 7</td>
<td>30 27</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>Mergosono</td>
<td>12 9 6 6</td>
<td>22 21</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>Kotalama</td>
<td>18 13 10 9</td>
<td>44 31</td>
<td>19</td>
</tr>
<tr>
<td>8</td>
<td>Kedungkandang</td>
<td>11 9 3 6</td>
<td>12 20</td>
<td>9</td>
</tr>
<tr>
<td>9</td>
<td>Sawojajar</td>
<td>28 23 11 12</td>
<td>45 51</td>
<td>23</td>
</tr>
<tr>
<td>10</td>
<td>Madyopuro</td>
<td>9 8 4 5</td>
<td>15 17</td>
<td>9</td>
</tr>
<tr>
<td>11</td>
<td>Lesanpuro</td>
<td>14 10 3 4</td>
<td>20 24</td>
<td>7</td>
</tr>
<tr>
<td>12</td>
<td>Cemorokandang</td>
<td>19 9 6 5</td>
<td>20 28</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>193 135 63 82</td>
<td>366 328</td>
<td>145</td>
</tr>
</tbody>
</table>

The bold numbers describe the type of roads, where:

(3) = 3-Way Junction
(4) = 4-Way Junction
(5) = Cul-de-sac
(6) = Cell Number
(8) = Addition (3) and (4)
(9) = Addition (5) and (6)

Table 1 and 2 show that the Lowokwaru district has more intersections which are 3-way junction, 4-way junction, cul-de-sac, cell number, and the number of linkage. It indicates that Lowokwaru district has more connectivity than Kedungkandang district because it has more 3-way and 4-way junctions.
Quadrant Configuration

Based on the calculation of the above elements of the road network pattern, the values are put into the quadrant configuration of road pattern. More detail data can be seen in Figure 3 and Figure 4.

**Figure 3.** Quadrant Configuration of Road Pattern of Each Village In Lowokwaru District

**Figure 4.** Quadrant Configuration of Road Pattern of Each Village In Kedungkandang District
Figure 3 and Figure 4 show that more element of road network located in quadrant I and II configuration of road pattern. It implies that some areas in the village is not quite sustainable although they are connected each other.

**Connectivity analysis**

Regarding to connectivity analysis, the data is calculated using Eq.1- Eq.4. The result for each village in Lowokwaru and Kedungkandang is showed in Table 3 and Table 4. The optimum value of LNR, CNR, and Grid pattern is LNR ≥ 1.2-1.4, CNR is ≥ 0.7, X> 0.5 and Cell> 0.5 respectively. For Alpha index and Gamma index, it is better if the value is closer to 1.

**Table 3. Index Connectivity of Each village in the Lowokwaru District**

<table>
<thead>
<tr>
<th>No</th>
<th>Village</th>
<th>LNR</th>
<th>CNR</th>
<th>Grid Pattern</th>
<th>Alpha Index</th>
<th>Gamma Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Merjosari</td>
<td>0.95</td>
<td>0.92</td>
<td>0.48</td>
<td>-0.02</td>
<td>0.33</td>
</tr>
<tr>
<td>2</td>
<td>Dinoyo</td>
<td>0.92</td>
<td>0.95</td>
<td>0.41</td>
<td>-0.03</td>
<td>0.32</td>
</tr>
<tr>
<td>3</td>
<td>Sumbarsari</td>
<td>1.05</td>
<td>0.94</td>
<td>0.40</td>
<td>0.03</td>
<td>0.36</td>
</tr>
<tr>
<td>4</td>
<td>Ketawang gede</td>
<td>1.11</td>
<td>0.93</td>
<td>0.40</td>
<td>0.07</td>
<td>0.38</td>
</tr>
<tr>
<td>5</td>
<td>Jatimulyo</td>
<td>0.99</td>
<td>0.92</td>
<td>0.41</td>
<td>0.00</td>
<td>0.34</td>
</tr>
<tr>
<td>6</td>
<td>Lowokwaru</td>
<td>0.96</td>
<td>0.92</td>
<td>0.44</td>
<td>-0.01</td>
<td>0.33</td>
</tr>
<tr>
<td>7</td>
<td>Tulusrejo</td>
<td>0.96</td>
<td>0.87</td>
<td>0.44</td>
<td>-0.01</td>
<td>0.33</td>
</tr>
<tr>
<td>8</td>
<td>Mojolangu</td>
<td>0.95</td>
<td>0.95</td>
<td>0.39</td>
<td>-0.02</td>
<td>0.32</td>
</tr>
<tr>
<td>9</td>
<td>Tunjungsekar</td>
<td>1.06</td>
<td>0.89</td>
<td>0.44</td>
<td>0.04</td>
<td>0.37</td>
</tr>
<tr>
<td>10</td>
<td>Tasikmadu</td>
<td>1.02</td>
<td>0.93</td>
<td>0.43</td>
<td>0.02</td>
<td>0.35</td>
</tr>
<tr>
<td>11</td>
<td>Tungkulwulung</td>
<td>1.35</td>
<td>0.94</td>
<td>0.40</td>
<td>0.20</td>
<td>0.47</td>
</tr>
<tr>
<td>12</td>
<td>Tlogomas</td>
<td>1.11</td>
<td>0.91</td>
<td>0.36</td>
<td>0.06</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td><strong>Average</strong></td>
<td><strong>1.04</strong></td>
<td><strong>0.92</strong></td>
<td><strong>0.42</strong></td>
<td><strong>0.03</strong></td>
<td><strong>0.36</strong></td>
</tr>
</tbody>
</table>

**Table 4. Index Connectivity of Each village in the Kedungkandang District**

<table>
<thead>
<tr>
<th>No</th>
<th>Village</th>
<th>LNR</th>
<th>CNR</th>
<th>Grid Pattern</th>
<th>Alpha Index</th>
<th>Gamma Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Arjowinangun</td>
<td>1.50</td>
<td>0.87</td>
<td>0.38</td>
<td>0.29</td>
<td>0.54</td>
</tr>
<tr>
<td>2</td>
<td>Tlogowaru</td>
<td>1.39</td>
<td>0.91</td>
<td>0.40</td>
<td>0.23</td>
<td>0.49</td>
</tr>
<tr>
<td>3</td>
<td>Wonokoyo</td>
<td>1.00</td>
<td>0.85</td>
<td>0.39</td>
<td>0.02</td>
<td>0.36</td>
</tr>
<tr>
<td>4</td>
<td>Bumiayu</td>
<td>1.18</td>
<td>0.88</td>
<td>0.37</td>
<td>0.11</td>
<td>0.42</td>
</tr>
<tr>
<td>5</td>
<td>Buring</td>
<td>0.94</td>
<td>0.84</td>
<td>0.44</td>
<td>-0.02</td>
<td>0.33</td>
</tr>
<tr>
<td>6</td>
<td>Mergosono</td>
<td>0.81</td>
<td>0.78</td>
<td>0.43</td>
<td>-0.08</td>
<td>0.29</td>
</tr>
<tr>
<td>7</td>
<td>Kotalama</td>
<td>1.07</td>
<td>0.76</td>
<td>0.42</td>
<td>0.05</td>
<td>0.38</td>
</tr>
<tr>
<td>8</td>
<td>Kedungkandang</td>
<td>0.52</td>
<td>0.87</td>
<td>0.45</td>
<td>-0.24</td>
<td>0.19</td>
</tr>
<tr>
<td>9</td>
<td>Sawojajar</td>
<td>0.73</td>
<td>0.82</td>
<td>0.45</td>
<td>-0.13</td>
<td>0.25</td>
</tr>
<tr>
<td>10</td>
<td>Madyopuro</td>
<td>0.71</td>
<td>0.81</td>
<td>0.47</td>
<td>-0.14</td>
<td>0.26</td>
</tr>
<tr>
<td>11</td>
<td>Lesanpuro</td>
<td>0.74</td>
<td>0.89</td>
<td>0.42</td>
<td>-0.12</td>
<td>0.27</td>
</tr>
<tr>
<td>12</td>
<td>Cemorokandang</td>
<td>0.59</td>
<td>0.82</td>
<td>0.32</td>
<td>-0.21</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td><strong>Average</strong></td>
<td><strong>0.93</strong></td>
<td><strong>0.84</strong></td>
<td><strong>0.41</strong></td>
<td><strong>-0.02</strong></td>
<td><strong>0.33</strong></td>
</tr>
</tbody>
</table>
The optimal condition is achieved if the village meet all connectivity indices. There is only one village in each district (Tunggulwulung and Tlogowaru) which meet two criteria namely LNR(1.35 and 1.39) and CNR (0.94 and 0.91). It indicates that the area of study is approximately closer to sustainability. The average value of each district which is below or approaching the standard value of indexes connectivity is the indication of the inferior sustainability.

Density of Road Network

The density of road network is analyzed and interpreted from the result of calculation using Eq.5- Eq.8. The result for each village in Lowokwaru and Kedungkandang is showed in Table 5 and Table 6. According Bintarto (1991) and Purnomo (2009), the value of Miu index is better if it is closer to 1. For density intersection, Linkage density, and Length of road density, it is better if it is densier than other.

**Table 5. Road network density in Lowokwaru District**

<table>
<thead>
<tr>
<th>Village</th>
<th>Intersection density (Unit/Ha)</th>
<th>Linkage Density (Unit/ha)</th>
<th>Long Road Density (km/ha)</th>
<th>Miu Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merjosari</td>
<td>0.19</td>
<td>0.18</td>
<td>0.10</td>
<td>-2</td>
</tr>
<tr>
<td>Dinoyo</td>
<td>0.68</td>
<td>0.62</td>
<td>0.23</td>
<td>-5</td>
</tr>
<tr>
<td>Sumbergesari</td>
<td>0.60</td>
<td>0.63</td>
<td>0.24</td>
<td>5</td>
</tr>
<tr>
<td>Ketawangedhe</td>
<td>0.84</td>
<td>0.94</td>
<td>0.22</td>
<td>9</td>
</tr>
<tr>
<td>Jatimulyo</td>
<td>0.30</td>
<td>0.29</td>
<td>0.18</td>
<td>0</td>
</tr>
<tr>
<td>Lowokwaru</td>
<td>0.62</td>
<td>0.59</td>
<td>0.21</td>
<td>-2</td>
</tr>
<tr>
<td>Tulusrejo</td>
<td>0.53</td>
<td>0.51</td>
<td>0.21</td>
<td>-2</td>
</tr>
<tr>
<td>Mojolangu</td>
<td>0.25</td>
<td>0.24</td>
<td>0.18</td>
<td>-3</td>
</tr>
<tr>
<td>Tunjungsekar</td>
<td>0.33</td>
<td>0.35</td>
<td>0.12</td>
<td>5</td>
</tr>
<tr>
<td>Tasikmadu</td>
<td>0.24</td>
<td>0.24</td>
<td>0.06</td>
<td>2</td>
</tr>
<tr>
<td>Tunggulwulung</td>
<td>0.27</td>
<td>0.37</td>
<td>0.10</td>
<td>19</td>
</tr>
<tr>
<td>Tlogomas</td>
<td>0.35</td>
<td>0.39</td>
<td>0.18</td>
<td>8</td>
</tr>
<tr>
<td>Average</td>
<td><strong>0.43</strong></td>
<td><strong>0.45</strong></td>
<td><strong>0.17</strong></td>
<td><strong>2.83</strong></td>
</tr>
</tbody>
</table>

**Table 6. Road network density in Kedungkandang District**

<table>
<thead>
<tr>
<th>Village</th>
<th>Intersection density (Unit/Ha)</th>
<th>Linkage Density (Unit/ha)</th>
<th>Long Road Density (km/ha)</th>
<th>Miu Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arjowinangun</td>
<td>0.10</td>
<td>0.16</td>
<td>0.09</td>
<td>16</td>
</tr>
<tr>
<td>Tlogowaru</td>
<td>0.09</td>
<td>0.12</td>
<td>0.05</td>
<td>14</td>
</tr>
<tr>
<td>Wonokoyo</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>1</td>
</tr>
<tr>
<td>Bumiayu</td>
<td>0.09</td>
<td>0.10</td>
<td>0.07</td>
<td>7</td>
</tr>
<tr>
<td>Buring</td>
<td>0.06</td>
<td>0.05</td>
<td>0.07</td>
<td>-1</td>
</tr>
<tr>
<td>Mergosono</td>
<td>0.48</td>
<td>0.39</td>
<td>0.18</td>
<td>-4</td>
</tr>
<tr>
<td>Kotalama</td>
<td>0.48</td>
<td>0.51</td>
<td>0.24</td>
<td>4</td>
</tr>
<tr>
<td>Kedungkandang</td>
<td>0.05</td>
<td>0.02</td>
<td>0.04</td>
<td>-10</td>
</tr>
</tbody>
</table>
There are only 3 villages in each district which have the highest value of intersection density, linkage density, and long road density. There are Lowokwaru (0.62), Ketawangede linkage (0.94), Sumbersari (0.24), Mergosono (0.48), Kotalama (0.48) and (0.51), and Sawojajar (0.28) respectively. It indicates that the area of study approximately to sustainability.

According to the focus of this study i.e. road and connectivity related to the concept of sustainability, therefore traffic density is not include in this discussion.

**CONCLUSION**

The calculation of sustainability indexes showed that Lowokwaru district has more intersection compared to Kedungkandang district. It is mean that Lowokwaru district has higher connectivity. Both Lowokwaru and Kedungkandang district located in quadrant I and II configuration of road pattern implying that it is not quite sustainable although some areas in the village are connected each other.

Connectivity analysis of Lowokwaru district consisting of LNR, CNR, Grid Pattern, Alpha Index, and Gamma Index come to the result that the value are 1.04, 0.92, 0.42, 0.03, and 0.36 respectively. All the value in Lowokwaru district is higher than Kedungkandang district. The value of connectivity analysis LNR, CNR, Grid Pattern, Alpha Index, and Gamma Index are 0.93, 0.84, 0.41, -0.02, and 0.33 respectively.

Road network density of Lowokwaru district is also higher compared to Kedungkandang district. It is indicated by the value of intersection density, linkage density, long road density, and Miu index which are 0.43, 0.45, 0.17, and 2.83 respectively. Meanwhile, the value of road network density in Kedungkandang district are 0.17, 0.15, 0.12 and -1.08 for intersection density, linkage density, long road density, and Miu index respectively.

In conclusion, for the connectivity, Lowokwaru district is more sustainable than Kedungkandang district indicated by the connectivity indexes. Lowokwaru district has better level of connectivity among villages. It implies that one of the attempts of alternative green concept is to minimize the impact of transportation on environment because it will be more efficient movement in Lowokwaru district.
REFERENCES

Books:
Bintarto, R and Hadisumarno. (1991), Analysis Method of Geography, Institute for Research, Education and Implementation of Economic and Social (LP3ES), Jakarta
Ewing, R, Best Development Practicies: Doing the Right Thing and Making Money at the Same Time, American Planning Association, Chicago, IL

Report:
Dardak, Hermanto, (2004), Integrated Infrastructure Development and Spatial Planning-Based Sustainable, Department of Public Works, Jakarta.
Dill, Jennifer. (2004), Measuring Network Connectivity for Bicycling and Walking, TRB 2004 Annual Meeting
Madiasworo, Taufan. (2010), Spatial Planning as the Basis of Integrated Urban Infrastructure Development and Sustainable, PSIL-UI, Jakarta.
United Nations Economic and Social Commission for Asia and the Pacific Environment and Sustainable Development Division (UNESCAP). (2009), Sustainable Infrastructure in Asia, UN ESCAP, Thailand.

Journal:
International Conference
Green Concept in Architecture and Environment

Sub Theme:
Human Settlement and Environment

Department of Architecture ITS Surabaya, September 2013
GREEN STRUCTURE CONCEPT IN COASTAL SETTLEMENT OF BANDA ACEH

Mirza Fuady*, Happy Ratna Santosa** and Bambang Soemardiono**
*) Department of Architecture, Faculty of Engineering, Syiah Kuala University, Banda Aceh, Indonesia; Doctorate Program in Department of Architecture, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia.
**e-mail : mirzafuady2@yahoo.com
**) Lecturer in Department of Architecture, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia.

ABSTRACT

Coastal settlement of Banda Aceh in the north of Sumatera Island has high potential risk of tsunami disaster. This matter caused by regional situation of Banda Aceh city, which located close to Indian Ocean and nearby meeting point of Indo-Australian and Euroasia plates which if collide can generate tsunami. In the year 2004, half of Banda Aceh city has been destroyed by tsunami disaster, especially its coastal settlement area. Based on this experience, the approach of disaster mitigation concept for coastal settlement with vision of environment represent wise choice on planning sustainable Banda Aceh for future generation.

This qualitative research try to explore the role of green open space as green structure of the city by considering aspect of tsunami disaster mitigation for coastal settlement of Banda Aceh. This research will evaluate the existence of green open space and post disaster reconstruction of coastal settlement area.

Result of this research is green structure concept in coastal settlement of Banda Aceh based on tsunami disaster mitigation and expected to contribute ideas for disaster mitigation in other coastal settlement areas.

Keywords: disaster mitigation, coastal settlement, green open space, tsunami

INTRODUCTION

Banda Aceh is located at the coastal tip of Sumatra Island and adjacent to the Indian Ocean. This location is disaster vulnerable because its close to meeting point of the Indo-Australian and Euroasia plates which if collide could potentially cause tsunami waves. In 2004, tsunami had destroyed many settlements and infrastructures of Banda Aceh from areas near the coast to most of the downtown area (BRR, 2005). Based on bitter experienced, future settlement planning should be responsive and adaptable to the possibility of disaster. Therefore, environmentally sustainable approach in settlement planning by considering aspects of disaster mitigation is a wise choice.
Coastal settlements of Banda Aceh was the location of the most damage caused by tsunami, so the future settlement planning must be responsive to the possibility of disaster. This is in line with Sukawi (2008), which declared disaster should be used as momentum to perform realignment of a residential neighborhood, so that people can rebuild the cultural, economic and social life. Realignment efforts should not only to minimize the risk of disasters but also to prevent or avoid the cause of the damage caused by the disaster.

In connection with the arrangement of post disaster settlements, Pratiwi and Koerniawan (2008) stated the importance of considering aspects of disaster mitigation to be applied in structuring settlements so that (a) it can minimize the risk and impact of disaster-prone areas in residential areas, public facilities and infrastructure, (b) new development cannot be carried out in disaster-prone locations without adequate precautions, (c) restore the land in disaster-prone areas to be productive land, (d) help secure public and private investment, and (e) prepare the location and circulation for evacuation in case of subsequent disaster.

In line with the development of sustainable coastal settlements, the construction should be done properly and in balance between physical development and the maintenance of ecological functions of the environment. According to Chen (2004), Pauliet and Kaliszuk (2005), green open spaces as urban green structures act to support sustainable urban life, hence the existence of the natural environment and green open spaces are important to consider in order to continue to support human needs and urban development in the future. Similarly, according to Irwan (2005) and Purnomohadi (2006), the presence of green space is important in controlling and maintaining the integrity and quality of the environment.

As a structural component of environmentally sustainable city concept, the existence of open green spaces are important element supporting the creation of sustainable settlements. This research try to explore the role of green open space as green structure of the city by considering aspect of tsunami disaster mitigation for coastal settlement of Banda Aceh. This research will evaluate the existence of green open spaces and post disaster development of coastal settlement areas. Result of this research is green structure concept in coastal settlement of Banda Aceh based on tsunami disaster mitigation and expected to contribute ideas for disaster mitigation in other coastal settlement areas. The benefits and contribution of this study is to provide recommendations to the city regarding the green structure concept for coastal settlement of Banda Aceh based on tsunami disaster mitigation, so it can be a consideration material in planning future coastal settlements of Banda Aceh.

LITERATURE REVIEW

Green Open Spaces as Urban Green Structure

Green open spaces can be interpreted as spaces in the city or the wider region in the form of area or region as well as in the form of elongated area or path which is more open in its use and without buildings. Green open spaces can present as city parks, urban forests, sports fields and recreation areas, funerals, green belts and green fields.
(DPU, 2008). According to Purnomohadi (2006) urban green open spaces can also form as protected forests, green belts and green lanes of river banks and beaches.

The presence of green spaces in the city helped shape the structure of city. This opinion is in line with Sinulingga (1999), where the structure of urban space is an arrangement of settlements, network of infrastructure systems and facilities. The elements that make up the structure of urban space consisting of (a) a collection of services including trade, finance, government which tend to distribute in groups in the service center, (b) collection of secondary industry (manufacturing), warehouses and wholesale trade which tend to congregate in one place, (c) residences and green spaces, and (d) transport network connecting the three places above.

Meanwhile Hastuti (2011), reveals the environment of coastal settlements have distinctive characteristics, where green open spaces planning in coastal settlements should be able to maintain balance and harmony between built up spaces and open spaces. The balance between city structure and the natural environment are able to mitigate some of the negative impact of environmental degradation and maintain balance, sustainability, health, comfort and increase the quality of the city environment. In general, the green structure of the coastal settlements can be green forest or non-forest such as park, green belt, yard and garden. Besides the presence as green structure, green open spaces in coastal settlements can also serve as ecological, hydrological, climatological, protective, social, cultural and aesthetic.

In connection with the presence of green open space in coastal areas, Tjallingii (2005), suggested a complementary relationship between green structure and water bodies in the city. Green structure will control water such as floods and rains. Similarly, water bodies will support fertility and beauty of the green areas in the settlements. The existence of water and green structure is needed not only on the natural environment, but also on other city areas such as housing, recreation areas, they will act to support the sustainability of the city.

Associated with the concept of sustainable development of coastal settlements, Dahuri (2003) stated the importance of considering aspects of (a) ecological sustainability of the natural environment, in improving the capacity and quality of ecosystems as the main focus, it will not pass its carrying capacity and (b) socio-economic sustainability, which implies the development of coastal settlements must consider the sustainability of society welfare.

Disaster Mitigation

Disaster mitigation is a series of efforts to reduce the risk of an event or series of events that threaten and disrupt the lives and livelihoods. Mitigation can be done through physical development, awareness and capacity building to face the threat of disaster. The disasters as events that threaten, disrupt lives and can result in human casualties, environmental damage, loss of property, as well as the psychological impact can be caused by natural factors or human factors (HSEM, 2009 and TDMRC, 2010).

Coastal settlements as residential areas are located in the waterfront areas which is very prone to tsunami. Therefore it needs strategic steps to protect residents with disaster relief starts from before, during and after a disaster occurs. One of the efforts made at the time prior to the occurrence of disasters is prevention and mitigation, which
is an effort to reduce or minimize the impact of loss or damage that can be caused by disaster (Bakornas, 2002).

According to Usman (2009), the tsunami disaster mitigation efforts can be grouped into two main parts, namely: (a) structural mitigation in the form of technical effort that aims to reduce wave energy in coastal areas. Structural efforts can be distinguished naturally by planting mangrove forests as green belt and the efforts made by the construction of breakwaters, sea walls, dykes, as well as strengthen the design of buildings and houses and other infrastructure to be resilient to disasters, (b) non structural mitigation in the form of non technical efforts related to the adjustment and regulation of human activities and land use policies to be consistent and in accordance with structural mitigation measures and other efforts. Non-structural efforts also include, among others: the standardization of building settlements and infrastructures, public economic activities, disaster mitigation simulation also early warning system of danger.

Research on disaster mitigation in disaster prone settlements have been made by several researchers. Samsirina, Poerbo and Syahyudesrina (2008), reveal important aspects of environmental regulation such as the environment and green open spaces. Neighborhood road in good connection is important for people to be able to escape to the higher and safer location. Shape of the road will determine how the layout of the housing will be created and can be elements of the environment that can increase alertness to residents in time of disaster. Characteristics of the road width and perpendicular to the shore, will help residents to see the arrival of tsunami waves from far away so that they can immediately run towards safer place.

Trees and vegetation in green open spaces in the form of natural or artificial forests can be designed to slow down and hold currents and waves which carried debris. According to Thuy (2008), tsunami reduction behind the coastal forest depends not only on vegetation specie, vegetation characteristics but also on arrangement of vegetation. As the same of vegetation characteristics, the vegetation arrangement has a significant influence on current velocity and hydraulics force behind the coastal forest.

Meanwhile Nasution (2005), in research on tsunami prone areas on the west coast of Aceh confirms 7 principles in dealing with the tsunami disaster mitigation, namely (a) identify the tsunami risk at the site, (b) avoid new development in tsunami inundation areas to reduce victims in the future, (c) set a new development in tsunami inundation areas to minimize future losses, (d) design and build new structures that can reduce the damage, (e) protect existing development from tsunami losses by rebuilding, planning and utilization, (f) take special precautions in managing and designing infrastructure and facilities, to reduce the damage and (g) make evacuation plan.

**METHODOLOGY**

This study used qualitative approach in assessing the role of green spaces as the urban green structure by considering aspects of disaster mitigation to coastal settlements of Banda Aceh which are prone to tsunami. This study will evaluate the presence of green open spaces and the development of post disaster coastal settlements. Evaluation begins with an analysis of space utilization plan in Masterplan of Banda Aceh 2009-2029.
Aspects which reviewed in this study include settlement development plan, road development plan and also the plan of green open space in coastal settlements and protected areas. By analyzing the development plans, its expected to be basis in formulating the concept of green structure in coastal settlements of Banda Aceh.

Supporting material used in this study as secondary data collected from several government offices such Masterplan of Banda Aceh in 2009-2029 by Bappeda, Banda Aceh in figure 2011 by BPS, coastal settlement planning after disaster from the Rehabilitation and Reconstruction Agency (BRR) and document of green open space management from the Department of Hygiene and Beauty (DKK) of the city of Banda Aceh. It also made direct observations of the use of spaces in coastal settlements which include recording images as the primary data. Other secondary data also had been collected from a variety of other related literatures.

RESULT AND DISCUSSION

Green Open Spaces in Coastal Settlements

In the Masterplan of Banda Aceh 2009-2029, it mentioned the provision of green open spaces in the city of Banda Aceh is specifically aimed at ecological functions, economic and aesthetic. Lands designated for urban green spaces will not be developed as built up areas. Green open spaces to be developed in the city of Banda Aceh, among others, are as follows:

a. Riparian green spaces developed on the northern limit of the loop line on the north and south with a width of 8-10 m.

b. Coastal border of green open spaces set 100 m from the high tide along the coast.

c. Green open spaces along the road network.

d. Green open spaces for funeral.

e. Green open spaces for urban park developed in the Old Town Center in Peunayong, New Town Center in Lamdom/Batoh, Sub City Centre Keutapang, and Sub City Center Ulee Kareng and in the centre of neighborhood (source: Bappeda 2009).

In general, the plan is continue the previous green open spaces plan and try to incorporate disaster mitigation considerations. This is especially noticeable with the affirmation of the limits specified coastal border 100 m of high tide along the coast. This effort also to make green open spaces as protective green belts on the coast.

In particular, Masterplan of Banda Aceh 2009-2029, also established green open spaces in the form of natural spaces, namely the development of mangrove forests. The mangrove forest areas serves as buffer zones for the surrounding area to govern water, flood prevention and erosion, also maintain soil fertility. In addition, this region also has a function to minimize the potential tsunami hazard for the surrounding area. Mangrove forest areas is directed at northern coastal city of Banda Aceh. Locations are included in this category is the location of the coastal zone that could potentially be developed mangroves and other coastal plants. Development of this area ranging from Ulee Pata area in Jaya Baru district extending to the coastal area of Alue Naga in Syiah Kuala district (source: Bappeda 2009).
Furthermore according to the characteristics of the region and the direction of development of the city, the planned of local protected areas such as coastal border and rivers include:

a. Coastal border region, which serves to protect coastal areas from activities that interfere with the preservation of the coast. This area is located along the banks with proportional width to the shape and physical condition of the beach that is 50-100 m from the point of the highest tide landward. Specified coastal border area along the coast that is, except the coastal areas used for public purposes, such as port/dock, open spaces, public spaces, tourism, and fishing settlements that already exist, as well as ponds that have obtained permission from the government.

b. Riparian areas, serves to protect the river from human activities that may interfere with or damage the function of river discharge, arranged as follows: (a) the river which has a depth of no more than 3 m the river banks are a minimum of 10 m from the edge of the river, (b) river has a depth of more than 3 m to 20 m, 15 m riparian is from the edge of the river, and (c) the river that has a depth of more than 20 m, the river banks is 30 m from the river bank (source: Bappeda 2009).

Green spaces planning in the Masterplan of Banda Aceh 2009-2029, has been mentioned several policies regarding the protection of natural spaces of coastal border and the river. But all this has not translated into a green open spaces planning in more detailed and specific of disaster mitigation aspects that can be realized in practice. City Spatial Detail Plan (RDTRK) for every district in the city of Banda Aceh that considers aspects of disaster mitigation is being prepared. But the plan has been delayed in completion because there are some corrections and improvements so that it has not been published yet.

The concept of Disaster Mitigation in Coastal Settlement

Tsunami is a tidal wave caused by an earthquake or landslide on the slope of the sea floor. Such tidal waves could hit coastal areas up to tens of meters high and hundreds to thousands of meters away from the beach, that can sweep and destroy all that is on the beach and on the mainland. Tsunami disaster mitigation has goals of tsunami disaster risk reduction in the city of Banda Aceh, which could be done with consideration for sustainability and participation of all parties concerned.

To avoid the danger of tsunami impact, there needs to be special spatial planning in the coastal border for tsunami wave to break down and also slow down the speed of the wave. Given policy in this regard is the establishment of coastal border of more than 100 m from the high tide line landward, and along the border created a distinctive zones consisting of mangrove zone, fishery zone land/pond and plantation zones. After the development of cultivation zones, residential zones were allowed to be developed.

In line with Usman (2009) regarding the structural efforts in disaster mitigation, from year 2005 to 2007, the government has built sea wall and breakwater in the coastal areas of Banda Aceh. This development keep the shoreline from abrasion. It also has made efforts to replant green coastal areas with the same local plant as before tsunami disaster in the form of casuarina and mangrove.
Determination of disaster prone areas in the coastal settlements and city generally performed as a tsunami disaster mitigation. Settlements located in tsunami-prone coastal areas that are vulnerable to sea tides, designated as a protected areas or green belts. The old settlement zone can be use in limited development by the provision of disaster mitigation. Similarly, zones of residential areas in the city center and safe zone far away from the coast can be develop as urban development, but still have to be set by regulation of development based on disaster mitigation (Figure 1).

In fact, despite being aware of the coastal region is prone to tsunami disasters, residents resettle in the previous coastal areas, especially people who work as fishermen. Wanting to go back to location near the beach is an ideal fit with the routine work for fish catching by boat. Therefore the arrangement of settlement in coastal areas must provides rescue access to safer place as presented by Samsirina (2008).

Development in the coastal zone is limited and prefer the space to support the development of zones in protected areas. If the cultivated area will be developed as the development zone it should be limited to anticipate the likely impact and the number of casualties and losses caused by the disaster. Related to disaster mitigation efforts in disaster prone areas, the development of the area should be accompanied by efforts to reduce disaster especially tidal waves and tsunami disaster with development support facilities for emergency conditions, among others:

a. Development of road networks for rescue
   The road network is useful for the rescue of runaway catastrophic events in a short time, as well as to track first aid and evacuation of casualties.

b. Development of public facilities for evacuation
This facility is needed to rescue people or to perform collection activities and aid for victims of disaster. This facility can be shaped as building for rescue (escape building), open space and others.

In line with Nasution (2005) regarding the principles in dealing with the tsunami disaster mitigation, the government has built three rescue buildings located in Desa Lambung, Alue Dayah Tengoh and Deah Geulumpang, and also two other buildings which can be used as rescue building which are the Tsunami Museum and Tsunami Research Center. Ideally this number should be increased based on total area and population served, for example in Lamdingin, Jeulingke, Tibang and Lamnyong region. While the salvage pathway which is the main road that connects the villages has been equipped with the tsunami warning signs and circulation directions to a safer place.

The Concept of Green Structure in Coastal Settlement

Green structures in coastal settlements should be arrangement based on disaster mitigation, emphasizes the importance of green spaces that is focused on: (a) the use for rescue that can be a field and hill in a safe area, (b) the use of green belt for protection can be included elements of coastal areas and it has direct visual so it help people run to the safe zone. In terms of utilization of coastal green belt as a protector, a combination of mangroves and coastal plants which is strong, such as coconut, casuarina, ketapang, hibiscus, tamarind, and cotton can be planted to reduce wave energy. Similarly, in each of the settlements should be protected by a row of trees in layers grown primarily along the waterfront, greenbelt, road corridor, escape roads and riverbanks.

There remains, however, a pressing need to better understand the roles that ecosystems can play in defending coasts. Coastal settlement and its populations are particularly vulnerable to the impacts of extreme events such as storm, hurricane, and tsunami, and these pressures may be exacerbated through the influence of climate change and sea level rise. This is in line with McIvor (2012), coastal ecosystems such as mangrove forests are increasingly being promoted and used as a tool in coastal defence strategies. While mangrove forests are usually found on shores with little incoming wave energy, they may receive larger waves during storms, hurricanes and periods of high winds. Large wind and swell waves can cause flooding and damage to coastal infrastructure. By reducing wave energy and height, mangroves can potentially reduce associated damage.

Meanwhile, in mitigation it should emphasized the circulation and the relationship between residential zone which is dangerous to other safer zone. Characteristics of the road width and escape route should be perpendicular to the beach. The road network also features a tree-lined corridor to protect people and reduce the damage by holding the objects or demolition assets as much as possible from the wave that swept away with it so it will not hit people as well as other buildings.
The strategies that can be applied in this concept are:

a. Establish a disaster-prone area delineation.
b. Conserve and protect the protected beach forest areas, urban forests and mangrove forests as protective function and defense against tsunami.
c. Adding and developing the green belt, escape and rescue hill in the green open spaces of the coast and coastal settlements.
d. Utilizing the riverside area as one of the green belt as part of urban green structures.
e. Set the density of vegetation adapted to the function of the area, the level of security against disasters and location.
f. Develop existing road and add new roads as escape route.
g. Develop settlements with disaster mitigation facilities (Figure 2).

Taking in consideration the overall implications of mitigation measures in the coastal settlement based on risk reduction such as restricting density that lead responsibility to each owner of the risk and cost they are willing to take, although in short term may be a more feasible solution, at long term may have some adverse results. The exposed population may confront greater risk, and the cost of the decreasing land value would be assumed by each owner, this would confront social and economic sustainability of development. Building codes on its side may also present some contradictions mainly regarding urban character, uses and activities that will need special considerations to provide guidelines and flexibility to adapt to local reality.

In line with Costa (2011), major measures regarding risk avoidance in hazard areas such as the designation of a greenbelt in Special Regulation, in spite of its initial high social and economic cost of enforcing the expropriation of land, at long
term may provide higher contributions to a broader community. It would also support previous community needs, would enhanced main city natural character, and most important, it would keep most exposed population out of risk, supporting issues of social, economic and environmental sustainability and contributing to further aspects of coastal settlement quality improvement.

Green open spaces as protective green structures will function effectively to mitigate tsunami wave energy if it is planned well in setting the density and type of plant, as presented by Thuy (2008). The selection of perennials such as casuarina and mangroves should be planted with appropriate density and layers, which should be placed between the coast and settlements. While in between settlements and salvage pathways toward a more secure location should not be any forest which could obstruct circulation.

CONCLUSION

In order to be sustainable, mitigation should reduce community vulnerability to tsunami risk, adopting measures that recognize ecological limits and enhance qualities of local ecosystem. Mitigation actions in coastal settlement should provide and enhance public access to the coast, promoting intensive uses in public space. Also should be concerned with improving movement and connections.

Green open space as an urban green structure in Banda Aceh play important role in tsunami disaster mitigation in coastal settlement area as protective and rescue function. Several mitigation approaches that can be used in structuring coastal settlements are as follows: (a) the areas most prone to tsunami designated as open spaces or protective green belts, (b) take over the tsunami hazard areas for open spaces functions which include buildings or hills for rescue and evacuation, (c) develop new restrictions on hazardous locations through land use regulations.

Related to disaster mitigation concept in Banda Aceh, several recommendations proposed, among others: (a) intensification of the green belts along the coast, with a layered planting along the coast to reduce the rate of wave and destruction towards settlement areas, (b) the realignment of roads and accessibility, to the area that is relatively safe, both in quality and quantity, (c) establish coastal settlements and building regulations, so that building, house and infrastructure has specific characteristics and are not vulnerable to tsunami hazard.

REFERENCES


BRR. (2005), Buku I: Rencana Bidang Tata Ruang dan Pertanahan. BRR NAD-Nias, Banda Aceh.


COMMUNITY-BASED SANITATION PROGRAM (SANIMAS) AS AN EFFORT FOR IMPROVING ENVIRONMENT QUALITY IN URBAN SLUMS SETTLEMENT

Winny Astuti, Ph.D* and Habibah**
*) Lecturer, Study Program of Urban and Regional Planning Researcher, Center for Information and Regional Development (PIPW) LPPM University of Sebelas Maret Surakarta Indonesia
**) Undergraduate Student, Study Program of Urban and Regional Planning University of Sebelas Maret Surakarta Indonesia
Email: winnyast64@gmail.com

ABSTRACT

As global warming and climate change has been proven factual, discussion on green development concept is rapidly expanding. In terms of Human Settlements, the second UN conference on Human Settlements II held in Istanbul, Turkey 1996 established two major issues. The first theme was adequate shelter for all. The purpose of this theme was to ensure adequate shelter for all and to ensure human settlements were safer, healthier, more viable, equitable, sustainable and productive. The second theme was sustainable human settlements development in an urbanizing world, which stated that waste is among ten important issues needs to be addressed.

Indonesia, a developing country where urbanization grows significantly over years, is facing the waste problem especially in urban areas. Sanimas, a program released by the central government, aimed to build sanitation infrastructure to upgrade its provision in urban settlements and further to improve settlements’ environment quality. Sanimas specifically targeted at dense and poor settlements in urban area where spaces are limited. Funded by AusAid (through Waspola project), Sanimas was coordinated nationally by Ministry of Public Works. In Surakarta, implemented in 2006, Sanimas constructed public toilets and communal wastewater treatment facility (IPAL, Instalasi Pengolahan Limbah) at Kelurahan Sangkrah, Kecamatan Pasar Kliwon. The research written in this paper purposed to identify the Sanimas’ implementation process and the networks of the institution related. This inductive research used interview as the main method in data collection, interviewing both formal and informal institutions related to program’s implementation and triangulation with secondary data.

The research found that implementation of Sanimas Program has developed a Community-based Organisation named KSM, which has roles for mediation between local government and community. Through KSM, interorganizational
networks have been developed, which indicated from expanding linkage of the community to several organizations, and to higher level government and foreign agency. In terms of relationships among institution, there were three groups of relationships: a direct and strong relationships and long lasted; a direct and strong relationship but ended, and Indirect, rather weak relationship, ended when Sanimas over Interorganizational networks sustains the implementation of Sanimas Program, improve quality of environment as well as increase community capacity and in turns escaping community from the urban poverty.

**Keywords:** community-based, sanitation, social networks, environment, Surakarta

**INTRODUCTION**

**Urban Poverty and Sanitation in Indonesia**

In many developing countries, poverty has become an immense issue particularly in urban areas. Due to its characteristics of settlements supply –lack of spaces, poor housing quality and infrastructure shortage, urban low-income community has higher risk of becoming poor than those in rural areas. Urban low-income communities have to pay for almost everything they need on a daily basis –things that rural people can get freely. Furthermore, urban low-income communities are highly vulnerable from economic shocks as well as environmental problems (The World Bank, 1990 in Moser, 1996). Their exclusion from decision-making process related to their neighborhood has ruled them out from access to government provision of urban services. Urban poor needs capacity building to participate and involve in the government program, where participation brings community members into contact with a wider network of individuals and organizations related to their cause. Turner (1987) and Silas (2005) believe that the community puts up four-fifths of the development in developing countries. Therefore, the community-based development becomes very important in creating collaborative planning in the implementation of the program.

Sanitation and water supply has become a considerable issue as in 2004, only 55 % of the global community gained proper sanitation supply and services. In Indonesia, Millennium Development Goals targeted 73 % of the population (around 25 millions of Indonesian) will gain access to sufficient and proper sanitation and water supply by 2015 (WSP, 2008). Development of sanitation infrastructure is constrained by high density population of informal settlements, where characterized by insufficient access to safe water; inadequate access to sanitation and other infrastructure; insecure residential status; poor Structural quality of housing and sufficient living area (UN Habitat 2003).

**Interorganizational Networks, Social Capital and Sustainability**

Report from Water and Sanitation Program (2011) stated that sustainable sanitation can be assessed from five indicators. The first indicator is **Health and hygiene,**
which includes the risk of exposure to pathogens and hazardous substances that affects public health at the sanitation system. Secondly, Environment and natural resources, that involves the required energy, water and other natural resources for construction, operation and maintenance of the system, as well as the potential emissions to the environment resulting from its use. The third indicator is Technology and operation, which incorporates the functionality and the ease with the entire system including the collection, transport, treatment and reuse and/or final disposal. This indicator also includes the possibility of technology being constructed, operated and monitored by the local community. The next indicator is Financial and economic issues in terms of the capacity of households and communities to pay for sanitation, including the construction, operation, maintenance and necessary reinvestments in the system. The fifth indicator is Socio-cultural and institutional aspects which refers to the socio-cultural acceptance and appropriateness of the system, convenience, system perceptions, gender issues and impacts on human dignity, efficient institutional settings.

Strong social and inter-organizational networks also enhance community capacity. In evaluating a community’s social networks, consideration can be made to three indicators. The first indicator is structural characteristics, such as size or number of linkages. The second indicator is the relationships among network members, such as the frequency and intensity of their contacts. The last indicator is the benefits that members receive from their network ties, such as emotional or tangible support and access to social contacts (Goodman et al, 1998). Study of social networks in Indonesia has examined the role of social capital in low-income people’s approaches to coping with resource shortage (Grootaert, 1999; and WorldBank, 2000 in Silvey and Elmhirst, 2003). Social hierarchies within networks lead to differentiated access to resources and differentiated work and service obligations. Social networks are by definition relational and dynamic (Silvey, R and Elmhirst, R, 2003; Degennes, A and Forse, M, 1999). Community organizations for the poor can be valuable and resourceful partners when it comes to find viable infrastructure solutions for the poor. Besides providing a means of idea sharing, asset pooling and mutual support, community organizations create channels for poor people to talk to their local and national government and to undertake collaborative development projects in housing, upgrading, land tenure, infrastructure and livelihood.

The purpose of community-based sanitation program is to established a framework for sustainable pro-poor services in Indonesia, through the development of effective and coordinated policy-making, institutional reform, strategic planning and awareness building (WSP, 2011). In operation of the program, this develops strengthened policy, institutions, strategises and action plan. Several coordination works has to be conducted by government supported by donors. Local capacity building is developed as well as behavioural change of poor settlements community toward sanitation.

In spite of reformed agenda of Government plan, increased investment in urban sanitation, indicator of success of Community-based Sanitation Program is also defined and implemented mandates and roles of stakeholders (WSP, 2011), Lesson-learned of Community-based Sanitation Program in some places shows
development of community based organisation. In Blitar, in order to sustain and strengthen work on sanitation, the municipality has facilitated the formulation of subdistrict and neighborhood sanitation POKJAs. This also prepared City sanitation Strategy as a basis proposal to the provincial government for having funding of some sanitation activities. In Jambi, the program formulated AKKOPSI (Aliansi Kabupaten/ kota Peduli Sanitasi (Alliance of District and Cities Concerned about Sanitation). In Jambi, a recently formed network of district and cities concerned about sanitation, which facilitates the sharing information and lesson learned. The role of municipal sanitation POKJA is established in the name of ‘Sanitation Coordination Team of Jambi City.

Therefore, social and interorganizational networks have been very important in implementation of Community-based Sanitation Program, where capacity of the community is increased indicated from enhanced connections to members of their neighborhood to address community wide concerned with several stakeholders involved in the program from the Government actors as well as private actors of development.

Sanimas Program

Sanimas stands for Sanitasi Berbasis Masyarakat (Community-based Sanitation), a national program in Indonesia that is developed based on the concept of community empowerment on infrastructure development. Sanimas specifically targeted urban substandard settlements and used demand-based technical solution to reduce water-pollution by small and medium enterprizes and settlements. The program was pioneered and funded by AusAID (Waspola Project) in cooperation with the World Bank in the early years. In 2004, Sanimas put into operation by Bappenas (Badan Perencanaan Pembangunan Nasional, Indonesian National Bureau of Planning and Development). Since 2006, SANIMAS has implemented nationally under coordination of Department of Public Works. DEWATS provides technical expertize to manage Community-Based Sanitation (CBS) as a viable sewerage and sanitation option in a specified areas, neither on-site systems or centralized sewerage systems, which can fulfill the demand of stakeholders for basic sanitation. Whether BORDA is a stakeholder’s partner of Community-based sanitation program, which has a role for conducting test to the quality of waste after having waste water treatment.

Indicators of success of the Community-based Sanitation Program are as follows (BORDA, 2011): firstly, increased central and local government sanitation investment, which is indicated from medium terms allocation budget up 400% for 2010-2015, national budget allocation up 200%, special budget allocation up 200% and local budget allocation up 300%. Secondly, Reform agenda features in government plans stated in the Roadmap Accelerated sanitation Development in Human Settlements adopted. Thirdly, High level policy statements and announcements by Vice President, minister of Public Works and Health and the National Development Planning Agency. Fourthly, role and mandates of stakeholders defined and implemented. Fiftly, City Sanitation Strategy formally adopted by municipalities.
SURAKARTA AS A STUDY AREA

Surakarta is a municipal city located in the core of SUBOSUKA region, Central Java, Indonesia. It is surrounded by three regencies, i.e. Boyolali, Sukoharjo and Karanganyar. With the area of 44.04 square-km, it is dominated by developed areas with the population of approximately 600,000 people. The levels of poverty were as high as 22% covering approximately 125,600 urban poor people (TKPKD, 2012). The numbers of household living in substandard houses with substandard infrastructure provision are found to be 36, 933 households distributed in the five districts of Banjarsari (12,136 hh); Laweyan (5,204 hh); Serengan (3,398 hh); Pasar Kliwon (6,202 hh) and Jebres (9,993 hh) (BPS, 2011). Of these numbers of household, 1,571 of them live in squatter settlements along the government land and illegal land such as rail land and riverbank area.

Figure 1. Maps of Surakarta, Central Java, Indonesia

Kelurahan Sangkrah, in Kecamatan Pasar Kliwon was selected as pilot project area of implementation of SANIMAS in Surakarta. The specific area consists of four RT (Rukun Tetangga, Neighborhood unit), namely RT 3 and RT 4 in RW 8, and RT 3 and RT 4 in RW 9. These areas are particularly densely populated slums having substandard sanitation facilities. Along with the construction, it was also hoped that the attitude toward public facilities would be better as the development used community-based approach. The research aimed at firstly, identify the process of implementation of Sanimas Program and secondly, identify the organizational networks developed during the implementation of the program.

RESEARCH METHODOLOGY

The research was conducted in qualitative method using inductive approach. Purpose of the study is to identify the process of Sanimas and it's institutional networks of the Program. Aiming to identify the process of Sanimas, in-depth interviews were used as the main method of data collection. Interviews were
addressed to several government institutions whose involved in Sanimas in Surakarta as follows: Planning and Development Board (Badan Perencanaan Pembangunan Daerah, Bappeda) of Surakarta, Board of Community Empowerment (Badan Pemberdayaan Masyarakat, Bapermas), Consortium of NGOs; and Department of Public Works. In-depth interview on the implementation of Sanimas was addressed to the head of KSM (in Kelurahan Sangkrah. Documents on Sanimas’ implementation records were also collected to examine Sanimas’ implementation thoroughly. Data then analyzed in two steps using content analysis from the document and the interview transcript to identify the process. Another step of analysis then was added to identify the networks of the institution. Networks were examined by using Goodman’s indicators, i.e (1) the role of KSM, (2) size or number of linkage, and (3) relationship among institutions, and (4) Social hierarchies among institutions

RESULTS AND DISCUSSION

Process and Mechanism of Sanimas Implementation

The process of Sanimas program can be classified in two stages, preparation stage and implementation stage.

A. Preparation Stage
   1. Socialization of Sanimas Program by LPTP DEWATS and BORDA as the Non-government Organization in charge in the Sanimas to the Local Government of Surakarta City in 2005, through Department of Public Works. This is followed by feasibility survey of the location according to the criterias, which was conducted by LPTP DEWATS.
   2. Location selection resulted in Sanimas implementation in two locations in Surakarta, one of the location is Kelurahan Sangkrah. There were six alternative locations in Kelurahan Sangkrah short-listed and examined.
   3. Verification survey by DPU (Public Works Local Institution) to six alternatives, resulted in selection of RW 8 as the target area of Sanimas implementation. LPTP DEWAT would facilitate and empowered the community through the whole process.

B. Implementation Stage
   1. A community forum was held to formulate KSM, named Insan Harapan. The forum consisted of beneficiaries and LPTP DEWATS. The KSM was developed representative of the community who communicates with the local government and other parties. Members and committee of KSM was led by Lurah (the chief of Kelurahan) and formalized with a Decision Letter.
   2. LPTP DEWATS, the local government of Surakarta and KSM Insan Harapan Sangkrah signed a Memorandum of Understanding (MoU). The MoU held the detail of Sanimas including detailed construction budget and
community contract. Total budget received from National Public Budget (APBN) was Rp 100 million in the form of building material, BORDA granted Rp 24 million, and a little number of budgets is allocated from the Municipality annual budget. This program also generated self-help activities in the form of fund and non-fund of total Rp 9 million. The MoU was followed community-based planning and self-helped construction of public toilet. LPTP DEWATS assisted and facilitated knowledge exchange and constuction design, whereas the SKPD Public Works took the monitoring role of the program. As a consequence to MoU signed between the Municipal Government and NGOs Rotary Club. This implies on provision of Public Toilet and by cooperation with AusAid funding, they provide extention of waste water connection to poor households.

4. KSM prepared the community action plan. Eventhough the technical construction and budget allocation plan of public toilet and communal IPAL have been design by LPTP DEWATS, the community has been asked for some ideas related to design. Basically, the community does not have capacity for technical construction design. Community has only involved for giving legitimation of the design before applicated to the area. The process was therefore followed by preparation of implementnation of proposal to the Department of Public Works. After having approvals from the Department of Public Works, the budget allocation can be distributed.

5. Public toilet and communal IPAL were being constructed by technical expertize from LPTP DEWATS. The community was basically do not technically involved in the construction stage, because of all the technical experts have been provided by the program. The community through the KSM has only involved as program monitoring. Construction of Public toilet and communal IPAL has been fit to the Detailed Engineering Design.

---

**Figure 2.** Construction of Public toilet and communal IPAL. Results of the Construction of Public toilet.

Sources: Astuti, 2012 and KSM Kelurahan Sangkrah, 2012

6. Accountability report was reported by LPTP DEWATS and KSM to the Government of Surakarta related to utilization of funding. LPTP DEWATS was facilitated a technical assistance during one year implementation of the Program in order to maintain the function of public toilet and communal IPAL in case of any damage or unfuction of the public toilet and communal IPAL. After one year implementation, the maintenance were therefore
transferred to the community. Therefore, even though the approach of the program is community-based program, in implementation the community does not fully participated in preparation of the proposal as well as in technical construction activities. Most implementation of program was dominated by the LPTP DEWATS. The BORDA has a role in conducting chemical quality test of the waste after process of communal waste water treatment.

7. After completing the program, the sustainability was indicated from the institutional networks developed during the implementation of the program. The Memorandum of Understanding (MoU) between KSM Insan Harapan and PDAM (Local Corporate of Water Supply) for waste water pump. Several training and community capacity building have been done such as socialisation of healthylife to the community. Department of Public Works was conducting test of sedimentation indicators. The community through sub KSM division of operation has responsibility for maintenance of the program results.

8. Several visiting guests from other parties to the Area have been proved that the implementation of Sanimas in Kelurahan Sangkrah has been success. The KSM Insan Harapan has been appointed as the best KSM in Surakarta.

9. Sustainability of the program shows from the neighborhood planning called Musrenbangkel, which is allocating some budget for maintenance. Some programs such as National Program of Community Empowerment (PNPM) has directed the program to kelurahan Sangkrah for the construction of new public toilet in 2013. The KSM has also preparing proposal to the Department of Public Works for Urban Sanitation Program called USRI.

**Figure 3.** Visitation of BORDA, the Major of Surakarta and ISSDP to Sangkrah

Sources: KSM Kelurahan Sangkrah, 2012

The Features of Interorganizational Networks in Sanimas

As one of the important aspects in community-based approach program, institutional aspect affects the chance of sustainability of Sanimas’ output. Sustainability promised to be high when there is better institutional capacity to manage the output of Sanimas. In this research, institutional aspect was assessed based on four indicators, namely the role of KSM, the size or number of the linkage related to the community after Sanimas implemented, the relationship among institution related to Sanimas, and the social hierarchies among institutions. These three aspects were

**Figure 3.** Visitation of BORDA, the Major of Surakarta and ISSDP to Sangkrah

Sources: KSM Kelurahan Sangkrah, 2012

The Features of Interorganizational Networks in Sanimas

As one of the important aspects in community-based approach program, institutional aspect affects the chance of sustainability of Sanimas’ output. Sustainability promised to be high when there is better institutional capacity to manage the output of Sanimas. In this research, institutional aspect was assessed based on four indicators, namely the role of KSM, the size or number of the linkage related to the community after Sanimas implemented, the relationship among institution related to Sanimas, and the social hierarchies among institutions. These three aspects were
derived from community capacity measurement tool (Goodman et al, 1998). Table 1 below shows the summary of findings in this study on institutional aspect.

Table 1. Interorganizational Networks and Institutional Aspects of Sanimas

| The role of KSM | Mediating local government and community  
Facilitating community to express their ideas on the program  
Monitoring the implementation of the program through the division of operation |
| --- | --- |
| The linkage of the community | Three linkages to non-governmental institution has been developed during implementation of Sanimas Program with LPTP DEWATs, BORDA and Rotary Club. LPTP DEWATs has linkage to the community during implementation of program as technical expert until after one year implementation. This has a role for capacity building to the community in construction stage. Rotary Club has only involved as sources of grants for construction of Public Toilet  
Two linkages to local government bodies were indicated, firstly the Department of Public Works as an owner of Sanimas Program and secondly with Bureau of Planning and Development as coordinative body  
Three indirect linkages to higher level government and foreign agency were identified, firstly with DEWATS as technical expert of the concept of Community Based Sanitation, who in charge in design and construction of Communal Waste Water Treatment (IPAL), secondly with Rotary Club, who distributed donation and grant for construction of public toilet, and thirdly UsAid as the owner of the Program |
| Relationship among institutions | Group 1. Direct, strong relationship, lasted until now  
It was found that at least two institutions have strong relationship with the community. There were Department of Public Works and the Bureau of Planning and Development. Relationship has been continued until recently. The KSM has proposed the continued sanitation program called USRI (Urban Sanitation and Rural Infrastructure) to the Department of Public Works for the year of 2013.  
Groups 2. Direct, strong relationship, ended when Sanimas over  
Some institutions such as LPTP DEWATS and BORDA have strong relationship during implementation of Sanimas. LPTP DEWATs and Department of Public Work signed MoU for implementation of Saniam in Kelurahan Sangkrah. After one year implementation of the program their relationships are over  
Group 3. Indirect, rather weak relationship, ended when Sanimas over.  
Rotary club has weak relationship and ended when Sanimas Program is over |
| Social hierarchies among institution | - In the Municipal levels,  
- National Level (policy level) : |
1. The role of KSM
On the first indicator, it was showed that the community itself had already learned to organize and identify their potential. KSM as the community-based organization were succeeding to encourage and facilitate community members to participate in the Sanimas process. Even though the preparation of proposal for budget allocation and technical experts have been provided by LPTP DEWATS, the community has been involved in community forum to give aspiration related to direction orientation and numbers of the public toilet. Some committee of KSM in division of operation has also involved in maintenance of the program. The model of Sanimas Program has been replicated to other areas in Surakarta.

2. The linkage of the community
Based on the number of the linkage, during the stages of Sanimas, the community had started their way to access the decision-making in higher level. Sanimas created links from local level to global agency. These links then bring to opportunities to keep contact until recently. Three linkages to non-government institution were LPTD DEWATS which has a role for technical expertize of the construction of Public toilet and communal IPAL, AusAid (waspola) as the funding agency cooperation with the World Bank and BORDA. Some linkage has been strong relationships until recently, such as linkage with BAPPEDA and DPU. Another linkage has been ended when Sanimas is over.

3. Relationship among networks member

Relationship among networks member shows 3 groups of relationship: **Group 1. Direct, strong relationship, lasted until now**, which relates to the government institution; **Groups 2. Direct , strong relationship, ended when Sanimas over**, which is done by the NGOs in implementation of the Program and **Group 2. Indirect, rather weak relationship, ended when Sanimas over**, which relates to the NGO as sources of fund for the program.
4. Social hierarchical among networks
Social hierarchical within networks is indicated in the National levels, Provincial levels, municipal levels and community levels. In the Municipal levels, the has succeeded in adopted the Sanimas based on the concept of Community-based Sanitation (Sanimas) and incorporated community action plan into the annual municipal budget plan. Some MoU with external institution such as Rorary Club for provision of public toilet. Community has to maintaine sustainability of the public toilet and wastafel. Municipal government has also signed MoU with LPTP DEWATS through Department of Public Works for technical expertise and assistance and BORDA for testing the quality of waste. Community as beneficieries has only involved in giving legitimation to the construction design of Communal IPAL and maintenance. In the National Level (policy level), Conducted by the Department of Public works by cooperation with BORDA as the NGOs in the National level. Whereas in provincial level, Conducted by Department of Cipta Karya Provincial level, who invites all the local government for socialization of the program. In the community levels, the LPTD DEWATS has highly connectivity with the community and the KSM

CONCLUSION

Community-based Sanitation Program (SANIMAS) is formulated not only for the purpose of increasing quality of environment in the densely poor populated slums area, but also empowering community in conducting the program through development of KSM. The role of KSM as mediating between community and the government and other parties has created interorganizational networks. In terms of the linkage of the community through KSM has started to access the decision making in the levels of local, national to foreign agency. Relationships among institutions have developed during the process of implementation, where some institutions maintaining relationships until recently. The relationships continue to other areas for replication of the Sanimas Program. Social hierarchies among institutions have been developed in the National level, Provincial level as well as local level. Interorganizational networks develop during implementation the program has increased community capacity, widening the networks society, empowering people, which increase the access of community to the sanitation and clean water resources. In turns will increase Water Poverty indeis and escaping the community from the poverty.

ACKNOWLEDGMENT

Directorate General of Higher Education (DIKTI) Indonesia for fully financial support to this research; Rector; and Head of LPPM Sebelas Maret University; Head of BAPPEDA; Head of SKPD Public Works.;Head of Kelurahan Sangkrak; Head of KSM Insan Harapan Kelurahan Sangkrak. And Reseach team and all parties, which cannot be mentioned one by one.
REFERENCES

TKPKD (2012) . Tugas Besar TKPKD. Article in Solopos 19 December 2011
ECO-HOUSING CONCEPT IN COASTAL SETTLEMENT
JATIREJO VILLAGE, PASURUAN REGENCY, EAST JAVA

Amalia Nur Indah Sari*, Maulana Sakti*, Happy Ratna Santosa**
*) Graduated Student, Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
**) Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
e-mail: maulanasakti20@gmail.com

ABSTRACT

Adequate housing is a basic needs and basic right for peoples. In the international scope, this is stated in the Universal Declaration of Human Rights (article 25) 1948 and on a national scale, in the Amendment of Constitutional (UUD 1945) article 28H(1). Many aspects related to define an adequate housing. One of the important aspects is about the housing condition that should be able to provide sufficient space and protecting against the weather or other threat that can harm the human health. An adequate housing can be achieved through the application of the eco-housing concept. This concept has a good interaction with the environment and avoids bad impacts to the environment as well as providing a good quality of life for the residents. For the government, the coastal area is one of the development priorities, primarily to improve the conditions of the fishermen settlement. This research took place in Jatirejo Village, Lekok, Pasuruan. Problems in this village such as the density issues, unhealthy environmental conditions, lack of facilities and infrastructure and poverty. This study used qualitative methods and case study research. Collecting data through interviews, observations, photography and literature review. The result of this study is expected to improve the quality of settlements and coastal environment in this region by applying the eco-housing concepts, especially using sustainable site planning to re-arrange the coastal settlement in the Jatirejo village.

Keywords: eco-housing, coastal settlement, sustainable site planning

INTRODUCTION

Housing and settlement are two things that cannot be separated and closely related to economic activity, industrialization and development. Settlement can be interpreted as a home or housing with all the elements and related activities. Settlement can avoid rundown condition and unfit for human habitation if residential
development in accordance with the applicable standards, one of them by applying the requirements of healthy home (Akil, 2003).

One of areas that need government’s attention is coastal areas. One of the priorities in the development of coastal areas in the field of settlement is increasing coastal settlement/fisherman settlement. Improvements to the coastal settlements are necessary in an effort to maintain quality of the coastal environment and improve the environmental quality of coastal settlements. Jatirejo village is one of the seaside village located in the Lekok Distric, Pasuruan, East Java Province. In the direction of Pasuruan district, District Lekok directed its development as part of the development of coastal areas and beaches. Given the proximity to the fishing activity, it is necessary to the provision of shelter for the fishermen close to where they perform activities. Ironically, until today there are still many problems in this village, such as high number of building density and the availability of infrastructure inadequate in terms of both quality and quantity.

Meanwhile, coastal settlement will naturally continue to grow over time. This needs a concept of integrated and sustainable coastal settlement planning. Therefore, this concept was about appointing discourse concerning the application of the concept of eco-housing, especially for the sustainable site planning on the coastal settlements in the Jatirejo village.

THEORY

Building Integration in Ecological Design

The term of ”ecology“ was first introduced by Ernst Haeckel on 1869 as a science of interactions between all kind of living things and their environment. The term derived from the Greek, oikos means household or residence and logos means science. Ecology is define as the study of the interrelationships between living things and their environment (Frick, 1998). According to this knowledge, architecture developed in order to create ecological harmony with nature and human.

According to Ryn (1998), there are five key principles in ecological design, are as follow:
1. The design should be appropriate for the detail of its placed. Should always be questioned about, how the condition of the place, activity which not harm the nature and activity that supported by nature on that place.
2. Present the criteria to evaluate ecological impact of the design that have created.
3. The third principle suggests to minimize the impact, we should work in harmony with nature.
4. The implications of the ecological design not only can be done by the expert only, but whole community should be participated.
5. Apply an effective transformation and concern for the sustainability design which created to provide the possibility for the community to learn and participate.
According to Widigdo (2010), on ecological approach, there are variety of viewpoints and emphasis, but all have the same direction and purpose, there are concepts of design by:
1. Promote the preservation of natural resources, help to reduce the impact of global warming through the understanding of the behavior of nature.
2. Manage soil, water and air to ensure the sustainability of the ecosystem cycles inside through the transcendent attitude toward human nature without forgetting that is immanent with nature.
3. Think and decision done holistically and contextually.
4. Design done technically and scientifically.
5. Create comfort area for the the physical, social and economic through build a harmony systems with nature and the surrounding environment.
6. Use the energy-efficient buildings system, preferably use passive systems (natural), in line with the local climate, recycling and use of local potential.
7. Use the ecological materials, suits with the local climate, use energy-saving start through taking from the local nature until it use for the building and the possibility of recycling.
8. Minimize negative impacts on nature, both waste and the impact of the activities.
9. Increase the absorption of flue gas by expanding and preserving vegetation and habitat for living things.
10. Using technology that considers the ecological values.
11. Led to the sustainable buildings design.

The Eco-Housing Concept

Eco-housing concept is a building system that is environmentally friendly and efficient in resource use. This can be achieved through an integrated approach in the design. Eco house also known as sustainable building. Practice this lead to an advantage in reducing the operating cost (with the use of minimal energy and water), improve occupant health, improving air quality inside the building and reduce environmental impact (by reducing waste water discharge and the effects of warming in the building) so the humans and other creatures on earth can live sustainably (Widyarti, 2010).

The eco housing concept was applied to a broad level and already penetrated to the political leadership in the Asia-Pacific region. The next Asia-Pacific leaders consider creating a working model of policy-making related to the implementation of eco-housing in regional governmental. To realize it, in 2006, UNEP (United Nations Environment Programme) and UN-HABITAT work together to promote and demonstrate eco-housing as a movement in the Asia-Pacific region. Some guidelines are encapsulated in the concept of eco-housing include:
1. Pre-design guidelines
2. Site planning
3. Material and product selection
4. Energy performance
5. Water management
6. Waste management
In this research, the discussion will be focused on the re-arrange the site of the Jatirejo village based on the sustainable site planning guidelines that contained in the principles of eco-housing.

Sustainable Site Planning According to Eco-Housing Concept

The purpose of sustainable site planning is to integrate design and construction strategies by modifying both, the site and building to achieve greater human comfort and operational efficiency. It minimizes site disturbance, climatic conditions and other utilization. The guidelines for achieving this are as follows:

1. Site infrastructure
   a. Confirm that the selected site does not fall within the disaster-control zone as specified by the local authority.
   b. Ensure that basic amenities such as bank, child care, post office, park, library, convenience grocery, primary school, clinic and community hall are near to or within the site premises.

2. Pollution considerations in site planning
   a. Reduce light pollution, all exterior lighting design should be shielded (not radiating upwards). Placement of lighting set a distance of 2.5 times the mounting height.
   b. Plan pedestrian access ways and bicycle tracks within site premises. Discourage use of fossil fuel-based vehicles on site.

3. Site layout
   a. The site layout should adequate sun protection and ventilation. Row buildings can be used as wind breakers.
   b. High-rise can increase ventilation in a dense development. Low-rise buildings should be sited so that they avoid excessive heat exchange with the environment and utilize their link with open spaces.
   c. The ratio of street width to building height determines the altitude up to which solar radiation can be cut off. In particular, for the streets running north–south, the street width to building height ratios should be kept as low as possible. This would provide mutual shading from the horizontal morning and evening sun. East–west streets should be avoided on account of the low sun in the mornings and evenings. However, if unavoidable, they should be kept narrow.
   d. Layout development for streets should be within 25 degrees of east–west.

4. Landscaping
   An appropriate landscape design is very effective to modifying the microclimate. It has a very important role to modulating the flow of air inside the building. In addition, landscaping provide shading to protecting the outside area. The maintenance must be taken to avoid excessive moisture. Vegetation selection
should be based on water needs and benefits for the micro-climate. The points that should be noted are as follows:

a. Before planting, the topsoil should be separated from others because the topsoil considered as less fertile. Topsoil which had been separated can be used as a material for building.

b. Maintain the existing vegetation on the site.

c. Do not changing the existing drainage pattern on the site.

Some methods of altering the air flow patterns by landscaping are shown in Figure 1 and Figure 2.

5. Land stabilization

The most effective way to prevent soil erosion and to stabilize soil is through the provision of vegetative cover by effective planting practices. The foliage and roots of plants provide dust control and a reduction in erosion potential by increasing infiltration and stabilizing soil. Temporary seeding can be used in areas disturbed after rough grading to provide soil protection until the final cover is established.
The vegetative cover also increases the percolation of rainwater thereby increasing the groundwater recharge.

a. Use of organic mulches has to be done to enhance soil stabilization. Organic mulches include shredded bark, wood chips, straw, composted leaves, etc. Inorganic mulches such as pea gravel, crushed granite, or pebbles can be used in unplanted areas. Mulching is good for stabilizing soil temperature also.

b. Use organic compost and mycorrhizal biofertilizer for remediation of alkaline soil, as is the case with soil affected by sea water intrusion.

6. Restrict run-off on site
   a. Minimize artificial hardscape to let the rainwater maximally seeping up to the soil.
   b. Pavement such as sidewalks and parking lot also needs to be designed to allow rainwater to seep well. For example, by conblock that has a big hole filled with soil, and allows the grass to grow on it. Pathway only purpose for walkers or cars with very small intensity. It has aesthetic benefits because some surfaces can be covered by the grass.

METHODS

To get a frame for the concept of eco-housing that appropriate with the conditions of Jatirejo coastal village, Pasuruan, this study use a qualitative approach. Several methods used to collect data in this study are as follows:

1. Observation (do directly by researcher), about the condition settlement and community in the research location.
2. Interview, interviewing the neighbourhood leader on the location research. It is based on who are considered know most about the information that the researchers needed.
3. Documentation, data collection through photography by documenting the real condition in the location as support for illustration observation data.
4. Literature review, to learn eco-housing guidelines which is use as determinant factor about the settlement concepts that can applied on the research location.

After the data from observations and interviews were collected, the data processed, identified and described using the analytical techniques that have been set. There are three kinds of activities in qualitative data analysis, there are reduction, data display and conclusion drawing/ verification.

There are several obstacles faced when conducting this research, include limited research time and the location research that too wide. It cause the researcher took a limited area to observe in only one neighbourhood groups (RT) that may represent whole of the study location in terms of the characteristics of neighbourhoods and communities.

RESULTS

Overview

The study area is located in Jatirejo village, Lekok, Pasuruan, East Java. Jatirejo village located in the northern coastal of Pasuruan and directly adjacent to the Madura Strait. Jatirejo village is one of the largest coastal fishing settlements in
Lekok district, in addition to Tambak Lekok, Wates and Semedusari. The total area is 2.24 Km\(^2\) and divided into 72 neighbourhood groups (Rukun Tetangga/RT).

Most of the residents work as sea fishermen who went to sea at dawn and return in the middle of the day. The yields are mostly deposited in the local fish processing. Most of the villagers Jatirejo are a Muslim and Maduranean.

Like the coastal communities in general, Jatirejo villagers is a traditional society with low social and economic conditions. Formal education that received by coastal communities in general much lower than urban communities. Facilities that available such as education, health, transportation and communication are not enough, while the population is not evenly spread and mostly concentrated in the coastal areas. Lack of public access to infrastructure and low levels of education and income of the people is what makes the slum settlements area.

**Physical Problems in Jatirejo Village**

1. **Building condition**
   The building conditions especially houses of Jatirejo Village residents are mostly made of permanent materials such as brick walls, it almost 60%. The others are houses made of wood and bamboo boards (shown in Figure 3).

   ![Figure 3. Physical Condition at Jatirejo Village](source: field survey, 2013)

2. **Village’s layout**
   The layout houses in the Jatirejo Village generally clustered. The houses generally facing the street or alley. The arrangement were unorganized so it is causing a lot small street that too narrow each other (shown in Figure 4).

   ![Figure 4. Site Condition at Jatirejo Village](source: field survey, 2013)
3. Road and pathway
The main road in each cluster in the village where made from paving but with very poor condition. There are many puddles especially near the fish market (shown in Figure 5).

![Figure 5. Road condition at Jatirejo Village](image)

**Figure 5. Road condition at Jatirejo Village**
Source: field survey, 2013

4. Green space
This village almost have no a green open space, so there are pretty barren and the heat is quite hot.

5. Communal Space
This village have no community center. The communal buildings were built by the government merely only for gathering while the fishermen gathering.

From the description above, can be concluded that the physical problem Jatirejo Village neighbourhood are as follows:

**Table 1. The Physical Problem in Jatirejo Village**

<table>
<thead>
<tr>
<th>No</th>
<th>Variables</th>
<th>Condition</th>
<th>Analysis and Propose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Building condition</td>
<td>People's houses looks dirty, some still made of non-permanent materials</td>
<td>Renovating the houses, gives counseling related to alternative construction materials as well to the residents for nursing their houses.</td>
</tr>
<tr>
<td>2</td>
<td>Building density</td>
<td>High density building and unorganized layout</td>
<td>Making the site planning proposal that integrated with the social, economic condition also the culture of the local residents.</td>
</tr>
<tr>
<td>3</td>
<td>Environment condition</td>
<td>No green space and have no communal space</td>
<td>Propose an arrangement including an attempt to get a green open space that suits with the needs of the community so as to update the environment quality.</td>
</tr>
</tbody>
</table>

Source: analysis, 2013
DISCUSSION

The village already have circulation patterns, it is implement the grid system where each cluster separated by a connecting road. But the irregularity actually occurred in these clusters. Building conditions and irregular housing located at the cluster makes the poor quality of lighting and ventilation as well as land use becomes ineffective. It required a restructuring proposal so that the space can be more effective especially also can provide a communal space for the residents in the Jatirejo village.

The first step of this process by selecting a cluster for an example (shown in Figure 6). Then doing some analysis about the number and the layout of the existing building mass (shown in Figure 7).

![Satellite photo of Jatirejo Village](source: Google earth, 2013)

**Figure 6.** Satellite photo of Jatirejo Village

![Illustration of the arrangement form of the existing cluster](source: analysis, 2013)

**Figure 7.** Illustration of the arrangement form of the existing cluster

There are several steps that can be applied to the arrangement of this site such as the following:
1. Creating a cluster boundary more clearly, it helps to determine the site and reinforce the patterns wide road network around the site (shown in Figure 8).
2. Rearrange the site, related to provide the green open space and communal space that needed by the community (shown in Figure 9).

3. The other way that possible is on site upgrading without changing too much the pattern that already exists (shown in Figure 10).
Some illustration of the re-arrangement better chosen by the consideration of the needs and readiness of the local residents to do the environment development. This is related to the physical assets that owned by residents such as land and buildings that may be cut or reduced because of the re-arrangement needs. So that the accurate calculations and carefully consideration to determine the most efficient arrangement are highly needed. The readiness of residents may include awareness of the importance to keep the environment as well for the environment to always stay organized and to obtain a healthy and comfortable environment to live.

The other thing that need to concern is about the participatory of the local residents itself. The residents should be involved in the whole process from planning, construction and post-construction. At the planning step the best thing that could possibly be pursued is the people that become a reference to determine the structuring concepts. The decisions were made in the design concepts took from the references of the needs and activities of the local residents. In the construction phase the local people are expected to play a role as power of the development, using alternative materials that can be done independently by the citizens, residents can also donate materials that already owned and to can become a construction supervisor. It is important to increase the possibility to save the construction costs that required for the re-arrangement.

CONCLUSIONS

To apply the eco-housing concepts, especially using sustainable site planning to re-arrange the coastal settlement in the Jatirejo village required a restructuring settlement's open space, so that the space can provide a communal space for the residents in the Jatirejo village. This concept should create a good interaction between natural environment and built environment (village settlement). There are three steps that can be applied to the arrangement of this site: (1) creating a cluster boundary more clearly to determine site and reinforce the patterns wide road network around the site, (2) rearrange the site to provide green open space and communal space that needed by the community, or (3) upgrading without changing too much the pattern that already exists. The purpose of this concept is to integrate the site and building to provide a good quality of life of the residents in the Jatirejo village.

REFERENCES


THE POSSIBILITY FOR PUBLIC GREEN OPEN SPACE PROVISION IN INFORMAL SETTLEMENT. CASE STUDY OF KAMPUNG KEJAWAN LOR, SURABAYA

Shirleyana*, Astri Anindya Sari**
*) Lecturer, Department of Architecture, Widya Kartika University, Surabaya, Indonesia
**) Lecturer, Department of Architecture, Widya Kartika University, Surabaya, Indonesia
e-mail: shirleyana@widyakartika.ac.id

ABSTRACT

Green open space has been a worldwide issue. Big cities in the world have a higher concerns regarding open space provision. Researchers have proven that open space will improve the quality of life of people. However, problems of green space provision are also arising related to scarcity of land which is a common problem to cities with high density of population. One solution offered in big cities is converting vacant lot into pocket park. However, this solution could be different for informal settlement. The problems are worsened in this higher density area. The limited space and no proper infrastructure induce big problems such as health and social problems. This paper would like to find out the possibility to create such pocket park in the very limited space of informal settlement. The case study area looked at the informal settlements in coastal area in Surabaya, which is supposed to build the city image as waterfront city. The situation in the settlement has decreased over years and need a revitalization effort. This study used literature review to find solution of problems derived from the field observation. Pocket park could be an alternative solution which includes three successful factors: community participation, local identity, and support from community organization and government.

Keywords: green space, informal settlement, pocket park, quality of life

INTRODUCTION

The need for green public open space has been a major issue in the world. Lerner (2003) mentioned that the existence of public open space as a means of community activities can bring the city to life which ultimately will improve the quality of the urban environment and life in society.

Recognizing its importance, the Government of Surabaya city has started to promote the program of green open space expansion in the recent years. Provision of good quality of green open spaces was performed by improving public space...
management, planning for new urban park, as well as enforcing temporary public open space through car free day program every week. These efforts have contributed to the increasing amount of green open spaces in Surabaya. However, the provision of green open spaces in highly dense settlements is still the biggest challenge for the municipality to improve the quality of life of the citizens.

Availability of public open space in residential areas is an absolute necessity to leave space for the community activity. Nevertheless, in highly dense settlement, the availability of vacant land to be used as a common space has often become the problem to provide appropriate public space for the community.

This study aims to explore the possibilities for the provision of qualified public open space in highly dense residential area in the city. The study selects Kampung Kejawan Lor in Kenjeran district, as the study area. Kampung Kejawan Lor is one of the coastal settlements in the eastern part of Surabaya which is densely populated and considered as an informal fishing settlement. The results of this research are expected to be a practical solution for the provision of public green open space which can improve the quality of the built environment and the quality of life of the community. It is considered very important because the presence of a fishing village with good environmental quality and distinctive community activities will strengthen the image of Surabaya as waterfront and coastal city.

The research method used in this study is field observations and spatial analysis to map the physical, social, and environmental problems that exist in the study area. Literature review eventually facilitates in seeking proposed solution from the issues raised in the case study area.

RESEARCH METHODS

This study undertook mainly in qualitative research. The study used literature review, direct observations and a range of interviews. Literature study is needed to give background and necessity of public green open space and to study the ways community develop green open space within their neighborhood. The case study is selected as one example of problems, to search for the possibilities for public green open space provision. Direct observations were conducted to evaluate green open space provision and the physical, social, and environmental problems that exist in the study area. Interviews with local residents were done to fill the information gap. The spatial observations were processed using descriptive analysis. Some successful case studies are reviewed in seeking proposed solution from the issues raised in the case study area.

LITERATURE REVIEW

The Need for Green Space

Urbanization is present in the worldwide, and it is considered as continuous process. It is a logical result when people move towards a better life and society (Kirmanto et
In the developing countries, UN has expected that 80 per cent of the world demography reside in urban areas in 2030 (Beardsley et al, 2009 in S. Gairola and Noresah, 2010). Thus, the world needs to maintain equilibrium balance between socioeconomic and environmental conditions, to minimize the urban development impact on the natural environment (Barredo and Demicheli, 2003 in S. Gairola and Noresah, 2010).

In Indonesia case, there were more than 112 million people living in the urban areas, reaching 52.03 per cent of total Indonesian population (Kirmanto, et al, 2012). The capital city, Jakarta, is ranked as 24th place for world’s biggest metropolitan. The urbanization has resulted in multiplication of urban issues, congestion, and green space elimination. The phenomenon of urban sprawling is not only happened in Jakarta and its periphery, but also in other Indonesian big cities such as Surabaya, Bandung, and Medan. The Indonesian big cities are now suffering the loss of green spaces. In these big cities, green open space has decreased from 35 percent into less than 10 percent. The green open space area is only around 7.08 m2 per capita in Jakarta. This is very low compared to other big cities in developed countries suchlike Stockholm with 80 m2, Berlin with about 30m2, and Paris about 15 m2.

Gill et al (2007) in S. Gairola and Noresah, 2010, has emphasized the importance of green space for cities on climate. Urban green spaces play significance role for future generation, since they provide ecological services, protecting cities from climate change effects. Kuo, F.E. (2010) has done research in benefits of nature to human physical and mental health. The studies found that greater access to nature, green views and environments brings healthier physical life, mental life, as well as social function. This means the green environments are not only benefiting individual life, but also building stronger social ties within neighborhood, more social interaction, hence less violence and crime.

Considering the need for green space, Indonesia has taken into consideration concept of green city to cope with the problems of urban sprawl (Kirmanto, et al, 2012). The Ministry of Public Work launched a program called Green City Development Program (GCDP) in 2011. They formulated Green City attributes as: green planning and design, green community, green open space, green water, green waste, green energy, green transportation, and green building. One of the attributes is green open space, which has been campaigned and transformed into various community activities such as Indonesia Berkebun. However, Indonesian citizens cannot rely on instant efforts, but need a continuous learning power to empower the community to realize the importance of green space.

Community Stories of Developing Green and Public Spaces

1. Kampung Kali Code Yogyakarta

Kampung Kali Code, located on the riverbank of Yogyakarta, is one of the informal settlements which eventually succeeded in increasing amount of greenery for its settlement. As well as other informal settlements problems, Kampung Kali Code also had similar issues of availability of land and poor economic conditions. The
kampung dwellers tried to overcome the poor conditions using the strategy for planting system, in accordance with the existing conditions (Felasari, 2005).

To overcome the scarcity of land problem, the community used pots and hanging pots as a medium for plantation. Plantation is placed in front of the individual houses as well as in common spaces such as the riverbank retaining wall. The existence of these plants creates a fresh and green ambience within the neighborhood.

Figure 1. Pots Are Used as a Plantation Media
Source: Felasari, 2005

Lack of financial capability is anticipated by selecting types of plants that not only green but also add an economic value that can be utilized by the community. This method is known as an urban farming. The plants categories for this farming method are: medicinal plants like ginger, fruits and vegetables (Felasari, 2005).

Urban farming method has been implemented in big cities in Indonesia, suchlike Jakarta and Bandung. These activities are considered to bring many benefits in terms of economic factor and social factor. The community can also learn how to manage the local farming within their neighborhoods (Santoso, 2012). Social cohesion will also turn out as a result of common activities. The perceived benefits are expected as a motivating factor. Hence the urban farming activities could take place on an ongoing basis.
2. Estonoesunsolar-Zaragosa, Spain

'Estonoesunsolar' literally means this is not a vacant lot, is the provision of public open space strategy in Zaragosa. The public open space provision is done by converting existing vacant lot into a temporary living public space (Di Monte & Gravalos, 2011).

The implementation of the program involved the Zaragosa Government as the initiator, the planning team, and the local community. In practice, the local people participated both in idea contribution and implementation of public space that suit their needs. The success of this project ultimately spread out throughout the city. There were some number of vacant lots that have been successfully converted into a children's playgrounds, basketball courts, urban gardens and squares, and they became a lively place and are well utilized by the community. The successful factor of this project is mainly due to good communication and cooperation between the government and the community. Direct community involvement from the beginning of the project, implementation and utilization foster a sense of ownership for the temporary created public open space. Sense of ownership and community participation are essential elements to achieve sustainable development.
Getting Innovative with Pocket Park

One way to increase green space area in available environment is to convert leftover spaces and other urban eyesore into pocket park. Many community groups created pocket parks to demonstrate their efforts in organizing more open space within their neighborhood (National Recreation and Park Association, 2013).

*The new landscapes that began to spring up in their hundreds throughout the cities towards the end of the decade were small-scale, made by volunteers or 'amateurs’, often expressing some highly idiosyncratic genius loci. They were called by different names: pocket parks, nature parks, community or neighbourhood gardens (Nicholson-Lord, 1987).*

This unique urban space is often created on vacant lots, rooftop and other forgotten spaces. Pocket park can be place to facilitate recreation, play areas for children, spaces for social interaction, thus it tend to act as a small scale neighborhood park (Blake, 2013). Some examples of pocket parks are even accessible to public, not only for the neighborhood. The initiative of the parks can come out from the community with the support from local community organization and local government. However, the place should have local identity, uniqueness and provoke positive social function. Otherwise, the place will return to former situation, a forgotten space (Shirleyana, 2013).

Pocket park does not only treat the abandoned space, but it also empowers the community to maintain their neighborhood. They can use recycled things from the streets or within the neighborhood and change what supposed to be garbage into useful and valuable thing (Atenistas, 2013).

Taking into account the way pocket park could be delivered and the positive impacts for the community, it is the time to seek ways of how the pocket park could be implemented in the blighted area of urban informal settlements.

**CASE STUDY AREA: KAMPUNG KEJAWAN LOR**

**Location and Characteristics**

Kampung Kejawan Lor, the study area, is a densely populated settlements located on the eastern coastline of Surabaya. Its location is directly adjacent to Kenjeran Beach in Madura Strait and has great marine potential. Most of Kampung Kejawan Lor dwellers depend on the marine products for their livelihoods. They work as fishermen, fisher laborers, fish sellers, fish crackers makers (Arifin et.al, 2012).
Kampung Kejawan Lor is divided into two areas (Figure 4), separated by 5 meter street wide. Area A consists of settlement area and public facilities such as community center, musholla, and public toilet room. Area B comprises of more dense settlement and located next to the sea. The study focuses on the problems occur in area B.
Houses in Kampung Kejawan Lor are connected by narrow pathways directly to the main street. The 1.5 meters wide pathway physically serves not only for circulation, but also functions as a common space for social interaction, relaxing, and doing activities to support their livelihood like cleaning and drying fishes. The usage of circulation area is mainly cause by no other options for shared place for the community. Almost all of available lots are occupied.

**Figure 5.** The Case Study Area  
Source: map - modified from Google Map, 2013, photos – authors’ photographs

The informal settlement of Kampung Kejawan Lor has lots of issues regarding open space provision. First thing which have been mention above, is lack of common open space. Secondly is the issue about lack of greenery for open space. Green plantation in this densely settlement is only derived from small amount of plants and trees planted by fraction of society. The trees and plantation do not function as a

**Figure 6.** Daily Community Activities in Kampung Kejawan Lor  
Source: Authors’ photographs, 2013

**Problems and Potentials**
shelter, thus make the open space extremely hot during daytime. The only available vacant lot is owned by the Municipality and at the present condition is occupied with garbage (Figure 7a). Furthermore, the pavement which covers the pathways contributes in high temperatures in daytime and flooding since water cannot be directly absorbed by the soil (Figure 7b).

**Figure 7.** Open Space is Full of Garbage and Suffered from Flooding  
Source: Authors’ photographs, 2013

Other issues raised from the case study is lack of hygiene which can be seen from trashes inside gutter and scattered in some parts of the settlements. Poor sanitary condition has made the impression of this settlement as a slum area and this is even worsened with the habit of drying clothes in front of their houses. From the interviews with local residents, it is found that the garbage collection happened because of lack of environmental awareness. This can be seen from their habit of throwing households waste directly into sea. Those households waste then returned back to the settlement when high tide came. Besides, there is no proper waste management system for Kampung Kejawan Lor. Moreover, the community does not have a high level of education. Hence, the awareness for environmental concerns and hygiene are absent.

**Figure 8.** Existing Pathways in Kampung Kejawan Lor  
Source: Authors’ photographs, 2013
RESULTS AND DISCUSSION

From the case study area, many problems regarding green open space were captured. There is no place for the community to have social interaction. The space is not only limited, but almost no vacant and open lot where the community could have space for relaxing and meeting their neighbor, except the pave ways in front of the houses. The houses were also in the poor condition, thus this exasperates the poor living condition. Moreover, household garbage can be found everywhere in the public space area, which makes the neighborhood turns into unhealthy places to live for.

For sure, Kampung Kejawan Lor needs a common public space and greeneries more than it has now. The community needs public open space where they can have opportunities for a pleasant recreation and fresh air to breathe. In order to fulfill these needs, the green space which suitable to their needs could be in the form of vertical garden (Figure 10), green elements of the houses such as balconies, walls (Figure 11), and green pave ways. In addition, planning for the public green open space needs to involve the community from the initiation of the project, implementation, and maintenance to ensure the sustainability of the green space.

The walkways where the community uses for social interaction can be designed integrating the needs of greeneries within the neighborhood (Figure 12). The vacant place can also be activated as urban farming function and public space with local identity for the community.

To sustain this effort, the community needs to form a community organization which is responsible for managing the physical facilities and keeping the environment clean. The household waste should be separated, thus it can be used as recycled products that can give additional income for the community.

**CONCLUSIONS**

For the informal settlements of Kejawan Lor, green space is inevitable necessity for the settlers. Green open space can be regarded as the community social and health needs. Green open space has proven its benefit to social function, environmental benefit, and at the end will improve the quality of life of the community. In such limited space, the existence of a park is not only determined by the size or visibility...
in terms of grounded space. To answer the problems in the case study area, there should be innovative ways to integrate the greeneries in the housing design by putting neighborhood meeting space in front of the houses. The proposed solution may not be the perfect answer for such perplexed problems. Nevertheless, the efforts to improve the quality of life of people should be our concerns towards sustainable living.

REFERENCES


<http://stage.4archiculture.com/index.php?t=blog/post/view&id=166> 
(Accessed on 29th July 2013).
This page intentionally left blank
HOW GREEN IS THE CONDITION OF LOW INCOME INFORMAL SETTLEMENT?
(Case Study : Fishing Village in Keputih, Surabaya)

Nurul L. Hasanuddin*, Novesty Noor*, Happy R. Santosa**
*) Master Student of Housing and Human Settlement, Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
**) Lecturer of Housing and Human Settlement, Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
E-mail: nurullestari84@gmail.com, novesty_88@yahoo.com, happyratna@yahoo.com

ABSTRACT

The various impacts of global warming occurred in many parts of the world. Drought, pestilence, floods, melting polar ice, smog, forest fires and climate change are some of the effects of global warming. Many efforts have been done to minimize the impact of global warming and climate change. In the field of settlement, some efforts were made to achieve sustainable settlements. This study aims to assess the conditions, the problems and the constraints faced by informal settlements related to efforts to achieve an eco-housing. As we know that the settlements of low-income communities are generally characterized by several traits, which is unlivable and unhealthy environment condition of housing, and the lack of infrastructure and facilities.

This study applied qualitative research methods, collecting data applied interviews and observation method, and descriptive analysis method. The results show that the conditions of informal settlements in the study area are not appropriate with the criteria of adequate settlement. It can be seen clearly by the condition of most houses that went untreated and suffered damage in some part, lack of clean water supply, inadequate condition of road network, and dirty and unhealthy conditions in environment. In addition to residential eligibility issues, application of the friendly environmental concept or green concept such as greenery around the houses is still in dire shortage.

Surely all the problems faced by the people have certain causes. Weak economic level, the lack of public awareness and concern for environmental health, as well as the mindset and the lack of knowledge society were factors which become an obstacle in efforts to achieve green concept in low-income informal settlements. Based on the results of the study it can be concluded that to establish the livable settlements and a friendly environment in the study area, several important steps need to be done, such as the improvement of the condition of the settlements...
(especially the supply of clean water), increased economic community, providing education to increase knowledge and awareness about environmental health, and the establishment of environmental cadres.

Keywords: Green concept, informal settlement, low income communities

INTRODUCTION

Global warming, which previously only considered a myth by most people, is now starting to feel the real impact. Various impacts of global warming occurred in many parts of the world. Drought, pestilence, floods, melting polar ice, smog, forest fires and climate change are some of the effects of global warming. These various effects bringing harm to humans.

Many efforts have been made in an attempt to address and minimize the impact of global warming and climate change. In the field of housing, efforts were made to achieve sustainable settlements. However, to achieve this goal in informal settlements inhabited by low-income people still face many constraints. Low-income neighborhoods are neighborhoods populated by people whose income is far below the minimum wage on average. Low income settlements are generally characterized by several traits, the condition of the house is not habitable, the environmental conditions that do not fit the health requirements, lack of facilities and infrastructure. This study discusses about the conditions of informal settlements inhabited by low-income people. This study uses the case study method, the study area is a settlement located on the outskirts of the city of Surabaya. The neighborhood was populated by low-income communities, where the majority of residents working in the informal sector.

STUDY AREA OVERVIEW

The study area is located in Keputih Village, Sukolilo District, Surabaya, East Java. It is located around pond area in dense settlements along the Keputih river and crossing directly to Laguna Raya Kejawen Putih street (see figure 1 and 2).

![Figure 13. Study Area](Source: Google Map)
DISCUSSION

Most of the residents in the study area work in informal sector. Such as, laborers, merchants, farmers and ranchers duck pond also boarding house venture (see figure 3). The majority of residents is a native of Surabaya city, only a few people come from outside Surabaya. Therefore, the social interaction of citizens is quite closely intertwined due to the existing cultural similarities (see figure 4).

**Figure 2.** Ponds and river in the study area  
Source: field survey, 2013

**Figure 3.** Boarding house and meubel venture, and charcoal  
Source: field survey, 2013

**Figure 4.** The social interaction of citizens in the study area  
Source: field survey, 2013

The Condition Analysis of The Settlement Based on Criteria of Decent Housing

In The Habitat Agenda, the issue about livable neighborhoods contains a commitment to provide and ensure access for community to obtain adequate housing. The purpose is to improve the condition of living space and sustainable development. Therefore, we can ensure the fulfillment of human rights in getting adequate shelter (healthy, safe, convenient, accessible and affordable). The Habitat Agenda generated by the Habitat II in Istanbul (1996) defines the definition of livable settlement includes the following criteria:

- Feasibility privacy
- Accessibility
- Security
- Ownership
• The stability and durability of building structures
• Adequate lighting and ventilation
• Availability of facilities and infrastructure

World Health Organization Expert Committee on Budihardjo (2009) suggested that a viable and healthy house should at least comply with the following criteria:

- The physiological needs; include optimal temperature in the house, lighting, protection against noise, good ventilation, as well as the availability of space for exercise and play for children.
- The psychological needs; include guarantees enough "privacy", opportunity and freedom to be a normal family life, a harmonious relationship between parents and children, the fulfillment of the requirements of social manners, and so on.
- Can provide protection against the transmission of disease and contamination; include the availability of water supply complied with the requirements, the sewerage facilities, availability of food store facilities, avoid insects or other pests that can spread disease.
- Can provide protection/ prevention against the risk of an accident in the house; include robust construction, to avoid the danger of fire, the prevention from possibility of accidental falls or other mechanical accidents, and so on.

**Table 1. The Condition Analysis of the Settlement Based on Criteria of Decent Housing**

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Housing conditions in the study area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land ownership</td>
<td>The settlement stands on a state land so that the land ownership status is still indistinct. This has implications for the high risk of eviction. They can live on the site simply due to compassion of government and society.</td>
</tr>
<tr>
<td>Privacy Feasibility</td>
<td>This settlement has quite high density of houses. Houses huddled together (virtually no distance between the houses) so that the feasibility of privacy has not been fulfilled.</td>
</tr>
<tr>
<td>Housing conditions</td>
<td>Most of the housing conditions in the study area not appropriate with the criteria. There is a house that has less than 21 m2/ lot and the brick wall is not plastered. The floor of the house, mostly without floor tiles. Approximately houses 90% of the total listed in the study area is semi-permanent home. The condition of the house looked unwell-maintained and there is damage to some parts of the building.</td>
</tr>
<tr>
<td>Aspects</td>
<td>Housing conditions in the study area</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Road network and accessibility</td>
<td>There are two pathways for accessing the study area. The main pathway is from Keputih eastern street that is commonly used by people. There is alternative path that passes through limestone deposits that connects to Pakuwon City residents. Public transportation are not allowed to pass the study area except privately owned vehicles. Some roads in the study area have been given pavement, others still unpaved.</td>
</tr>
<tr>
<td>Clean water</td>
<td>This settlement has not been served by PDAM. The cost of getting clean water needed everyday in the community is Rp. 1000 for 12 cans of water from a source (mosque) nearest to the study area.</td>
</tr>
<tr>
<td>Electricity and telephone networks</td>
<td>Previously, the study areas are not served by electricity and telephone networks. Electricity network was installed in 2011 by PLN but only for part of the settlement.</td>
</tr>
<tr>
<td>Drainage, solid waste management and sanitation systems</td>
<td>A drainage system is not available in the study area so that rain water directly absorbed by the ground, while the domestic wastewater flows directly from the house to the ground around the house or flows directly into the river. Waste management efforts by community appear in recycling waste into compost by using composter presence in every 5 meters along the road of settlements. For sanitation systems, whole house have toilets, but there are still houses that do not have a septic tank.</td>
</tr>
</tbody>
</table>
### Housing conditions in the study area

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability facilities</td>
<td>In the study area there is no open space, sports facilities and a playground for children that can be used by people to gather and socialize. The activity took place on the edge of the road. There are several points along the roads which are usually gathering places for residents to socialize and where children to play. The facility in the study area which include places for worship (two mosques), neighborhood hall, and some food stall in front of people house. People can access other facilities such as schools, health care, local shop/ market, etc at nearby village by foot or using transportation.</td>
</tr>
<tr>
<td>Environmental conditions</td>
<td>In the study area there is a lot of ponds that are farmed by people. River conditions in the study area appear less protected, which can be seen from trash heaped in the river. Mangroves in the study areas grow naturally around the river. But for the last few years, some of this mangrove area has been converted and covered with ground limestone as a result of development of commercial area projects by the private sector. There are also greening efforts like planting an ornamental plants and medicinal plants of the area around the settlement for aesthetics aspect also the health benefits.</td>
</tr>
</tbody>
</table>
Based on the description above it can be seen that the environmental conditions of low-income communities have not fulfill the criteria of adequate settlement. It is obvious from description of the housing condition and the surrounding environment.

Analysis of settlement conditions based on the criteria of sustainable settlements

Eco-housing is part of sustainable housing. The UN Habitat Global Report 2012 contains several methods that need to be done to achieve sustainable housing and settlements, as follows:

• Housing energy consumption
• Building materials that are environmentally friendly
• Empowerment and community participation
• The housing sector and household income
• Making the initial investment for long-term savings
• Culturally appropriate affordable housing
• Institutional responsibility for promoting sustainable affordable housing.

Descriptive analysis of the settlement conditions in the study area based on the criteria of sustainable settlements listed in the UN Habitat Global Report, is as follows.

• Housing and Energy Consumption
Find alternative ways to save energy consumption in housing. Building energy consumption is measured in two ways, embodied energy (production, transport, assembly and material specific techniques used), and the energy used for maintenance (ventilation, heating, water and electricity).

✓ Implementation of the concept of energy saving and water in study areas has not been done. It can be seen by the use of energy source from petroleum and natural gas and the use of household equipments that are not based on energy saving principles. Energy and water saving concept was not implemented due to the mind set and consumption patterns that do not realize the importance of saving energy and water.
• Environmentally Friendly Building Material
Building materials used for housing and settlements must be environmentally friendly. Wood is one of the environmentally friendly materials. Other materials that can be used include steel, concrete, glass and plastic.
✓ Most of houses in study area are semi-permanent house, using brick material, bamboo, wood, and plywood. Basically the material used is environmentally friendly enough, but the use of these materials is caused by the limited choice of materials because of the low level of income.

• Empowerment and Community Participation
Sustainability of the social aspect includes many dimensions such as empowerment of all income groups, ages and ethnicities, regardless of gender, communities should be involved in the collecting information, planning, implementation, maintenance and monitoring processes associated with housing. Empowering communities to influence the process of urban development through a democratic system, and, if possible, give the poor the means to build their own homes in a way that they want.
✓ Empowerment and community participation in the study are a still not adequate, either participation in planning or monitoring process.

• The Housing Sector and Household Income
It is important to link income (employment, productivity) for housing policy in ensuring the long-term solution. Jobs can be created through new construction and reinforcement, the production of energy-efficient materials or recycled.
✓ There are some people in the study area who develop domestic business. Livelihoods of people are very diverse but all of it in the informal sector, such as project workers, under employed workers and fish farmers.

• Making The First Investment for Long-Term Savings
Sustainable low-cost housing offers significant economic benefits in terms of required energy even though the initial cost is higher.
✓ This concept has not been implemented in the study area. People prefer to use cheap equipment but wasteful of energy.

• Culture Appropriate Affordable Housing
Aspects such as the shape, the design, layout, materials, etc., must reflect a world view, values, ideals, lifestyle of residents and cultural groups it serves. Start projects with a focus on local needs, the community-based approach.
✓ Houses in the study area was built by the communities (self-help) therefore it fit the needs and activities of its occupants.

• Institutional Responsibility for Promoting Sustainable Affordable Housing
Government and law, policy and institutions are responsible for the development of sustainable urban form. Local governments in particular should support the provision of affordable housing to fulfill demand, to ensure low-cost housing, subsidies regulatory framework for tenants or for units of affordable housing.
Institutional role in providing financial assistance such as affordable loan guarantees, subsidized, long-term loans and mortgages.

✓ All of the houses in the study area were built by the community (self-help). The houses condition reflects the economic level of its residents communities in the study area including the lower-income segments of society. Therefore they build houses adapted to their economic capability (affordable). However, from the aspect of sustainability, the housing is not in accordance with the criteria of sustainable housing.

Environmental Sustainability Index in The Informal Settlements of Low Income Households

*Sustainability Environmental Index (ESI)* consists of five (5) core component that includes 22 indicators, as follows.

a. Environment system, including air quality, water quality, water quantity, tread earth systems, and biodiversity.

b. Environmental stress, including reducing air pollution, reducing pressure on water resources, reduction of pressure on the ecosystem, waste reduction and level of consumption, and reduction of stress on the population.

c. Vulnerability, including environmental health and support the basic needs of human life.

d. Social and institutional capacity includes science / technology, capacity for debate, regulation and management, environmental information, eco-efficiency, reducing the failure of public choice, the private sector response.

e. Global services, covering international commitment, participation and funding global scale and protect international cooperation.

Of the total 22 indicators, not all found in the study area. Some indicators of *Sustainability Environmental Index (ESI)* found in study region are as follows.

- Environmental systems
  Regarding air and water quality observations and measurements still need more details about it. However, in general it can be said that the quality of air and water in the study area are essentially similar to other surrounding areas. For water supply, residents in the study area are still not directly served by public water corporation (PDAM). Residents for the purchase of water and loaded into a jerry can, then jergen is transported using a cart. To get clean water as much as 12 jerry can residents pay 1,000 rupiah.

- Biodiversity in the study area also requires more detailed observations so it is quite difficult to conclude without any clear and specific data.

- Environmental stress
  Some indicators in this component, which is clearly found in the study area is the reduction of waste (See Figure 5).
Vulnerability

For these components, the environment and health aspects of sustainability of daily living needs are still weak in the study area. Environmental condition in the study area is not a habitable environment and not fulfills health standards. It can be seen from the physical condition of houses, roads, and facilities in the study area. There are about 70% of existing houses are inadequate/unhealthy house. It is about 10% of the total house is not served electrical network. Approximately 95% of roads network in the study area has not been given pavement. Besides physical conditions, economic conditions are still low. Residents in the study area was categorized as low income people who work in the informal sector, such as working odd jobs, street vendors, and others, in which the income is uncertain and has not been able to sustain a adequate living.

Social and institutional capacity

About the social and institutional capacity in the study area are also still very low/weak. Non-formal institutions that exist in the region is still a religious institutions and youth organization. There is no institution that play a role in the aspirations of citizens and increase the capacity of the socio-political residents. It is also affected by the low level of education as well as lack of access to information.

Global service

Regarding international commitment, participation and funding global scale and protect international cooperation is not encountered in the study area.

CONCLUSION

The conditions of informal settlements in the study area have not fulfill the criteria of adequate settlement. It can be seen clearly by the condition of most houses that went untreated and suffered damage in some part, lack of clean water supply, inadequate condition of road network, and dirty and unhealthy conditions in environment. In addition to residential eligibility issues, application of the friendly environmental concept or green concept such as greenery around the houses is still in dire shortage. Weak economic level, the lack of public awareness and concern for environmental health, as well as the mindset and the lack of knowledge communities is a factor which is an obstacle in efforts to achieve green concept in low-income informal settlements. To achieve an adequate housing and environmentally friendly
in the study area have made several important steps, including improved housing conditions (especially water supply), increasing economic, educational provision to increase knowledge and awareness about environmental health, as well as the formation of environmental cadres.

ACKNOWLEDGMENT

Thanks for all those who have helped in carrying out the research. Specially our deep gratitude to Professor Johan Silas, and all lecturers of Housing and Human Settlement and also all academic staff in our department.

REFERENCES

UN HABITAT (2012), Going Green : A Handbook Of Sustainable Housing Practice in Developing Countries. UNON. Nairobi.
The Habitat Agenda (1996), UN Habitat
THE ENVIRONMENTAL BENEFITS OF AGROFORESTRY SYSTEMS IN RELATION TO SOCIAL SUSTAINABILITY

Anizah Mohd Salleh*, Nor Zalina Harun**
*) Master Student, Kulliyyah of Architecture and Environmental Design, International Islamic University Malaysia, Kuala Lumpur, Malaysia
**) Kulliyyah of Architecture and Environmental Design, International Islamic University Malaysia, Kuala Lumpur, Malaysia
Email: anizah_izzah@yahoo.com

ABSTRACT

Agriculture sector has become a major contributor to the national gross domestic product. High demand for agro-based products has increased the expansion of agricultural land through monoculture systems. However, as the land for agriculture are decreasing, more natural forests being converted into agricultural land. The conversion is globally giving negative impacts towards environment including forest degradation, habitat fragmentation, and climate change. Being in environmental concern, the practices are considered as unsustainable since the systems decrease the value of the natural environment in long term period. Understanding this phenomenon, numerous literatures on agroforestry systems are studied as part of environmental design. ‘Agroforestry systems’ is a collective name of land use systems through maximum utilization of agricultural land in order to provide multiple outputs as well as protect the natural resources. The systems are seen as the sustainable agriculture practices since they contribute to the positive development in agriculture industry in terms of environmental, social, and economic aspects. This paper aims to study the environmental benefits of agroforestry systems in relation to social sustainability aspects. The objective of this study covers the identification of agroforestry benefits which contribute to the development of human population from components integration perspectives which consist of agricultural crops, plant materials, and animal species. Using content based analysis, this paper interfaces the benefits acquired from the mutual interaction of these three components. Significantly, the study proves that agroforestry systems give positive environmental impacts on air and water quality, soil improvement, biodiversity conservation, carbon sequestration, and climate change mitigation, as well as solve the issues of food security and safety. It shows that agroforestry systems are performing better than monoculture systems as they are environmentally friendly, socially reasonable and economically feasible through diversification of input and output.

Keywords: agroforestry, components integration, environmental benefit, social sustainability
INTRODUCTION

This paper is divided into four main sections. It discusses the reviews on environmental benefits of agroforestry systems in relation to social sustainability in sustainable agriculture perspectives. The theoretical idea of the paper explains the environmental issues in agriculture sector, specific understanding of sustainable agriculture, social sustainability in agriculture sector and factors that are influencing the social sustainability of sustainable agriculture practices. Next, content based analysis is used to clarify agroforestry systems as sustainable agriculture practices by focusing on their environmental and social benefits. Then, the finding shows that the environmental benefits of agroforestry systems are continuously solving the issues in agriculture sector. Lastly, the paper is followed by the conclusion of the paper which agroforestry is proven environmentally friendly, socially reasonable as well as economically feasible through diversification of input and output.

Thus, this paper aims to study the environmental benefits of agroforestry systems in relation to social sustainability aspects. The objective covers the identification of agroforestry benefits which contribute to the development of human population from components integration perspectives. As there is an increased demand for agro-based product, this study may provide useful baseline for the implementation of agroforestry systems. The agroforestry systems are an alternative to replace unsustainable agriculture practices of monoculture systems which are globally giving negative impacts towards environment including forest degradation, habitat fragmentation, and climate change.

Environmental Issues in Agriculture Sector

Agriculture sector becomes a major contributor to the national gross domestic product. High demand for agro-based products has increased the expansion of agricultural land through monoculture systems. Monoculture system in agriculture sector requires large area of forest to be cleared in order to provide an area for the agricultural purposes (Oxfam Case Study, 2011). For example, the increase in global demand for food and fuel are driving rapid expansion of oil palm monoculture plantation (Grain, 2006; Laurance, Lian, Butler, Sodhi, Bradshaw, Neidel, Consunji and Vega, 2010). Due to this rapid expansion, Butler (2005) affirmed that many primary forest areas has been cleared for the agricultural purposes that leads to the deforestation around the world.

For eight years back, there are ten countries which indicated as the world’s highest deforestation rate of primary forest. It leads by Nigeria, which was about 55.7%. Another African country faced high deforestation was Malawi with the rate of 14.9%. Whereas, Vietnam (54.5%), Cambodia (29.4%), Sri Lanka (15.2%), Indonesia (12.9%), North Korea (9.3%), and Nepal (9.1%) were pointed as among the highest deforestation rate of primary forest in Asian countries. Meanwhile, only two countries in Central America namely, Panama (6.7%) and Guatemala (6.4%) faced serious deforestation of primary forest (Figure 1). Not even in the context of decreasing primary forest land area, there is a global concern on the impact on the issues of forest clearance for the agricultural purposes through monoculture systems.
For this reason, there are many studies were discussed by author concerning to the factors that contribute to the environmental issues in agriculture sector. The information was compiled and tabulated in Table 1. There were many factors that contributed to the environmental issues including socio-economic aspects. Nevertheless, based on the numerous studies conducted, unsustainable agriculture practices through monoculture systems have received the most significance catchword among authors in agriculture field.

The practices of forest clearance and conversion into agricultural land are globally given the negative impacts towards environment including forest degradation, habitat fragmentation and climate change (Wong, 2001; Walls, 2006). Due to the conversion of forest area into agricultural land, it has threatened the biodiversity particularly in tropical countries of Malaysia and Indonesia. Forest area in both countries are habituated by various species of terrestrial habitat (Fitzherbert, Struebig, Morel, Danielsen, Bruhl, Donald and Phalan, 2008; Sheil, Casson, Meijaard, van Noordwijk, Gaskell, Sunderland-Groves, Wertz and Kanninen, 2009). Aratrakom, Thunhikorn and Donald (2006) and Sheil et al. (2009) claims that a number of wildlife exotic and endangered species including orangutans (*Pongo* spp.), Sumatran tiger (*Panthera tigris sumatrae*), Sumatran elephant (*Elephas maximus sumatrensis*), tapirs (*Tapirus* spp.), clouded leopards (*Neofelis* spp.), forest-dependent birds and butterflies has extinct due to the forest conversion activities.

In addition, the over-dependence on monoculture systems has made the farmers to consume huge quantities of chemical fertilizers and agrochemical products (pesticides, insecticides, herbicides and fungicides). It is to ensure consistency and profitability of yield production (Wong, 2001; Faridah Ahmad, 2001; Rodriguez, Sultan and Hilliker, 2004; Asy Syura and Tsan, 2008; Yue-Wen, 2009; Kassie and Zikhali, 2009; Chandara, 2011). However, the usage of chemical fertilizer and agrochemical are causing great pressures to the environment although
it considers as modern agriculture practices (Wong, 2001; Faridah Ahmad, 2001; Rodriguez et al., 2004; Walls, 2006; Kassie and Zikhali, 2009). It reduces soil fertility, degrade soil, lead to biodiversity loss and pollute water bodies even though it assures high outputs production for short-term period (Wong, 2001; Faridah Ahmad, 2001; Rodriguez et al., 2004; Merem, 2005; Grain, 2006; Kassie and Zikhali, 2009; Chandara, 2011). Hence, the practices of monoculture systems are considered as unsustainable agriculture practices since the systems decreasing the value of the natural environment for a long term period. The practice of monoculture system can be replaced by implementing agroforestry approach since the approach is one of the sustainable agriculture practices.

Table 1. Summary of Factors of Environmental Issues in Agriculture Sector

<table>
<thead>
<tr>
<th>Author</th>
<th>Factors influencing the environmental issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butler, 2005</td>
<td>Clearing and forest conversion</td>
</tr>
<tr>
<td>Walls, 2006; Yue-Wen, 2009; Hamuda and Patko, 2010</td>
<td>Intensive and industrialized agriculture</td>
</tr>
<tr>
<td>Hamuda and Patko, 2010</td>
<td>Intensification of food production due to population growth</td>
</tr>
<tr>
<td>Walls, 2006; Hamuda and Patko, 2010</td>
<td>Insufficient irrigation system</td>
</tr>
<tr>
<td>Walls, 2006; Hamuda and Patko, 2010; Oxfam Case Study, 2011</td>
<td>Changes and excessive use of land</td>
</tr>
<tr>
<td>Hamuda and Patko, 2010</td>
<td>Over exploitation of natural resources</td>
</tr>
</tbody>
</table>

Source: Researcher, 2013

Sustainable Agriculture

Based on the vast issues in environment, one of the most vital sectors that need to be developed in a sustainable way is agriculture sector. Agriculture sector is seen as the fundamental supplier for food, fibre, and shelter for human population (Smith and McDonald, 1998). It is reported that food sufficiency, environmental stewardship, socio-economic viability and equity are the major paradigms of sustainable agriculture development (Smit and Smithers, 1993; Smith and McDonald, 1998). Hence, sustainable agriculture is the practice of farming using principles of ecology, and the study of relationship between organisms and their environment. As mentioned by Kassie and Zikhali (2009), sustainable agriculture is an alternative in agriculture systems that address the constraint faced by human especially among poor farmers to increase their quality of life as well as improve the environmental conditions. It has the ability to fulfill the high demand on food production with minimum damage to the environment and human compared to the conventional agriculture.

The views on the importance of sustainable agriculture can be viewed in three perspectives namely, environmental or biophysical or ecological, economic and social perspectives (Smith and Smithers, 1993; Smith and McDonald, 1998; Kassie and Zikhali, 2009). Environmental perspectives focus on the plant development including plant growth and its management which affected by agronomic study of soil, water, and crops (Smith and Smithers, 1993). From economic perspectives, the
importance of sustainable agriculture is seen from its sufficient economic returns as an enterprise at the farm level and vital economic sector at the regional and national level as the sector contributes large amount in national gross domestic product (GDP) (Smith and McDonald, 1998; Dahlan Ismail, 2009). Finally, the social perspectives suggest that agriculture is the primary supplier for food, fibre, and shelter which provides basic societal needs for human population and boost quality of life of the surrounding community (Smit and Smithers, 1993; Smith and McDonald, 1998; Kassie and Zikhali, 2009). The interaction of those dimensions known as principles of sustainability as shown in Table 2. The principles are referred in the development of agriculture sector as a mean to create a sustainable agriculture industry.

Table 2. Principles of Sustainability in Sustainable Agriculture Perspectives

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Description</th>
</tr>
</thead>
</table>
| Environmental | - Ecologically sound practices that have little to zero adverse effect on natural ecosystems which enhance environmental quality and the natural resource base.  
- Protecting, recycling, replacing and maintaining the natural resources base such as land, water, and wildlife that contribute towards conservation of natural capital. |
| Economic | - Alternative uses of land that are economically profitable can improve the economic viability of a farm: improving soil management and crop rotation can increase yields, enhance soil quality and water availability which can raise the value of the farm.  
- Economic viability can be achieved through reduction on the usage of machinery, chemical fertilizer and pesticide costs. |
| Social | - Relates to the quality of life of those who work and live on the farm, as well as those in the surrounding communities.  
- Ensures equitable revenue or returns to different stakeholders of the agricultural production chain. |

Source: Researcher, 2013

Social Sustainability

Sustainable development is becoming a dominant criterion in guiding current development in planning stage. Generally, the concept of sustainable development is closely related with humanity. As mentioned by United Nations Documents (n.d.), human has the ability to create and improve the development to become sustainable during planning stage. Thus, it has been adopted in many developing countries such as Malaysia, Indonesia, Brazil, Papua New Guinea and Zimbabwe (American Mathematical Society [AMS], 2013) in order to protect the incorruption of the global environmental and developmental system at the local, national and international level (Malaysia Productivity Corporation [MPC], 2010).

Referring to the principles of sustainability, social sustainability is often positioned in relation to ecological or economic sustainability (McKenzie, 2004). Basically, social sustainability can be defined as the process of improving the quality of life within communities (McKenzie, 2004). Littig and GrieBler (2005)
stated that the theory of social sustainability is based on the concepts of needs and work. It is the activities that are applied to fulfill human needs by considering the interdependence process between society and nature. The focus is on the man and nature relationship on human action which influences the stability of natural resources.

The Model of Social Sustainability developed by WACOSS (2002) stated that there are five principles of social sustainability. Those are equity, diversity, quality of life, interconnectedness, and democracy and governance. In comparison, Magis and Shinn (2009) provided with four principles consist of equity, human well being, democratic government, and democratic civil society. Equity involves generations and cultural interaction, and individual, community and political participation (McKenzie, 2004). Next, quality of life and human well being are related to the formation of livable communities by considering education and health care, access to public goods and services, employment, transportation, as well as housing (Magis and Shinn, 2009). Interconnectedness, on the other hand, reveals the positive impacts of integration both formal and informal interaction of the human and ecosystems through the diversification of function, idea and expression (WACOSS, 2002). Apart from that, democracy and governance engages with the structure of community and government in creating sustainability and livability of communities (WACOSS, 2002; Magis and Shinn, 2009).

Those principles are fundamentally characterized based on the life options for local community throughout the world. Based on both studies, the principles of social sustainable in relation to sustainable agriculture generally can be explained in Table 3.

Table 3. Principles of Social Sustainability in Sustainable Agriculture Perspectives

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of life</td>
<td>- Engages with the human and social well being by fulfilling the individual basic of needs and continuously improve and reduce the agricultural issues of communities including food security and safety.</td>
</tr>
<tr>
<td>Equity</td>
<td>- Relates to the equitability to have a healthy environment in all countries especially to defeat poverty alleviation by practicing self-sufficient agriculture approach.</td>
</tr>
<tr>
<td>Diversification</td>
<td>- Promotes diversification of agro-based products which encourages the communities to connect with the public and private agencies in processing and structuring the sustainable agriculture systems.</td>
</tr>
</tbody>
</table>

Source: Researcher, 2013

Factor Influencing Social Sustainability in Sustainable Agriculture Practices

Social and environmental aspects are interdependence and equally important in the sustainability concept. In a study conducted by McKenzie (2004), there are five factors studied in order to assess the changes in communities as follows:

i.  nature: natural resources, ecosystem services and aesthetic value
ii. human: knowledge and skill
iii. social: network
iv. institutional: institutional structure in the private or public sector
v. production: built environment and manufacture

The factors are measured to determine and increase the level of social sustainability of the communities by referring to the concept of social sustainability. Figure 2 shows the relationship between society and nature.

Figure 2. Relationship between Society and Nature
Source: Researcher, 2013

METHODOLOGY

Using content based analysis, the gap of this paper is focusing on the environmental benefits of agroforestry systems which spontaneously give positive impacts towards human population especially rural communities. Hence, this paper interfaces:

i. the clarification of agroforestry systems as sustainable agriculture practices; and

ii. the benefits acquired from the mutual interaction of three components in agroforestry systems.

Based on numerous journals and articles gained from scholars, all related information are identified, analyzed, and synthesized accordingly based on the theme as follows:
Agroforestry Systems as Sustainable Agriculture Practices

‘Agroforestry’ is a collective name of land use systems through maximum utilization of agricultural land in order to provide multiple outputs as well as protect the natural resources (Nurul Ain, Mohd Nazip, Abdul Rasip and Tsan, 2011; Handayani and Prawito, 2011). It involves the integration of agricultural crops, plant materials, and livestock production (Nurul Ain et al., 2011). These systems capture the traditional agriculture practices and adapt it using modern and new scientific technologies and knowledge (Wong, 2001; Oxfam Case Study, 2011; Handayani and Prawito, 2011) with the aim to provide long term sustainability instead of focusing on the maximum yield production.

According to a study conducted by Kassie and Zikhali (2009), a sustainable agriculture involves interaction of soil, crop, and livestock production which could benefit the environment such as nutrient cycling and fixing as well as soil restoration. In addition, low external input technology is also considered as sustainable agricultural development based on the criteria of the practices (Kassie and Zikhali, 2009). It involves soil and water management, soil fertility management, crop establishment, and controlling weeds and pests (Tripp, 2006). The criteria can be characterized in Table 4.

It shows that agroforestry systems are fulfilling those criteria by practicing low external input technology which considered as sustainable agriculture practices. In a study conducted by Handayani and Prawito (2011), the agroforestry systems are considering the criteria of self-sufficiency, economically viable for small scale farm, diversification of components and adaptation of new technologies. Therefore, agroforestry systems are a positive, creative and sustainable alternative approach to replace the monoculture systems which largely depend on the forest clearance (Wong, 2001; Oxfam Case Study, 2011). Wong (2001) claims that the overall income of agroforestry systems is greater than monoculture systems. Hence, the systems are seen as an approach in sustainable agriculture practices since it contributes to the positive development in agriculture industry in terms of environment, social and economic aspects (Oxfam Case Study, 2011; Nurul Ain et al., 2011).

Table 4. Criteria of Sustainable Agriculture Practices

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Example of practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil and water management</td>
<td>- Terraces and other physical structures to prevent soil erosion</td>
</tr>
<tr>
<td></td>
<td>- Contour planting</td>
</tr>
<tr>
<td></td>
<td>- Hedgerows and living barriers</td>
</tr>
<tr>
<td></td>
<td>- Conservation tillage</td>
</tr>
<tr>
<td></td>
<td>- Mulches, cover crops</td>
</tr>
<tr>
<td>Soil fertility enhancement</td>
<td>- Manures and composts</td>
</tr>
<tr>
<td></td>
<td>- Biomass transfer and green manures</td>
</tr>
<tr>
<td>Crop establishment</td>
<td>- Planting pits</td>
</tr>
<tr>
<td></td>
<td>- System of rice intensification</td>
</tr>
<tr>
<td></td>
<td>- Intercropping</td>
</tr>
<tr>
<td>Controlling weeds</td>
<td>- Intercrops and rotations</td>
</tr>
</tbody>
</table>
Mutual Interaction between Components

The concept of sustainability is largely depending on the interaction between people and environment by providing long term stabilization of the development (Handayani and Prawito, 2011). Since agroforestry systems are a part of sustainable agriculture practices, the environmental benefits of agroforestry systems continuously give impacts towards human population. Ahmad Fauzi and Huda Farhana (2006) claims that agroforestry systems are practiced to increase land productivity, sustainability, and equity as well as accomplish the social goals. Nevertheless, the starting point of the benefits on environment and social aspects are influenced by the mutual interaction between suitable components integration as shown in Figure 3.

The components in agroforestry systems consist of agricultural crops, plant materials and animal species especially livestock. The integration between those components involves agronomic studies that support the selection of those components in agroforestry systems by means of environmental benefits. The interaction of plants, animals, soil, and water may beneficially provide food and feed resources as well as environmental sustainability (Handayani and Prawito, 2011). As mentioned by Nair (2011), agroforestry systems are recognized as an approach in environmental protection. It becomes the foundation for the improvement and development of agriculture into industrialized nations in the world. Hasnol Othman, Farawahida and Zulkifli Hashim (2012) mentioned that the integration of leguminous cover crops (LCC) in the agricultural land could improve the soil fertility and crops growth as well as reduces immaturity period of the crops. The establishment of cover crops such as *Mucuna bracteata* becomes crucial in the peat soil area for the reduction of peat fire risk during dry season. Hence, positive mutual interactions between components are able to develop sustainable agriculture setting which improve the productivity and the welfare of the rural community.

Agroforestry systems are mostly practiced by the farmers in rural communities. The norm of agroforestry systems involves the poor, small farmers and rural communities who are living in the gloom of poverty and hunger (Sharashkin and Gold, 2005). It has been reported that 50% of the 4 billion poor, rural people are depending largely on the livestock in order to sustain their basic quality of life (Dahlan Ismail, 2009; Kassie and Zikhali, 2009). Meanwhile, in a study conducted by Ahmad Azhar, Norman Kasiran, Suhaimi Muhammed and Wan Hanisah (2008), oil palm crops are more suitable to be integrated with fruit trees species. Basically, the integration of agricultural crops with fruit trees and vegetables are significantly providing additional nutrition for human especially in poor countries (Handayani and Prawito, 2011). Furthermore, natural medicinal or herbs plant has the ability to heal many diseases and ailments naturally faced by poor communities. For example, 80% and 70% of African and Indonesian people depend on the medicinal herbs that are planted in their agricultural land. Therefore, the benefits of agroforestry on environmental and social aspects are closely linking...
each aspect to another in order to provide a better nation in developing countries. Many studies express the importance of agroforestry in environmental aspect across the environmental quality and ecosystem services which continuously give positive impacts towards communities as shown in Table 5.

![Diagram: Mutual Interaction between Components in Agroforestry Systems](source: Researcher, 2013)

**Figure 3.** Mutual Interaction between Components in Agroforestry Systems

**Table 5.** Summary on the Benefits of Agroforestry Systems

<table>
<thead>
<tr>
<th>Author</th>
<th>Environmental benefit</th>
<th>Social benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dahlan Ismail, 2009; Oxfam Case Study, 2011</td>
<td>Reduce herbicides contamination and encouraging the use of integrated pest management.</td>
<td>Improve nutrition and health of the rural community.</td>
</tr>
<tr>
<td>Dahlan Ismail, 2009</td>
<td>Biological control of weeds.</td>
<td>Improve people’s access to food and income.</td>
</tr>
<tr>
<td>Dahlan Ismail, 2009; Nurul Ain et al., 2011; Handayani and Prawito, 2011</td>
<td>Improve soil fertility.</td>
<td></td>
</tr>
<tr>
<td>Ahmad Fauzi and Huda Farhana, 2006; Oxfam Case Study, 2011</td>
<td>Improve soil condition through nitrogen fixation and erosion avoidance.</td>
<td></td>
</tr>
<tr>
<td>Handayani and Prawito, 2011</td>
<td>Carbon sequestration.</td>
<td></td>
</tr>
<tr>
<td>Handayani and Prawito, 2011</td>
<td>Hydrological or irrigation system.</td>
<td></td>
</tr>
<tr>
<td>Oxfam Case Study, 2011; Handayani and Prawito, 2011</td>
<td>Crops, trees and shrubs act as windbreaks and hedges.</td>
<td></td>
</tr>
<tr>
<td>Dahlan Ismail, 2009;</td>
<td>Crops, trees and shrubs provide shades that reduce heat problems.</td>
<td></td>
</tr>
</tbody>
</table>

Source: Researcher, 2013
FINDINGS

According to Nair (2011), the environmental benefits are classified based on the ability to plant materials through applicable component arrangement. Appropriate farm management on the selection of suitable components integration and arrangement can:

i. reduce agrochemical pollutants runoff;

ii. accumulate high amount of carbon (C) in soil profile through the availability of cover crops on the aboveground and belowground; and

iii. improve soil productivity through biological nitrogen fixation, efficient nutrient cycling and deep capture of nutrients.

Therefore, based on the numerous literature gains on the environmental benefits of agroforestry systems, there are four main categories:

i. air quality;

ii. water quality;

iii. soil improvement;

iv. biodiversity conservation; and

v. carbon sequestration and climate change mitigation.

Air Quality

Agroforestry systems are one of the approaches that are considered as sustainable agriculture practices due to the practice of zero-burning techniques. Considering that the issue of forest clearance for the preparation of monoculture systems has caused environmental problems, such as air pollution, agroforestry systems improve the air quality by practicing zero burning techniques in which plants and animal waste are processed to be used as organic fertilizers (Dahlan Ismail, 2009).

Moreover, the benefits of agroforestry on the air quality are largely depending on the appropriate selection of components integration and arrangements. Trees that are planted in linear lines act as windbreaks and shelterbelts to protect agricultural crops and livestock. In addition, the integration of plant materials in agricultural land is able to prevent soil erosion and mitigate odor from dung and urine of the livestock caused by wind. Hence, the integration of agricultural crops, plant materials, and animal species through agroforestry systems are beneficially improving the air quality of the surrounding environment.

Water Quality

Agroforestry systems have 80% higher conservation value of water than monoculture systems (Handayani and Prawito, 2011). Better interaction of belowground plant materials in agroforestry systems assist the water quality of the farm. In addition, the usage of plant materials as riparian buffers are strongly encouraged and supported by agricultural policies in the United State due to its advantages in improving water quality (Tomer, Dosskey, Burkart, James, Helmers and Eisenhauer, 2009). In essence, riparian buffers that are planted or grown along
water bodies has the ability to slow down surface runoff from carrying extra fertilizer or nutrient in agricultural land. As such, the amount of nutrients that are carried along through runoff to the ground and surface water can be reduced to avoid nonpoint source water pollution (Michel, Nair and Nair, 2007). In a study conducted by Tomer et al. (2009), it is mentioned that riparian buffers at the first order streams have the greatest potential in improving water quality than the larger streams. They stated that the quality of water was improved by:

i. slowing water movement;
ii. trapping pollutants;
iii. encouraging infiltration;
iv. increasing nutrient uptake and storage;
v. increasing transpiration; and
vi. promoting denitrification in the shallow subsurface.

Soil Improvement

Agroforestry system provides major natural services in soil management including soil improvement. Nair (2011) proposes that soil improvement through agroforestry system can be determined based on three conditions:

i. nitrogen gases (N\textsubscript{2}) input increased through plant-soil fixation,
ii. nutrients availability enhanced through decomposition and production of plant materials biomass, and
iii. nutrients utilization from deep root of plant materials.

Diversification of species through agroforestry systems generate many source of nitrogen fixing for the soil improvement. Basically, the natural use of nitrogen from plant materials reduces the need for the nitrogen fertilizer of agrochemical products. In a study conducted by Hasnol Othman et al., (2012), leguminous cover crops (LCC) have beneficial effects on soil by fixing and providing nitrogen (N) to the main crop, improve palm growth as well as lessen competition from harmful weeds. It is because soil nutrient absorption is depending on the selection of suitable components integration. The suitable selection of cover crops such as *Centrosema pubescens*, *Desmodium audifolium*, *Pueraria phaseoloides* and *Calopogonium caeruleum* to be planted in the inter-row of agricultural crops provides additional nutrient for the soil improvement (Jalaludin, 1996). Other study by Chia (2011) mentioned that integration of teak with oil palm crops are highly recommended due to its strong tap root which are able to reduce the soil nutrient competition of these two integrations. Hence, the interaction of various species of plants can maintain and improve soil productivity and performance due to difference level of tolerance in soil pH.

Biodiversity Conservation

Agroforestry systems that combine and interact various species of flora and fauna provides a habitat for the biodiversity. According to Callo-Concha et al. (2009), agroforestry systems are the provision of the environmental services in agriculture sector through its benefits on conserving the biodiversity. Callo-Concha et al. (2009)
found that agroforestry system can help to preserve a higher level of biodiversity as well as provide sustainable landscape connectivity through the encouragement and intensification of the agricultural practices. It can tolerate certain level of disturbance by providing sustainable and productive agriculture practices instead of practicing monoculture systems. This is because the systems involve the clearance of natural forests, and disturb the habitat of various species of flora and fauna. The rationale behind the positive response towards biodiversity of agroforestry system is based on three factors (Nair, 2011):

i. accumulation of agroforestry system preserve protected areas from any corruption actions;

ii. expansion of agroforestry system increase land area for biodiversity habitation in relation to landscape purposes; and

iii. diversification of plant materials species in farming systems.

The analyses in the work of Callo-Concha et al. (2009) found that species diversifications are among the factors that influence the availability of habitat for various biodiversity in agricultural land. It is based on the advantages of components integration that provides different structure and dynamic natural cycle, thus, is able to reduce deforestation through its successful implementation (Callo-Concha et al., 2009). By integrating various types of trees species in agricultural land, it has the potential to provide sustainable supply diverse range of tree products which formerly harvested in forest area. Therefore, the integration of suitable components in agricultural land is proven not affecting but increasing the quality and quantity of main agricultural crops.

Carbon Sequestration and Climate Change Mitigation

Agroforestry systems that integrate various types of plant materials have the capability to capture and utilize natural growth resources such as light, nutrients, and water. The systems provide higher probability to sequester carbon (C) than single species crops cultivation as the integration between trees and crops are possibly become carbon sink sources and provide temporary storage of carbon (Handayani and Prawito, 2011). Somarriba, Cerda, Orozco, Cifuentes, Davila, Espin, Mavisoy, Avila, Alvarado, Poveda, Astorga, Say and Deheuvels (2013) mentioned that carbon stocks are acquired from the compartments and tree use or form systems. Compartment systems involve aboveground, root, soil, litter and dead wood. Meanwhile, tree use or form systems involve the interaction of components including agricultural crops, timber species, fruit tree species, palms, ornamentals and other. Moreover, higher soil organic carbon (C) content is influenced by the diversity and richness of plant materials species in agricultural land. Handayani and Prawito (2011) stated that there are three factors that influence the rate of carbon sequestration. One of them is the age of agroforestry systems.

The amount of carbon storages that produced by plant-soil systems are possibly mitigate the climate change (Somarriba et al., 2013). The carbon stocks in shaded area of agroforestry systems are seen helping to mitigate climate change. For example, the canopy of trees and oil palm crops integration provides shades and reduces the heat problems faced by livestock such as cattle (Dahlan Ismail, 2009).
As a whole, the diversification of components in agroforestry systems provides the sources of carbon sequestration which are continuously mitigate the climate change.

Food Security and Safety

In relation to the social aspects, the benefits acquired from the environmental aspects of agroforestry systems are simultaneously defeating the sustainable agriculture issue of food security, food safety and environmental degradation (Yue-Wen, 2009; Handayani and Prawito, 2011). This is due to the goal of agroforestry systems which is to fulfill human needs in food consumption and maintain the standard environmental quality of the surrounding ecosystems (Handayani and Prawito, 2011). In addition, agriculture sector is continuously being the main supplier of food since it contributes major proportion for the gross domestic product in all developing countries.

The practices of sustainable agriculture through agroforestry systems are solving the issues of inequitable and poor food production and distribution. High food productions are needed to execute the increase of human population by 925 billion in 2050 (Wollenberg, Campbell, Holmgren, Seymour, Sibanda and von Braun, 2011). In a study conducted by Sharashkin and Gold (2005), 70% of population in Russia is practicing agriculture in order to produce food for the country. Besides that, agroforestry approach is implemented among Bolivian farming communities in order to overcome the issues of poverty and hunger by generating employment and income for the rural communities (Oxfam Case Study, 2011). These have shown that agroforestry systems have been implemented in many countries as an alternative to increase the quality of life among poor rural communities.

CONCLUSIONS

Agroforestry systems are performing better than monoculture systems as they are environmentally friendly, socially reasonable and economically feasible through diversification of output. The agroforestry systems are economically viable because they increase farm income, especially among smallholder farmers during the low productive periods, and the replanting phase of the crops. Thus, a better understanding on the roles of agricultural crops, plant materials and animal species in agroforestry systems may provide and enhance the environment and quality of life especially among the rural communities.

ACKNOWLEDGMENT

My gratitude goes to my supervisor who has helped me in the process of accomplishing this paper. She has guided me in organizing the information and idea systematically and efficiently. Also, the appreciation goes to Ministry of Higher
Education (MOHE) for providing research grant through Fundamental Research Grant Scheme.

REFERENCES


This page intentionally left blank
THE SETTLEMENT PATTERN OF MARISO WATERFRONT TO THE ENVIRONMENTAL CONDITION

Edward Syarif*, Endang Titi Sunarti Darjosanjoto**, I Gusti Ngurah Antaryama**

*) Doctoral Programme, Departement of Architecture, Institut Teknologi Sepuluh Nopember (ITS), Surabaya, and Hasanuddin University, Makassar, Indonesia

**) Departement of Architecture, Institut Teknologi Sepuluh Nopember (ITS), Surabaya, Indonesia

e-mail : edosyarif@yahoo.com

ABSTRACT

Mariso settlement is located on the waterfront of Makassar. It is formed by reclamation process done by the local community. Reclamation process caused forming a new settlement of Mariso and changed the waterfront environment of Makassar. This paper is aimed to describe changes of the settlement patterns of Mariso waterfront and influences to the environmental condition. This research was conducted by using diachronic reading analysis techniques, supported by the logic of space theory and the green architecture concept. The results of this research indicated that the settlement patterns of Mariso initially formed individual pattern on the water, then developed into elongated pattern, clustered pattern and combined pattern. The settlement patterns of Mariso were influenced by community activities related to their livelihood and the kinship system of the community. The individual pattern, elongated pattern and forming open space pattern were settlement pattern suits the principles of green architecture on the waterfront. This paper can be a concept for developing settlements in the reclamation area in accordance with environmental friendly.

Keywords: Mariso, settlement patterns, the logic of space, environmental friendly

INTRODUCTION

The increase of need for city space causes the coastal area to be one of alternative of the urban development area. Consequently waterfront area became dense and developed without considering the environmental characteristics. The waterfront area is a form of development of the urban structure that oriented to the waters such as lakes, rivers and the sea, which maximize the potential and characteristics of the city (Zhand, 1999).

According to Dahuri, et al (1996) the form of urban and settlement in coastal areas should be an integration and not contrary to the coastal ecological. It describes
that the settlement patterns of waterfront needs integrated arrangement with the coastal ecological and environmentally friendly. Furthermore, Vale and Robert (1991) explains that green architecture is one of the means used to achieve ecological architecture and environmentally friendly in order to achieve a balance in the system of human interaction with the environment. Green architecture is the architecture which minimize of negative impact on the environment.

Phenomena in the waterfront area of Makassar describes that the development of Makassar as coastal city has impacts on the surrounding coast area. One of them is the new settlement of Mariso formed due to changes of the sea to be settlements. The Mariso settlement was initially formed as an adaptation of community to the coastal environment, in terms of fishing communities. This is in line with Norberg-Zshulz (1985) explaining that live and dwelling in a place indirectly describe the relationship between humans and their environment. It is describe that the relationship concept of the human with the environment. On the other side, the Mariso settlement is developing due to the need of urban space and proximity to city facilities.

The Mariso settlement grew spontaneously on the waters occupying the empty spaces, so that transforming the waterfront area. The settlement patterns of Mariso do not integrate with the coastal environment. It caused the coastal areas losing their function and damaged the coastal environment. The Mariso settlement patterns are formed not environmental friendly. It is not utilized the potential natural resources, such as the climate and natural energy, so that settlements unhealthy formed. Karyono (2010) explains that the green city is a condition of a city that is safe, comfortable, clean, and healthy for the inhabitants by optimizing the natural potential and social communities.

Based on the above phenomenon, this paper aims to describe the changes of the settlement pattern and to explain the influences to the environmental condition of waterfront.

THEORETICAL BASE

Waterfront is a dynamic area of the city, a meeting place on land and water (Breen and Rigby, 1994). The waterfront settlement is settlement located on the waterfront, where the settlements optimally and efficiently utilize the existing potential on the waters (Rahman, 2006). The process formation of the waterfront area influenced by the environment condition aspect, socio-cultural aspects, economical aspects, aspect of population and aspect of government policy. The most influence aspect in the formation of the waterfront settlements are socio-cultural of the society, so that culture of waters will be reflected on the settlement form. On the other side the dependence of community on the beach is an aspect that influences the coastal settlement patterns (Sairinen and Kumpulainen, 2006). It describes that dependence of community on the beach will influence toward the waterfront settlement patterns. According to Cakaric (2010) that the environmental condition factor causes the development waterfront area are forming:

1. Longitudinal Pattern, following the line of the waterfront.
2. Concentric pattern, surrounding the waters.
3. Irregular pattern, spreading around the waterfront following the physical shape of water areas.

The spatial pattern of the coastal settlement has different forms according to the ecological characteristics and the growth processes. The research showed that the spatial pattern of the coastal settlements generally formed elongated pattern, clustered pattern and scattered pattern (Kostof, 1991 and Darjosanjoto, 2007). Figure 2 shows that sketch of the spatial patterns of coastal settlement:

Figure 2 explains that there are four essential elements that exist in coastal settlements, namely: buildings, activity centers, open space and water as elements.
forming environment. These four elements should be integrated in the spatial arrangement of environmental settlements and do not conflict with the coastal ecology.

According to Wreen (1983) and Sastrawati (2003), some characteristics of the waterfront area which must be considered to get successfully spatial ordering of the waterfront area are:

1. The natural conditions of waterfront should be the consideration in ordering space.
2. The image of the waterfront area.
3. Access should be able to provide guarantees of an easy achievement.
4. The building orientation should view to the water.
5. The landscape arrangement is required because the area has the potential for erosion and abrasion.
6. The existing social culture of the local community should not be overlooked in the arrangement of the waterfront area.
7. The waterfront area development must comply with regulation, such as the beach line and the rules of building density.

The development of the waterfront area should be directed to the protection of the environment and to utilize land that is not productive. Therefore, the development of the waterfront area should be carried out according to the characteristics of the local environment.

Vale and Robert (1991) explains that some of the green architecture principles to the environment include:

1. Respect for Site
   The settlements are not to damage the original site conditions.
2. Conserving Energy
   The settlements should minimize the use of electrical energy (to maximize the natural energy to the building).
3. Working with Climate
   The settlements should be based on the climate and existing energy sources.
4. Respect for User
   The settlements should be suits to users and meet all his needs.
5. Limiting New Resources
   The settlements should optimize the needs of new natural resources, so that the resource is not depleted and can be used in the future.

Green architecture is an architectural concept that seeks to minimize adverse effects on natural and human environment and generate a better place to live and be healthy, which is done by utilizing natural resources efficiently and optimally.

The green architecture principles to be analysis basis to the influence of Mariso settlement pattern to the green architecture on the waterfront area.

**RESEARCH METHODS**

This research will describe the influence of the settlement patterns to the environmental condition of waterfront. Diachronic reading analysis technique is
used which is supported by the logic of space theory and the green architecture principles.

To describe changes of the settlement pattern is conducted by reading the settlement development. It is using diachronic analysis techniques based on a series of map from the previous time (Darjosanjoto, 2006). Further, the settlement map which is equipped by a cluster of residential buildings as a base to convert the study map into the logic of space map. To analyze changes of the settlement pattern existing, those map needs to be converted by adopting the method of Hillier and Hanson (1984). The conversion result of cluster of buildings and open space maps are then used to interprete the settlement patterns according to the occurred form. Further, the settlement patterns formed were analyzed based on the green architecture concept (Vale and Robert, 1991) to explain the influence of settlement patterns to the environmental condition of waterfront area.

The settlement patterns solution through Hillier and Hanson (1984) approach, is the settlement patterns that can be described logically as settlement spaces formed from the basic structure of settlement which consist of buildings and outer spaces. Hillier and Hanson explained that the settlement pattern interpreted through to reveal how buildings and outer spaces can be related to other buildings that sprung up. The buildings and the outer spaces are analogous to the closed cells with an entrance. The interpretation of settlement patterns in the logic of space analysis approach has its own diversity. The interpretation of settlement patterns according to Hillier and Hanson can be described in table 1:

Table 1. Interpretation of Settlement Pattern

<table>
<thead>
<tr>
<th>No.</th>
<th>Cell Form</th>
<th>Interpretation</th>
<th>Settlement Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><img src="image1" alt="Cell Form" /></td>
<td>The building consists of one cell and overlooks the open space of its own.</td>
<td>Individual pattern</td>
</tr>
<tr>
<td>2.</td>
<td><img src="image2" alt="Cell Form" /></td>
<td>Building or cell consists of two or more adjacent buildings and facing open space.</td>
<td>Elongated pattern</td>
</tr>
<tr>
<td>3.</td>
<td><img src="image3" alt="Cell Form" /></td>
<td>Building or cell consisting of two or more adjacent and facing the same open space.</td>
<td>Forming of open space pattern</td>
</tr>
<tr>
<td>4.</td>
<td><img src="image4" alt="Cell Form" /></td>
<td>Building or a cell that consists of elongated and forming of open space pattern.</td>
<td>Combination pattern</td>
</tr>
</tbody>
</table>

Source: Hillier dan Hanson (1984)

Table 1 shows the development of settlements genotype, has done through the merging process of several cells and open space that formed on settlements. In the figure is also displayed some changes in the structure of settlements because of the increase in building. Hiller and Hanson (1984) formulate some developments of the
settlement formation to assist in the interpretation of settlements patterns. From figure above, according to Hiller and Hanson (1984) the settlement formation consist of individual pattern, elongated pattern, forming open space pattern and combination pattern.

The research was conducted in Mariso waterfront settlement in Makassar city, South Sulawesi Province. The waterfront settlement of Mariso was formed through the process of changing the sea to be settlements. This research is focused to explain the development of settlement patterns formed from 1980 to 2013. Location of the research is described in figure 3:

RESULTS AND DISCUSSION

The Physical Changes of Mariso Waterfront

The Mariso settlements are located in west Makassar city and it is located on Losari bay. The Mariso settlements are formed by the process of changing the sea area to be settlement. Reclamation process conducted by the local community has caused to physical changes Mariso area. The development of Mariso is forming elongated from inland areas to the ocean and filling of empty waters area. The Mariso settlements are growing due to communities reliance on the beach, as a fishing community and a location near the town center, so that many people choose to live and work in Mariso. The establishment of new settlements in the Mariso area has caused physical changes of Makassar waters. The development of Mariso area is described in figure 4:
Figure 4. The Development Pattern of Mariso Area, 1980 – 2012
Sources: Google Earth

Figure 4 explains that initially the Mariso settlements were formed on the waterfront, then evolved into the sea forming elongated from the mainland into the sea, and formed new settlements. The establishment of the new settlements of Mariso has caused: 1) changes of the function of the sea from a source of livelihood and conservation area into settlements, 2) forming reclamation of the beach, 3) changes in the extent of area, 4) changes of coastline 5) occurs building density, and 6) forming the irregular settlements.

The Mariso settlement patterns were formed spontaneously so that they were not in accordance with the environmental characteristics, especially the natural condition, the image of waterfront and the rules of coastal areas. The Mariso settlement has caused the changes of the coastal area. It impacts on the loss function of waterfront area. The uncontrolled development of buildings in Mariso causes the building density level which has exceeded the rules in the coastal area and also causes lack of open space.

The Pattern of Mariso Settlement

To interpretate Mariso settlement patterns was used the logic of space theory (Hillier and Hanson), by describes logically basic structure of the settlements in the form of buildings and outer spaces as cells. The settlement patterns are interpreted by explains how the buildings and outer spaces relate to other buildings.

The Mariso settlement patterns were analyzed based on the growth of settlements groups ranging from 1980 to 2012. In this analysis, group of settlement into two groups, namely group 1 settlements formed in 1980-2000 and settlement group 2 which was formed in 2000-2012. The interpretation of Mariso settlement pattern described in table 2.
**Table 2. Interpretation of Mariso Settlement Pattern**

<table>
<thead>
<tr>
<th>Settlement Group</th>
<th>Settlement Development Map</th>
<th>The Logic of Space Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>The development of Group Settlement 1, 1980-2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The condition in 1980</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The condition in 2000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Individual Pattern</td>
<td>Elongated Pattern</td>
</tr>
<tr>
<td></td>
<td>Forming of open space Pattern</td>
<td>Combined Pattern</td>
</tr>
</tbody>
</table>

- The layout process of buildings begins with forming of the spread houses on the water by the fishing community.
- The increase number of buildings correlated with changes of the sea area to be settlements.
- Initially forms individual settlement patterns, then evolving to be elongated patterns, forming open space patterns and combined patterns.
- Dominant settlement pattern in group 1 is elongated pattern.
- The individual pattern impacts to the changes of the waters area into settlements.
- The elongated pattern impact to the development direction of settlement to the sea.
- The forming of open space pattern and combined pattern are influenced by the kinship factor, which impact to alley formation and density.
The development of Group Settlement 2, 2000 – 2012

- The layout process of buildings begins with forming of the spread houses on the water by the fishing community.
- The increase number of buildings correlate with changes of the sea area to be settlements.
- Initially forms individual settlement patterns, then evolving to be elongated patterns, forming open space patterns and combined patterns.
- Dominant settlement patterns in group 2 are individual pattern and elongated pattern.
- The individual pattern and elongated pattern are impact to the changes of the waters area into settlements.

Table 2 explains that the Mariso settlement patterns is initially forms individual settlement patterns, then evolved to be elongated patterns, forming open space patterns and combined patterns. The individual pattern and the elongated pattern are influenced by community activities in terms of linkage to the beach. The forming of open space pattern and combined pattern are influenced by the kinship factor. The individual settlement pattern develops and spreads on the waters causing a new settlement on the Makassar waterfront area. The elongated pattern causes the development direction of settlement to the sea and changes the coastline. The forming of open space pattern and combined pattern causes dense settlements and formed alley, so that influences the movement pattern. The growth and layout of buildings correlate with the changes of the sea area to be settlements.
Figure 5 shows the layout of the house caused by the need of the community on the beach which formed individual pattern and elongated pattern.

![Figure 5: The Layout of The Houses Condition](image)

Figure 6 shows the layout of the house caused by kinship factors which caused the forming of open space pattern and combined pattern.

![Figure 6: The Layout of The Houses Condition](image)

**The Influence of The Settlement Pattern of Mariso Waterfront To Green Architecture**

To explain the influence of Mariso settlement patterns to the green architecture used parameters of the green architecture principles by Vale and Robert (1991) and the parameters by the Indonesian Green Environment Measurement (IGEM). This parameter is used to measure the effect of settlement patterns to the potential and the environmental damage.

According to Vale and Robert (1991) there are five indicators of the green architecture which considering the need of the analysis, namely a) indicator of the respect for site is a damage on the environment, b) indicator of the conserving energy is to maximize the natural energy to the building, c) indicator of the working with climate is utilize of the energy resources into the building, d) indicator of the respect for user is an adaptation of community on the site, e) indicator of the minimizing new resources is suitable to the form and structure of the building. Of the indicators above, it can identified the influence of Mariso settlement patterns to the green architecture.
To measure the influence of Mariso settlement patterns to green environment level used assessment analysis by IGEM standards (Karyono, 2010). According to IGEM the green environmental level standards include a) very safe, b) safe, c) fairly safe, and d) is unsafe. Four categories of values are between 1-4, consists of a very safe (4), safe (3), fairly safe (2), and unsafe (1). Following IGEM standards, identification the influence of Mariso settlement patterns to the green architecture principles is described in Table 3.

Table 3. The Assessment of The Settlement Pattern To The Principles of Green Architecture

<table>
<thead>
<tr>
<th>The Settlement Pattern</th>
<th>The Green Architecture Principles</th>
<th>Score</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Respecting Site</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conserving Energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Working with Climate</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Respecting User</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimizing new Resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual Pattern</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Elongated Pattern</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Forming Open Space Pattern</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Combined Pattern</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3 explained that the individual pattern is settlement pattern safe to waterfront environmental. The elongated pattern and forming open space pattern are settlement patterns fairly safe to waterfront environmental. The combined pattern is settlement pattern unsafe to waterfront environmental. The individual pattern, elongated pattern and forming open space pattern are settlement pattern suits the principles of green architecture. They are minimize damage of the waterfront environmental and optimize utilization the natural resources of the waterfront environment.

CONCLUSIONS

The logic of space method was showing the change of Mariso settlement patterns. The settlement which was initially oriented to the sea as a reflection of livelihood become the land oriented settlements. The settlement patterns of Mariso were initially formed as the individual pattern, then developed to be the elongated pattern, forming open spaces pattern and combined patterns. The individual and elongated patterns were influenced by communities activity in terms of linkage to the beach. The forming of open space patterns and the combined patterns were formed from the house groups caused by the kinship factor.

The individual pattern, elongated pattern and forming open space pattern were settlement pattern suits the principles of green architecture. They were minimize
damage of the waterfront environmental and optimize utilization the natural resources of the waterfront environment.

The settlement patterns of Mariso were evolved forms the combined pattern, so they were not in accordance with the concept of the green architecture because did environmental damage and did not utilize the potential of the coastal environment. On the other side, forming the slum settlements and exacerbating the view of waterfront city.

From the above conclusion, it is advisable to emphasize on ordering space of the waterfront settlement especially structuring the layout of the buildings, circulation and open space which are suitable with the environmental characteristics and the socio community condition, so that they can give comfort to the community. This needs planning of the waterfront area, so that forms of the settlements should be integrated with the waterfront environment, especially environmental friendly. Accordingly, as decision makers the government of Makassar city are expected to make a development planning of the area by taking into account the environmental characteristics.

REFERENCES

Dahuri, Rokhmini dkk.. (1996), Pengelolaan Sumber Daya Wilayah Pesisir dan Lautan Secara Terpadu, Pradya Pratama, Jakarta.
Karsono, Tri Harso (2010), Green Architecture, Pengantar Pemahaman Arsitektur Hijau Di Indonesia, Rajawali Pers, Jakarta

This page intentionally left blank
ABSTRACT

This study is an effort to develop multiple functions of coastal areas in settlements and ecotourism based on the potentials of social and local culture. The coastal area of the research is located in the Village of Labuan Bajo, Donggala. This area is a tourist destination area in Central Sulawesi province. Although tourist visits each year has increased, this does not directly affect the lives of the people especially the fishing settlement. Facts show that more than 25% of the people are poor fishermen. This problem may be due to coastal settlements development patterns that are not integrated with the potential for coastal areas.

Development of the green settlements concept relating to coastal ecotourism is defined as an effort to liberate people from a variety of limitations that impede efforts to build prosperity by using the concept of green housing approach. Houses and settlements functions as the basis of economic development of the family, uses of energy-saving concept of 3R (reduce, reuse, recycle) and to not damage nature. Thus, local economic development and infrastructure problems may be solved by the concept of green settlement concept based on coastal ecotourism.

The method used in the research is participant observation. Data is quantified with SPSS tools and analyzed by the method of correlation. The results answers the potential for coastal locations that can support ecotourism in coastal settlements with a green approach.

Keywords: green settlement, coastal ecotourism

INTRODUCTION

Implementation of housing and settlements in Indonesia cannot be separated from some global agenda in the field of housing and settlements, especially Habitat Agenda 21 on sustainable development. In addition, in Agenda 21 as well as the Habitat Declaration II has declared commitment of the Indonesian people for the
need of development that emphasizes empowerment in the administration of housing and settlements (MNLH, 1977).

Housing and settlement development is not just homes and infrastructure to produce the necessities of life, but also an attempt to meet all the needs of the community to be livable, economically and socially healthy environment in order to ensure sustainable quality of life.

In accord to the commitments above, Central Sulawesi Provincial Government through the Regional Tourism Development Master Plan (RIPPDA) 2007-2017 form efforts to encourage an integrated approach to tourism planning and development of synergistic ecosystem with the respect to urban and rural areas, in particular to develop sustainable coastal region. In the aspect of coastal development in Donggala City, particularly ecotourism in Tanjung Karang village located in Labuan Bajo district as a tourist destination areas in Central Sulawesi (Dep.KEBUDPAR.RI, 2007).

The potentials of coastal ecotourism attraction in Donggala is cultural tourism potential for nature tourism development. It can be seen from the increasing tourist arrivals every year, but it does not directly affect the lives of people, especially in the fishing settlement as there are still more than 25% of the people are classified as poor fishermen. Thus needs to be upgraded to support the construction of fishing settlement on the coastal ecosystems and ecotourism Donggala. Conditions worsened with ecotourism consumption needs, such as accommodations and tour guides that can be managed by local communities.

Coastal ecotourism appeal has not been integrated with community involvement as an actor. Settlements as the basis of people's lives, especially fishing settlement can be developed in a variety of ecotourism activities. Therefore, the concept of development in the region needs sustainable development approach. This is in accord with the opinion of Harg (2005) that there are some ecological methods of development of the area functions as settlement. This method is the concept of land use more than one land use, in particular green residential land use.

Through the development of settlement towards ecotourism services with the green settlement based on an ecological approach, it is expected that regional development can be prevented speculatively. Green settlement approach is expected to lead in increased settlement functions that are integrated with ecotourism. Dual function may be one approach to community development in order to improve the welfare of society in line with the eco-tourism destination.

RESEARCH AREA

Research conducted in the village of Labuan Bajo is located in Banawa District. Location of the study can be seen in Figure 1 and 2. Reasons for choosing the location is within the following considerations:
1. The fishing settlement in Labuan Bajo village is identified as slums (Rusli, 2006).
2. The fishing settlement located on land and sea have the potentials for development of beach tourism.
3. Potentials of the appeal of coastal areas in Central Sulawesi Donggala is not optimized therefore results of coastal ecotourism has not been fully appreciated.

THEORY AND LITERATURE REVIEW

The Concept of Sustainable Development

Sustainable development concept was popularized through reports of WCED (World Commission on Environment and Development) entitled "Our Common Future" (day ahead of us together) which was published in 1987. Reports often called Brundtland Commission report defines sustainable development as development that meets the needs of current generations without compromising the ability of future generations to meet their own needs (WCED, 1987).

The implications of the opinions expressed above are WECD which stressed on the importance of the condition of natural resources in the development plan of the region, rural and urban, and there should be efforts to minimize its environmental impact. This is in accord with the opinion of Marlia, et al (2013), that every person in the world produce rubbish every day consequently it is conceivable that the resulting amount of garbage piles. In the end, garbage disposal may become a problem in the future if not handled properly. Therefore we need the participation of all the people to deal with this through principles of 3R (recycle, reuse, reduce).

Principles of 3R (reuse, reduce, recycle) is a solution to process household waste into craft products, compost or utilizing waste into power source (power plant waste). 3R occur through the reduction of resource extraction as raw materials can be met from waste recycled and reused. Sustainable development and environmentally aware can be defined as "the conscious and deliberate effort that integrates the environment, including the resources into the development process of
the region/local to ensure the ability, well-being and quality of life for present and future generations to come" (Askary, 2003).

Development is successful when the ecological development (helps to preserve the environment), economic (improved welfare) and human (social benefits). The characteristics of environmentally aware development, includes: (1) ensure equity and fairness, (2) value biodiversity, (3) using an integrated approach, (4) using a long-term approach.

Based on the opinion above, the construction can be said to be successful if it has an ecological approach. Synergy with these opinions, Harg (2005), states that there are several methods of ecological approaches related to development of the area for a function based on the following:

1. Symptoms of nature is a dynamic interaction process, responsive to natural functions, opportunities and barriers that exist for human use. Therefore, the value of an area has intrinsic suitability for a particular use, both are single, or multi-function.

2. Development of the region speculatively can have a detrimental effect on the realization of the potential of the region as a whole, where an uncontrolled growth would have a negative impact.

3. This method is the concept of ecological land use that are complementary based on the investigation of areas that support more than one land use, the area where the well is seen as an area that demands the separation of land use zoning or as an opportunity to combine some functions land use.

The implications of an ecological approach described by Harg emphasize the importance of considering the ecological conditions in the natural environment as well as the regional development plan is to minimize the adverse environmental impacts.

The Concept of Sustainable Settlements

Agenda 21 of the global concept of environment and development sectors containing the agenda of sustainable development should be linked in more detail into local concepts that focus on specific issues, particularly in the settlement include:

1. **Human settlements**, settlements that are sustainable and environmentally friendly.
2. **Urban Water Supplies**, in search of clean water solutions
3. **Solid Waste Management**, solutions in handling and recycling waste.
4. **Urban Pollution and Health**, finding solutions through pollution and its relation to environmental health.

Based on the description of the global concept of Agenda 21 above, especially the aspects of the issue of coastal settlements, fishing settlement in Labuan Bajo village is identified as slums and pockets of low-income communities. This corresponds to the findings of Rusli (2006), that the settlement has not seedy value levels and the availability of green open space (RTH) with a value of 1.00. This assessment is based on the identification and the indicator matrix slums (Laboratory of Housing and Human Settlement ITS, 2000). As for all the slums are due to factors such as housing conditions, availability of infrastructure, and vulnerability
status of the population. The four indicators are categorized as unsupported housing and settlement conditions that are livable. Furthermore, supporting aspects such as the values of mutual cooperation, citizen participation and the desire to improve the region to be more feasible and productive can be expected.

Silas (2000), opinionated that the need for housing concept developed not only on the study and analysis of settlement infrastructure needs, but also the function of the home that can be more productive with social and economic activities that are reliable as a variety of home-based enterprises (HBEs) or home-based business. This principle is relevant to the concept of green housing development, where the process and products must be produced from environmentally friendly society.

This is in accord to Wunas (2011) that the development of suburban areas requires innovation and responsiveness of stakeholders in order to increase comfort and region by involving the community as a performer with the basic principles of sustainable housing design, such as:
1. Sustainable use of space, green space, rain water catchment area and the housing plan that is integrated with nature.
2. Integration of land use with housing, social facilities, and economy and transportation system planning that prioritizes pedestrians, bikes, and buses, as well as the parking lot is equipped stop.

Rationally the space of living conditions needs to be built by the community, both to perform a variety of social, cultural and economic activities based on coastal ecosystems and ecotourism.

The Concept of Green Settlement

Karyono (2010) references that essentially architecture aims to design green settlement that focused more on people that live and conduct their activities connecting physical form settlements, settlements align with nature, creating spaces and make a quality residential neighborhoods as a place rich with diversity. In addition, the expected use of natural resources and the least possible negative impact on nature, the environment in which people live. According to Karyono (2010), there is some concept of green housing, among others:
1. Tread processing

   This parameter is related to how to choose a safe site to put up buildings. On the other hand, physical changes such as cut and fill footprint can be minimized. Completion of the application of the concept of building houses with stilts considered as the safest of the destruction of the site, and do not reduce the ability of tread surface percolate rainwater.
2. Energy Savings

   Energy parameters relates to the amount of energy consumed as well as the percentage of utilization of renewable energy sources in buildings. The building is considered good if the support of human activity requires low energy consumption. On the other hand, renewable energy sources such as biofuels, heat and sunlight, water energy sources, wind and others can be fully utilized.
3. Use of Materials
Green settlement requires the use of materials that do not contaminate the environment and endanger human. Renewable materials such as wood, bamboo, branches, leaves, and other material is recommended, in addition to the use of material reuse and recycle.

4. Water

Dominant parameters measured in the concept of green housing. Buildings that are low in water consumption will get good grades.

5. Waste

The result in human waste management and building is a way to measure the level of green building. Disposing of dirty water or as much as 3 liters of organic waste on land 500 m² certainly will not cause any pollution. Waste disposal continuously for a long period of time will cause the soil, water and air to be polluted. Environment in small and large scale will be contaminated, polluted and contaminated vegetation ultimately, human health and also threatens human life. This parameter has a high value, if the lower the ability to purify waste land because of the amount of waste that is disposed of the better green residential level.

6. Quality In Space

There are two parameters which are measured to determine the level of physical comfort felt by residents. The first parameter is the air quality of a composition comprising forming air gases such as oxygen (O2), weak gas (N2), carbon dioxide (CO2) and water vapor (H2O). With the measured composition requirements are met, a room is considered chemically clean or healthy. Both the measured parameter associated with building user comfort when the composition of the aspects of physical comfort, the comfort of spatial (space), thermal (temperature), visual (sight), auditory (hearing) and smell (olfactory). Thirdly, furniture placement and the right equipment for the delivery of activities. When all three parameters are met then the settlement/green building gets high marks.

By using six parameters above, generally all buildings both modern and traditional can be assessed level of green with high scores and good.

The Concept of Coastal Ecotourism Development

Ecotourism is defined as a form of tourism that emphasizes the responsibility towards our environment, provide economic benefits and maintain the cultural integrity of local people (Tuwo, 2011). Definition of ecotourism can lift products and services like the richness and uniqueness of traditional arts and culture of natural potential. To that end, coastal tourism development with the potential appeal of nature, diversity of flora and fauna such as marine parks, cultural attractions, and nature, as well as coastal and marine sports tourism (Kusumastanto, 2003).

This is in accord with the opinions of Yulanda (2007), while the concept of eco-tourism development beach/coastline comprises of:

1. Marine tourism
2. Recreation of beach and sea
3. Resort
4. Tourism in diving and snorkeling tour, jet ski, boat glass, submarine
Operationally, coastal tourism focuses on the natural environment and local culture with the principles of good local products based on the needs of accommodation, attraction, and food joints that is appropriate to local conditions. This is in accordance to From (2004) that suggest the tourists usually have a lot to learn from the local people, not vice versa. Tourists will not demand extra performances and entertainment, but rather encourages the local community to give a performance that is owned by the local community (From, 2004). Based on the concepts and definitions of ecotourism beach/coastal, supported by the desire of the lovers who really want ecotourism terms of quality and ecosystem integrity.

Ecosystem approach is used in the management of ecotourism for the region there is a high interaction. The interaction of factors including social, economic and environmental. These factors need to be identified based on scientific principles, such as the opinions of Weaver (2002) in Nugroho (2012), that a conceptual management of environmental impact in the management of ecotourism has two reasons, namely micro-sustainability by implementing the principles of conservation and sustainability macros by applying the principle of sustainability in attraction areas, construction of tourist facilities and infrastructure that can be influenced and influence the environment.

Therefore, there are 5 principles of ecotourism development that must be met, namely: first, prevent or overcome the impact of tourist activity on the landscape and local culture. Second, to educate the importance of conservation to tourists and local communities. Third, set up and management of ecotourism attraction in the region that can receive income directly. Fourth, community involvement. Fifth, all development efforts including facilities and utilities must maintain environmental harmony (Tuwo, 2011).

RESEARCH METHODS

This study uses participant observation, field data-operational defined and quantified. The samples determined by mapping heterogeneous population/sample based on characteristics such as: sample the fishing settlement with the majority of people working as a fisherman (owners and labors), civil servants, police and military and Entrepreneurs. For ecotourism beach/coastal, can be mapped based on ownership of such businesses, worked as a tour guide, restaurant employees and businessmen, tourist taxi business, kiosks and stalls, souvenir and art workers handcraft from coconut wood. With the quantitative data, then the use of technical analysis tools SPSS correlation method.

RESULTS AND DISCUSSION

Green settlement

Physical condition is characterized by spatial settlement land use functions of more than one land use to the majority of the population is a local community. Therefore,
the potential of the concept of culture correlates creating green neighborhoods. There are six parameters were measured to assess the settlement as a settlement of green as the empirical data in Figure 3-8.

**Figure 3.** Front View of Productive House  
Source: field survey, 2012

**Figure 4.** Productive House plan  
Source: field survey, 2012

**Figure 5.** Clean water resource  
Source: field survey, 2012

**Figure 6.** Productive House Type Stilted  
Source: field survey, 2012

**Figure 7.** Front Elevation of Productive House on Stilts  
Source: field survey, 2012

**Figure 8.** Garbage piles without recycling  
Source: field survey, 2012
In addition to the above empirical data, there are few similar studies have been conducted on the coastal settlements in the district of Labuan Bajo. The parameters used for the high valuation given number (1), moderate is given numbers (2), and given the low number (3). Analysis of the sixth green settlement parameters described below:

1. Site development
   
   Processing aspect of the site is assessed by building density between the built and not built area. Built area at the location of the study is less than 60% hence is identified that the region still has not built more than 60%. Therefore, this region is still allowed to be developed. In addition, physical changes such as cut and fill in the site have not been applied in the region despite the hilly topography. Completion of the application of the concept of building homes with stilt houses are considered the most secure against site vandalism. Based on figure 3 and 4 shows the majority of the stage type building. Thus, processing assessment aspects of the site can be considered moderate (2).

2. Clean Water Needs
   
   To meet the needs of water, people make well drilling/pantek and buy water. Based on the criteria of green settlements, these limitations are less supportive from the community to improve welfare. Thus, the condition of water infrastructure less support improved public health. Based on Figure 5 shows that the source of tap water in a dilapidated condition that the source of water used only wellbore. Less number of wells available to meet the needs of the community. The concept of green housing undervalued aspects of clean water (3).

3. Waste
   
   This aspect concerns the availability of private toilets, latrines and septic tank on the collective respondents in the region. Based on questionnaire survey concluded that the study area is categorized as slums by the value of 1.69-2.13. In general, people defecated into rivers, forests, and the sea. Household waste management has not use recycling system but still littering the place (river, sea and forest). Thus, environmentally friendly behavior will impact on the health and hygiene as well as the length of time it would threaten the productivity of the community. Based on Figure 8, the green housing concept for the valuation aspects of waste is considered low (3).

4. Energy
   
   Energy utilization in the slum area of research showed the criteria. This is due to the lighting needs of the space that still uses kerosene lamp and cooking needs that still uses firewood. Firewood as an energy source derived from neighborhoods such as coconut wood, coconut fiber, charcoal and coconut shell. Based on the assessment of green housing concept, aspects of firewood including renewable material that can be assessed for energy aspects of being (2).

5. Use of Materials
   
   In the study area was found 3 categories based on the use of building materials. Traditional buildings generally use local grade wood and coconut wood, leaf thatched roof, and floor boards. Modern buildings generally use brick walls, tiled floors and roof constructed of wood with corrugated iron cover and zinc metal.
Building materials used in its entirety is a local and renewable materials. The assessment of the material aspects can be considered good (2).

6. Quality In Space

There are two parameters which are measured to determine the level of physical comfort felt by residents. First, the air quality in the study area using the majority of houses on stilts. Thus aspects of physical comfort of the six parameters are assessed including furniture layout can create a level of comforts for residents, visitors and research area manager.

Coastal Ecotourism Development Concept

For the development of ecotourism there are 5 principles that must be met as can be seen existing condition ecotourism as follows:

In addition to the above empirical data, the findings of Rusli (2012) indicate the presence of a variety of unexploited coastal potential with the concept of ecotourism development in Donggala coast. Ecotourism development aimed at providing economic benefits to local communities to improve wellbeing. In terms of environmental (ecological), it aims to improve the environmental quality of coastal settlements in Donggala. Therefore, there are 5 principles of ecotourism development that must be met, namely:

1. Requires management to the communities to form a working group.
2. Potential of natural resources is a shared responsibility so that activities that
cause pollution to contaminate region.

3. Plan space/area according to the value of local wisdom. Uniqueness can lead to curiosity, to learn with the community and the process of social and cultural interaction with the principle of shared learning. This process is a plus for tourist and economic benefit.

4. The level of participation of coastal communities in Donggala is relatively low which may be caused by the level of public education.

5. Provision of transportation and utility with a natural approach because tourist tend to like the natural conditions and the corresponding local culture.

CONCLUSION

Based on the results of research conducted in the coastal ecotourism in Donggala city, a few things that can be summed up that assessment of green settlements obtained for the study area consists of 3 rated moderate (2), and 1 rated high (1) and 2 is considered low (3). Thus, it is necessary the development of coastal areas with the concept of green housing that can support coastal ecotourism.

Coastal tourism development concept with 5 parameters measured, aspects of local supporters can use the potential of natural resources and productive home-based culture. The environmental impact of the production process applies recycling system and environmentally friendly actions. To that end, the concept of tourism development in coastal Donggala can support increased fishing settlement functions. Potential appeal of coastal areas and the values of local wisdom is attractive for ecotourism promotion to come to a place. All solid waste, liquid waste and sewage from coastal areas must be treated and disposed of in such a way that it meets quality standards of waste and environmental quality standards. Recycling system needs to consider the environmental carrying capacity of all the recipients, such as water, soil, and air.

REFERENCES

GREEN CONCEPT OF KAMPUNG MANGROVE GUNUNG ANYAR TAMBAK IN SUPPORTING SUSTAINABLE SETTLEMENT

Palupi Sri Narisywari*, Chintia Putri Agnesi*, Happy Ratna Santosa**
*) Master Student, Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
**) Lecture, Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
email: cipu1102@yahoo.com

ABSTRACT

Development of Gunung Anyar Tambak region as mangrove eco-tourism brings positive impact to the surrounding community, especially in terms of improving the prosperity environment, community economic development and sustainability of settlements. Gunung Anyar Tambak region is included in the development of east coastal area of Surabaya. When people pay less attention to environmental sustainability, it is feared that the environment quality will declined. This can have an impact on the sustainability of the housing and society.

This research is a case study, observed the social phenomena, natural environment and economic activities in the area of eco-tourism community in Gunung Anyar Tambak eco-tourism region. The analytical method used is descriptive qualitative analysis techniques using indicators of environmental sustainability (ESI). The result of the study shows positive impact in the application of the green concept in Kampung Mangrove Gunung Anyar Tambak. As expected, the green concept optimizes the direction that can be an alternative to sustainable settlement development to support the eco-city.

Keywords: eco-city, green concept, mangrove eco-tourism, sustainable settlement

INTRODUCTION

Gunung Anyar Tambak mangrove eco-tourism region are included in the East Coastal Area development of Surabaya (Pamurbaya) with ecological and economic functions. Ecologically, mangroves can protect marine biota and also serves as a place of diverse living organisms. Mangroves have considerable influence on the microclimate of a coastal region. In addition to the ecological function, it can be an economics support to mangrove coastal areas that the benefits can be felt directly by the surrounding community. Mangroves can be additional source for income to
coastal communities and also indirectly affected the economic development in the kampungs.

Settlements in coastal areas will face problem when dealing with development efforts to conserve the environment. Therefore, this study will formulate green concept to support the settlement development in Gunung Anyar Tambak region, so that the settlement development can run sustainably without disturbing the environment.

LITERATURE REVIEW

Fisherman Settlement

According to WALHI (2008) in Nugrahanti (2012) fisherman settlement in Indonesia generally have low level of social welfare and the poor quality of the coastal environment. Adequate level of social welfare is shown on the lower area of distribution in many coastal areas. One of the causes is lack of infrastructure in marine and fisheries sector. Low quality of the environment in residential areas due to the lack of availability of basic infrastructure that has adverse affects to the fisherman productivity.

Fisherman settlement by Kusnadi (2008) in Rusli (2012), suggests the general problem on matters relating to:

a. Poverty and social inequality
b. Limitation access to capital, technology, markets
c. Low quality of human resources
d. Degradation of environment resources
e. Are not as pro-development policies are optimally on fishing communities

Green Concept in Building and Housing

Green building according to Green Enterprise Community (2010) is a holistic concept, encompassing more than a single building feature or system. It is grounded in the building science principles of maximizing durability, systems design and home performance, while also mitigating negative environmental and health impacts associated with the built environment. Green building also extends beyond the house or building to include site and location characteristics, such as compact development, smart growth, walkability and access to public transportation. It also provides a platform for innovation in design, construction and rehabilitation, from building envelope improvements to active renewable energy systems.

Based on FHLBA (2005) in HAC (2007), at the regional and community levels, green-built housing can help increase local economic growth by encouraging use of local and regional materials. Furthermore, USGBC (2006) in HAC (2007) says that utilization of a green framework can help protect and preserve open space, increase transportation options, reduce solid waste, minimize strain on local infrastructure, more properly manage storm water and reduce water pollution, improve air quality, and enhance community well-being by planning for growth.
Sustainable Housing and Settlement

According to UN-Habitat (2012) Housing is one of those basic social conditions that determine the quality of life and welfare of people and places. Housing is also part of the relationships between society and the environment. Based on UN-Habitat (2012) there are two interrelated function of housing, which are as follows:

- Housing as physical structure: residential buildings/shelters, their design, material qualities, their arrangement in space, and the ecological interaction with the physical environment
- Housing as social structure: residence based activities, their character, social qualities, and their socio economic interactions in space with the immediate communities and wider society.

Furthermore, UN-Habitat (2012) explained that sustainable houses are those that are designed, built and manage as:

- Healthy, durable, safe, and secure
- Affordable for the whole spectrum of incomes
- Using ecological low-energy and affordable building materials and technology
- Resilient to sustain potential natural disasters and climatic impacts
- Connected to decent, safe and affordable energy, water, sanitation and recycling facilities
- Using energy and water most efficiently and equipped with certain on-site renewable energy generation and water recycling capabilities
- Not polluting the environment and protected from external pollutions
- Well connected to jobs, shops, health- and child-care, education and other services
- Properly integrated into, and enhancing, the social, cultural and economic fabric of the local neighbourhood and the wider urban areas
- Properly run and maintained, timely renovated and retrofitted

According to Wunas (2011) in Rusli (2012), there some basic principle of sustainable housing and settlement planning:

- Sparing use of land up, the number of inhabitants and the number of projected home early.
- Qualified environmental quality for increased productivity.
- The location of settlement development does not interfere with the environment.
- Balanced use of space, building space, and integration with nature.
- Integration of land use (housing, social facilities, and economic) with transportation system planning.
- Utilizing elements of nature to the fullest
- Building a social current and future lifestyle concerned with energy saving and ecological potential of environmental care.
Environmental Sustainability Index (ESI)

Sustainability indices for countries provide a one-dimensional metric to valuate country-specific information on the three dimensions of sustainable development: economic, environmental, and social conditions (Bohringer, C and Jochem, P, 2007). According to Sherbinin (2003) environmental sustainability is measured through 20 “indicators,” in five core components:

1. Environmental System, such as water quality, air quality, water quantity, biodiversity, and land.
2. Reducing Stresses, such as reducing air pollution, reducing water stress, reducing ecosystem stresses, reducing waste & consumption pressures, and reducing population pressures.
3. Reducing Human Vulnerability, such as basic human sustenance and environmental health.
4. Social and Institutional Capacity, such as science and technology, capacity for debate, environmental governance, private sector responsiveness, and eco-efficiency.
5. Global Stewardship, such as participation in International Collaborative Efforts, greenhouse gas emissions, and reducing trans boundary environmental pressures.

METHODS

This study presents a case study of a fisherman settlement located in the mangrove eco-tourism, Kampung Gunung Anyar Tambak Surabaya. The discussion and analysis of this research is based on observations, interviews, literature studies, and using analytical techniques of environmental sustainability index (ESI) and descriptive qualitative. Literature study is needed to examine the existing conditions in the field, whether social, economic activity, environmental conservation and community efforts in the settlements development. Further analysis of environmental sustainability index (ESI) is formulated based on the existing condition. Then found a green concept that supports the development of sustainable settlements in accordance with the study area.

Locational Descriptions

*Kampung* Gunung Anyar Tambak Mangrove is located in Gunung Anyar Tambak, District Rungkut. This *kampung* have a boundary with Sidoarjo regency and separate by a river. The boundaries are:

• North : Green Land and Settlement
• South : River (border with Sidoarjo)
• West : East Wiguna street
• East : Green Land and Farms
This is one of the coastal areas of East Surabaya that have potential to developed in ecology and economic aspects, both in terms of natural resources and human resources.

RESULT AND DISCUSSION

Infrastructure Conditions

Distribution of urban facilities in kampung Gunung Anyar Tambak has been served by variety of urban facilities. Environmental infrastructure are already available include the roads using asphalt and paving, power supply systems, water supply systems, drainage, telephone, and others (Figure 2). Beside environmental infrastructure, the region also has education, health, trade facilities and other urban infrastructure (Figure 3). Education facilities is already available as urban infrastructure, with good condition and able to serve community’s needs in Gunung Anyar Tambak, such as Kindergarten, play group and Dahlanuddin islamic elementary school.
Economic Aspect

Most of the people in Kampung Gunung Anyar Tambak worked as fishermen, fish farmer, and construction worker. Housewives engaged in developing Kampung mangrove, such as processing and selling mangrove noodles and mangrove syrup, processing sea fish, also organize and manage household waste plastic (See Figure 4).

Environmental and Ecosystems of Mangrove Conditions

Gunung Anyar Tambak has developed as mangrove ecosystem. Local people maintain and conserve the mangrove ecosystem. In order to prevent mangrove ecosystems from damages, only old or mature mangrove fruits were taken. How to cut fruit also must be careful in order to avoid injuries to leaf and root of mangrove (See Figure 5). Gunung Anyar river containing phenolic compounds was 0.005 mg/l which is derived from oil motorboat. Mangrove plants are found in the area was 1517 trees/ha.
Women also planted ornamental plants, medical plants, as an effort to preserve the environment. In addition, people also utilize aerob composter to make fertilizer, which is used for greenery the kampung environment (See Figure 6).

Figure 5. Mangrove ecosystem and eco-tourism in Kampung Gunung Anyar Tambak
Source: field survey, 2013

Figure 6. Ornamental and medical plants, as an effort to preserve the environment
Source: field survey, 2013

Kampung Gunung Anyar Tambak has developed as mangrove tourism. Peoples that visited the mangrove tourism area are international and domestic tourists especially for kids to conduct outdoor education. International tourist visiting Kampung Gunung Anyar Tambak is to learn the conservation concept of mangrove ecosystem in Surabaya.

Figure 7. Guest Visits from Vietnam, Philippines, Malaysia, Thailand, Singapore, Myanmar, Brunei, and Timor Leste
Source: Swaraguna.blogspot.com

Peoples Participation

There are fisherman communities in kampung Gunung Anyar Tambak, who participated in maintaining the mangrove ecosystem and participate in collecting plastic waste from the river. In addition, there are kampung cadres and
environmental managers who encourage the peoples to participate in waste bank programs and other environmental programs. Bank Waste Program is a program of plastic waste, paper and other waste collection. It processed the waste into useful items and mostly are sold. Recycling programs are also conducted to produce items such as pencil, pin, and ashtray. The sales of plastic waste are collected into kampung cash. It can be used for electricity payment and managing the kampung environment to become cleaner and beautiful (Figure 8).

![Figure 8. Local Communities in collecting and processing plastic waste](image)

Source : field survey, 2013

**Analysis**

The discussion and analysis of this research is based on observations, interviews and literature studies. This research using analytical techniques of environmental sustainability index (ESI) and descriptive qualitative. Existing conditions were analyzed based on the indicators of Environment Sustainability Index. The result of the analysis is expected to support the development of sustainable settlement in study area. In Table 1, explain descriptive analysis of the study area based on the indicators of Environment Sustainability Index.

<table>
<thead>
<tr>
<th>Component</th>
<th>Indicator</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Stresses</td>
<td>• Reducing Air Pollution</td>
<td>• People have planting greenery in front of their home and mangrove ecosystem area. This action including into support the green concept to reduce air pollution and increase air coolness of local environment.</td>
</tr>
<tr>
<td></td>
<td>• Reducing Ecosystem Stress</td>
<td>• Gunung Anyar Tambak area has mangrove ecosystems that are conserved and also planted new mangrove.</td>
</tr>
<tr>
<td></td>
<td>• Reducing Waste and Consumption Pressures</td>
<td>• Bank Waste Program utilizes plastic waste and household garbage to be processed and resold. It aims to support the green concept with priority the 3R concept.</td>
</tr>
<tr>
<td>Human Vulnerability</td>
<td>• Basic Sustenance</td>
<td>• The main occupations of the people are fishermen and fish farmer. Most of the people have low income.</td>
</tr>
<tr>
<td></td>
<td>• Environmental</td>
<td></td>
</tr>
<tr>
<td>Component</td>
<td>Indicator</td>
<td>Analysis</td>
</tr>
<tr>
<td>----------------------------</td>
<td>------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Health</td>
<td></td>
<td>• Kampung Gunung Anyar Tambak is clean enough, although still encountered some dirty drains by plastic waste.</td>
</tr>
<tr>
<td>Environmental Systems</td>
<td>• Air Quality</td>
<td>• Air quality is quite good because there are located nearby mangrove ecosystems, open lands, and quite away from industrial area.</td>
</tr>
<tr>
<td></td>
<td>• Water Quantity</td>
<td>• The quality and availability of water are met, because water supply tunnel was ready in kampung area. But it is not proper for drinking.</td>
</tr>
<tr>
<td></td>
<td>• Water Quality</td>
<td>• The main problem in the Gunung Anyar UPN river is phenol contained (oil and fuel oil from the motorboats), which exceeds the threshold of 0,005 mg/l (threshold limit of 0,002 mg/l). But the level of toxicity of the compound is not harmful to the marine biota.</td>
</tr>
<tr>
<td></td>
<td>• Biodiversity</td>
<td>• Kampung Gunung Anyar Tambak have 5 varieties of mangrove plants. The varieties are Avicenna marina, Avicenna alba, Excoecaria agallocha, Avicenna lanata, and Xylocarpus granatum (BLH, 2012). Mangrove plants are found in the area was 1517 trees/ha.</td>
</tr>
<tr>
<td>Social and Institutional Capacity:</td>
<td>• Science/Technology</td>
<td>• Science and technology development are still simple or traditional.</td>
</tr>
<tr>
<td></td>
<td>• Regulation and Management</td>
<td>• Kampung Gunung Anyar Tambak has an environment cadre and environmental management to regulate and encourage the development programs in the kampung. Training leadership has not developed for leadership regeneration.</td>
</tr>
<tr>
<td></td>
<td>• Environmental Information</td>
<td>• Information about efforts to protect the environment has spread to the local community. Used media information such as the internet is also utilized local people to develop micro-enterprises.</td>
</tr>
<tr>
<td></td>
<td>• Eco-Efficiency</td>
<td>• Ecological environment efficiency utilize the waste become useful items.</td>
</tr>
<tr>
<td></td>
<td>• Private Sector Responsiveness</td>
<td>• The private sector who involved in the development kampung Gunung Anyar Tambak is Corporate Social Responsibility (CSR) PLN.</td>
</tr>
<tr>
<td>Global Stewardship</td>
<td>• International Commitment</td>
<td>• Effort to conserve environment in Kampung Gunung Anyar Tambak will impact on the environment in the local and regional scale. It’s one way to implement the international commitments. This application need more encourage and support in order to achieve international commitments.</td>
</tr>
</tbody>
</table>

Source: Analysis, 2013
Aspects that have met the criteria for green concept can become strength aspect in kampung Gunung Anyar Tambak, meanwhile aspect that haven’t met the criteria yet for green concept can become weakness aspect in kampung Gunung Anyar Tambak. Strength and weakness of the area can become the basis of the formulation to optimize human settlement development with green concept to support eco-city. Based on the previous description, there have aspects that become strength and weakness of *kampung* Gunung Anyar Tambak to support green concept. It is described in Table 2 and Table 3.

### Table 2. Strength aspects in *Kampung* Gunung Anyar Tambak

<table>
<thead>
<tr>
<th>No.</th>
<th>Strength Aspects</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>• Reducing Air Pollution</td>
<td>• Peoples planted green plant in along the way, in front of their house and nearby mangrove ecosystems. This action supporting green concept to reduce air pollutant and increase air coolness environment</td>
</tr>
<tr>
<td>2.</td>
<td>• Reducing Ecosystem Stress</td>
<td>• Gunung Anyar Tambak area has mangrove ecosystems that are conserved and also planted new mangrove.</td>
</tr>
<tr>
<td>3.</td>
<td>• Reducing Waste and Consumption Pressures</td>
<td>• Bank Waste Program use plastic waste and household garbage in the river area to be processed and resold. It aims to support the green concept with priority of 3R concept.</td>
</tr>
<tr>
<td>4.</td>
<td>• Air Quality</td>
<td>• Air quality is quite good because there are located nearby mangrove ecosystems, open lands, and quite away from industrial area.</td>
</tr>
<tr>
<td>5.</td>
<td>• Water Quantity • Water Quality</td>
<td>• Quality and availability of water are met, because water supply tunnel was already available. But it still not proper for drinking.</td>
</tr>
<tr>
<td>6.</td>
<td>• Biodiversity</td>
<td>• <em>Kampung</em> Gunung Anyar Tambak has 5 varieties of mangrove plants ecosystems.</td>
</tr>
<tr>
<td>7.</td>
<td>• Environmental Information</td>
<td>• Information about efforts to protect the environment has spread to the local community. Used media information such as the internet is also utilized local people to develop micro-enterprises.</td>
</tr>
<tr>
<td>8.</td>
<td>• Eco-Efficiency</td>
<td>• Ecological environment efficiency utilize the waste become useful items.</td>
</tr>
<tr>
<td>9.</td>
<td>• Private Sector Responsiveness</td>
<td>• The private sector who involved in the development <em>kampung</em> Gunung Anyar Tambak is Corporate Social Responsibility (CSR) PLN.</td>
</tr>
</tbody>
</table>

Source: Analysis, 2013

There are 9 aspects that have supported the concept of green concept in the Kampung Gunung Anyar Tambak area. These aspects consist of aspects of Reducing Air Pollution, Ecosystem Reducing Stress, Reducing Waste and Consumption pressures, Air Quality, Water Quantity, Water Quality, Biodiversity, Environmental Information, Eco-Efficiency, and the Private Sector Responsiveness.
Table 3. Weakness aspects in Kampung Gunung Anyar Tambak

<table>
<thead>
<tr>
<th>No.</th>
<th>Weakness Aspects</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>• Basic Sustenance</td>
<td>• The main occupations of the people are fishermen and fish farmer. Most of the people have low income.</td>
</tr>
<tr>
<td>2.</td>
<td>• Environmental Health</td>
<td>• Kampung Gunung Anyar Tambak is clean enough, but still encountered some dirty drains by plastic waste in this area.</td>
</tr>
<tr>
<td>3.</td>
<td>• Science/Technology</td>
<td>• Science and technology development is still simple or traditional.</td>
</tr>
<tr>
<td>4.</td>
<td>• Regulation and Management</td>
<td>• Kampung Gunung Anyar Tambak has an environment cadre and environmental management to regulate and encourage the development programs in the kampung. Training leadership has not developed for leadership regeneration.</td>
</tr>
<tr>
<td>5.</td>
<td>• International Commitment</td>
<td>• Effort to conserve environment in kampung Gunung Anyar Tambak will impact on the environment in the local and regional scale. It’s one way to implement the international commitments. This implementation need more encourage and support in order to achieve international commitments.</td>
</tr>
</tbody>
</table>

Source: Analysis, 2013

There are 5 weakness aspects in the Kampung Gunung Anyar Tambak area. Weakness aspects from the study area consists of Basic Sustenance, Environmental Health, Science / Technology, Regulation and Management, and International Commitment.

Based on analysis in Table 2, there are 9 aspects that can support green concept to develop Kampung Gunung Anyar Tambak. Aspect that become weakness (Table 3) can be formulated to optimize the settlement in Kampung Gunung Anyar Tambak to adjust green concept.

Optimization strategies of green concept in Kampung Mangrove Gunung Anyar Tambak are consist of:

1. Conducting outreach to poor communities, especially in developing the use of information technology, eg internet usage. The advantages of using the internet are develops a side business by utilizing scrap items through the 3R principles (reduce, recycle, reuse). Fishermen and housewives to increase the income and welfare of the community should follow the awareness program.
2. Training and guidance for youths and children to conservation and utilization of mangrove-based environment.
3. Increasing knowledge and growing awareness of youth and children to plant ornamental plants around their homes. It is important to create a greener and beautiful environment.
4. Increasing community participation in Kampung Gunung Anyar Tambak by trainings, workshops, and discussions programs.
5. Increasing promotion by utilizing electronic media especially the internet, to promote mangrove ecosystem as one eco-tourist destinations in the city of Surabaya.

CONCLUSIONS

There are 9 aspects that supported the concept of green in Kampung Gunung Anyar Tambak. These aspects consist of Reducing Air Pollution, Ecosystem Reducing Stress, Reducing Waste and Consumption pressures, Air Quality, Water Quality, Water Quantity, Biodiversity, Environmental Information, Eco-Efficiency, and the Private Sector Responsiveness.

While aspects of the study area are weak, the optimization can be formulated for new green concept. Weakness aspects from the study consists of Basic Sustenance, Environmental Health, Science / Technology, Regulation and Management, and International Commitment.

Kampung Gunung Anyar Tambak has weaknesses that may impede the achievement of the implementation of the green concept. To improve the realization of the green concept, it is necessary to optimize the implementation of the green concept. Efforts to optimize the green concept is primarily concerned through the empowerment of the community in implementing the 3R (reduce, recycle, reuse) and the use of electronic media in particular internet usage to support the realization of the concept of green, to create a sustainable living environment.

ACKNOWLEDGMENT

Institute of Technology Sepuluh Nopember (ITS) for Fresh Graduate scholarship; Head of Housing and Human Settlement Laboratory; Head of Architecture Department, ITS; All lecturers and staff in Housing and Human Settlement field; Head of environment cadre in Gunung Anyar Tambak; all people which cannot be mentioned one by one.

REFERENCES

Badan Lingkungan Hidup Kota Surabaya. (2012), Laporan Pengendalian Pencemaran Kawasan Pesisir dan Laut tahun 2012 (Reports Pollution Control Coastal and Marine Areas in 2012), Badan Lingkungan Hidup Kota Surabaya


UN-Habitat. (2012), *Sustainable Housing for Sustainable Cities: A Policy Framework for Developing Countries*, UNON, Publishing Services Section, Nairobi


-----., (2012), *Gunung Anyar Mangrove menjadi Mata Indonesia (Recent Gunung Anyar Mangrove into Indonesian Eye)*, <http://swaraguna.blogspot.com>
SUSTAINABLE SETTLEMENTS THROUGH GREEN KAMPUNG APPROACH

Rita Ernawati*, Happy Ratna Santosa**, Purwanita Setijanti**
*) Ph.D Students-Department of Architecture, ITS Surabaya
**) Lecturer-Department of Architecture, ITS Surabaya
Email: *) myreeta80@yahoo.com

ABSTRACT

Sustainable settlements is related to the fulfillment of basic human needs. Environmental issues related to how to minimize the impact of the built environment on the environment and conservation is an essential policy. This paper seeks to elaborate on one aspect of sustainable settlements with the establishment of the green kampung approach. Kampung is a form of informal settlements in Indonesia, which is able to accommodate more than 80% of the population, so that the existence of the kampung in creating sustainable settlements is essential. Qualitative descriptive analysis done by compiling primary and secondary data to formulate the basic principles of the kampung ability to transform. Surabaya chosen as the focus because it is a city that consistently protect the existence of the kampung. In an effort to create a livable settlement, the kampung in Surabaya have been transform especially in environment management. High community awareness of the importance of a healthy environment is one of the motivations in creating the green kampung. Through an integrated approach, these efforts are able to built a livable kampung not only for the present generation but for future generations as well.

Keywords: green kampung, environment, sustainable settlements

INTRODUCTION

Settlement has an important role in building the human civilization in order to provide place to meet the needs of inhabitants in the present to the future. The needs is increasing in urban areas due to urbanization, so it appears the phenomenon of informal settlements. Informal settlements are an integral part of the development in developing countries that do not have a policy of providing adequate public housing. Since the 1970s the existence of informal settlements is seen as a solution to solve the housing problem, although on the other hand is relatively poor housing conditions.

Since the end of World War II, housing development has gained significance within policy arenas in the public domain. This is partly a reflection of the shift from
warfare to welfare regimes addressing social and human development. However, it should be remembered that initial motivations driving postwar development were stemmed from fundamental aspirations to restore devastated cities. While such tendencies may be identified worldwide, the proportion of low-income households clustering in substandard settlements has continued to increase, and remains high in developing countries.

Settlements development in line with the history of world civilization experienced rapid dynamics. Failure of urban development Pruitt Igoe housing project in the United States opened up opportunities for new housing development paradigm. Since the 1970s began to develop the theory of self-help housing (housing by the people), initiated by JFC.Turner (1976) based on research conducted in the city of Lima, Peru. The existence of the home by the people is seen as a solution to solve the problem. Approach to housing development which was originally a top-down approach is transformed into a local empowerment approach (local enablement) (Badshah, 1996:11).

FRAMEWORK AND METHODOLOGY

This paper aims to elaborate the implementation of green approach in the settlements development. Green approach will focused on the kampung wich self-help developed by community. The analysis will conduct by discriptive qualitatiif, through data documentation from various resources. Based on UN-Habitat sustainable housing framework, the discussion will focused on environment, social, culture and economic dimension. The main data compiled from Surabaya City Development Board and field survey.

SUSTAINABLE SETTLEMENTS

Sustainable development is a concept that is very popular both academic and practical. After more than 20 years the idea of sustainable development appears there are at least 21.5 million web page link google and 17,000 discuss research results on sustainable development in a variety of perspectives (Lapka, et al 2009). It shows that the concept continues to evolve and become commodities for various purposes.

Sustainable development is a recognised principle for economic and social activities. Although it remains a “shifting concept” depending upon in which sustainability context it is applied and from which value position, a common ground understanding owes to the 1987 Brundtland report (WCED, 1987) and the 1992 Rio “Earth Summit”, which defined it as “meeting the needs of the present generation without compromising the ability of future generations to meet their own needs”. Sustainable development is seen as a multidimensional process that links environmental protection with economically, socially and culturally sound development. Those links are referred to as a four-dimensional approach to sustainable development, highlighting the need for a harmonious association
between environmental, economic, social and cultural dimensions (UN-Habitat, 2012).

In the context of settlement Choguill (1996) does not specifically distinguish between sustainability and sustainable development. Formulation of sustainable settlements in line with WECD, which emphasized that fulfillment is not just enough for current and future generations, but more than that. In the presented approach is based on a perspective of sustainability settlement expert, Choguill formulate that sustainable settlements is related to the fulfillment of basic human needs, environmental issues related to how to minimize the impact of the built environment on the environment and conservation is an essential policy. On the basis of practical experience in various countries, locality is very important in achieving sustainability, where local problems require local solutions. Sustainable housing not simply as units or clusters of self-sufficient “green buildings”, but as socially-enhancing and environmentally friendly residential practices integrated into the wider urban/settlement systems (UN-Habitat, 2012).

By the beginning of the 21st century the field of green architecture has changed its way in a more complex issues under green urbanism works. Beyond the traditional approaches, green architecture theory and practice have enlarged its concerns with a multidisciplinary vision. The term green architecture has enlarged its boundaries and infrastructure, technology, ecology, art network systems are combined in one total vision. In the context of sustainable planning, city sites become a major subject for designers with multivariable design lexicon, which includes the terms produced by the vocables of “re”: rehabilitation, renovation, restoration, reclamation, recovery, etc. include green structures and spaces between them. In these areas the land is covered by structures which are fundamental for green architecture. With their scale and materials, these structures have dominance on the land where they are located. Green areas have a different characteristics depend on the urban activity (Huseynov, 2011).

**KAMPUNG AND SETTLEMENTS DEVELOPMENT IN INDONESIA**

Informal settlements are an integral part of the phenomenon of development in developing countries that do not have a policy of providing adequate public housing. Globally informal settlements began to be understood as a potential in solving the housing problem in the 1970s, where the UN Habitat and several international organizations paid special attention to it. In Agenda 21 at the Earth Summit in Rio Brazil stressed the importance of the ability of local communities to provide their own housing. To achieve sustainability, empowerment needs of informal settlements in terms of the legal guarantee of the habitat, the development of the informal economy, and social capital (Peresthu, S, Tunas, D, 2005).

Kampung in Indonesia have unique characteristics that indicate the peculiarities of history, ability, effort, struggle even independent soul community, with geographic, economic, social and culturally diverse. In the urban context, *kampung* represents the concept of autonomy housing where the villagers have the freedom and authority to determine their own lives on the environment (Setiawan,
2010). According to Turner (1976) informal settlements (kampung) also represents the concept of housing as a process and as a verb, which is interpreted as an effort by the public housing development can not be seen as a one-shot process, but it is a dynamic and continuous process as the development of economic and social communities.

Roychansyah (2010) state that kampung represents a dynamic process by which groups of people largely poor in providing housing, environmental control and develop joint efforts to improve lives through mutual cooperation. Kampung has a multidimensional aspect which includes not only the physical aspects but also social, economic and culture. Kampung is closely related to the strong kinship of the city's history and growth of the city experience. Indonesian kampung existence in a substantial role in the development of the city, because kampung accommodate the housing needs of 80% of the urban population (Mc Gee, 1996 in Roychansyah, 2010).

**DISCUSSION**

*Kampung in Surabaya as Case Study*

Surabaya city formed from the kampung that developed since the Dutch, which spread from the central city to the suburbs. Based Assessment and Planning Revitalization in Kampung Surabaya conducted by City Development Board (Bappeko) in 2012 found many kampungs with varieties of unique historical, social, economic and environmental. It shows that the kampung is able to survive in line with the changing times.

Surabaya is one of the cities that are consistent in developing the kampung as an integral part of urban development. Globally, the kampung in Surabaya had been known through the successful implementation of the Kampung Improvement Program (KIP). Award has been obtained from kampung improvement efforts was The Aga Khan Award for Architecture (1986), The UNEP Award (1990), and The Habitat Award (1991). With this success, a reference to the Comprehensive KIP implemented in other regions (Solo, Pekalongan, etc.). Thailand at Baan Mankong program administered by CODI (Community Organization Development Institute) also adopted the approach of KIP in Surabaya. The success is supported by a community organization that is able to negotiate to improve the quality of the environment through good cooperation with the government and other development stakeholders (Silas, 1992).
KIP has been implemented since the colonial time and have been transformed into other programs based on community needs and urban achievement. The success of KIP should be seen integral to the development of the city. Transformation of KIP conduct by the city government. To maintain the outcome of the KIP and other program, Green and Clean was initiated in order to remain the inhabitant for always keep the kampung livable.

As the center of economic development of East Indonesia, the commercial and office building development in Surabaya are very high, especially in the city center. Site in the middle of the city become an attraction for investors to develop a range of business facilities. On the other hand, these condi-tions lead to vulnerability to the kampungs in the middle of the city to be able to compete with the market mechanism (Ernawati, et.al, 2013). Without proper management, activities in a large city such as Surabaya will cause an imbalance to the environment. Degeneration of green areas and increased waste problems which, in the long run, will impact negatively to the quality of life of the people.

**Green Kampung Approach A Step Toward Sustainable Settlements**

Surabaya have implemented green approach by conducting Green and Clean Program. This program is a community-based waste management program which covers various environmental aspects, such as domestic waste handling, betterment of water drainage, and trees planting. Since 2004 with the support of local NGO’s, the Surabaya Municipality started a community education program about waste management. The substance of the education program included how to sort organic and non-organic waste, how to make use of waste applying the principles of Reduce, Re-use, Recycle (3R). Green and Clean Program was initiated to encourage the kampung inhabitants to improve their environment quality, although many kampungs have been conducting the environment management long time before. Green and Clean program involved many agency including the kampung...
inhabitants. In 2005 the Surabaya City Government created several competitions to popularize and bring the program to a wider level and become benchmarks in waste management in Indonesia.

Sustainable housing offers a great spectrum of opportunities to promote economic development, environmental stewardship, quality of life and social equality. Meanwhile mitigating the precarious convergences of the problems related to population growth, urbanisation, slums, poverty, climate change, lack of access to sustainable energy, and economic uncertainty. UN Habitat formulate policy framework in realizing sustainable housing on a national, regional (city), and this neighborhood. The discussion in this paper covers the context of kampung development using frameworks formulated by UN Habitat. The discussion will focus on community efforts to improve the environmental quality of the kampung by green approach.

### Micro Policy Framework (Neighborhood)*  Kampung Response**

<table>
<thead>
<tr>
<th>Environmental</th>
<th>Kampung Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green design, using sustainable local construction and materials.</td>
<td>Application of the principles of the 3Rs in waste management.</td>
</tr>
<tr>
<td>Sanitation, preventing hazardous and polluting materials.</td>
<td>Adapt to a consensus in the community.</td>
</tr>
<tr>
<td>Affordable use of resources.</td>
<td>Plantation for reduce solar heat.</td>
</tr>
<tr>
<td>Improving resilience and adaptation of homes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social</th>
<th>Kampung Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empowering people and ensuring public participation.</td>
<td>Participation in environmental management.</td>
</tr>
<tr>
<td>Ensuring health, safety, well-being in residences.</td>
<td>The environment cadres, through specific trainings play role as information provider to the member of the community on how to manage household waste.</td>
</tr>
<tr>
<td>Creating a sense of community, ‘sense of place’, and identity.</td>
<td>Organizing the event together in strengthening community cohesion.</td>
</tr>
<tr>
<td>Meeting specific needs and wants in housing (including those related to gender, age and health).</td>
<td>Management of environment infrastructure in a democratic way.</td>
</tr>
<tr>
<td>Providing access to infrastructure and public spaces.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cultural</th>
<th>Kampung Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culturally responsive settlements and house planning and design.</td>
<td>Housing in the kampung is a form of identity for residents in accordance with the needs and characteristics.</td>
</tr>
<tr>
<td>Improving aesthetics, diversity and cultural sophistication of the built environment and residence.</td>
<td>Improved quality home on their own.</td>
</tr>
<tr>
<td>Helping community creativity (i.e. via amenities; affordable sporting, cultural and entertainment facilities.</td>
<td>Each kampung has a creativity and innovation in the environment development.</td>
</tr>
</tbody>
</table>
The figure below show the image of the *kampung* with the green aproach, that is able to demonstrate sustainable potential. There are four figure that represent fourth dimension of sustainable settlement by green aproach. Figure 3. show the implementation of environmental dimension by createing green *kampung*. Every inch of land in the *kampung* revegetated to create a green environment and maintain the balance of nature and make better weather.

Many *kampungs* have built communal wastewater treatment installations, based on their creativity. These installations improve environmental quality while saving the community money on water consumption. Waste management in the *kampung* conduct by family-based. This activity is done through 3R (reuse, reduce, recycle) approach. The initiative conducted by the community with the awareness for health and beautiful *kampung*. Green and clean *kampung* increasing the health quality of the inhabitant thereby increasing productivity.

The social dimension of sustainable settlements in the *kampung* is by empowering the inhabitants to increasing the quality of life. Community participation in every aspect of development was the key element. The implementation of the social dimension in *kampung* can be seen on the community participation on the environment management. Figure 4 show how the community work together in (not only the adault but also the young) collecting and shorting the...
garbage. Many activity (event) conducted to increasing social cohesion (arisan, pengajian, etc).

**Figure 4. Garbage Collection by Old and Young Community Member**

Housing in *kampung* was built by the community based on the need of every family. In the *kampung* we can find many type of housing, that represent cultural responsif of the inhabitants and level of creativity. Improving and maintaining of housing in the *kampung* conduct by the owner. The cultural dimension of sustainable settlements represent on the housing tipology and improving the quality of housing in the *kampung*. Figure 5. show the aesthetic, diversity and cultural sophistication of the housing in the *kampung*.

**Figure 5. Housing Tipology in Kampung**

The fourth dimension of sustainable settlements is economic aspect. *Kampung* represent the heterogen community in the urban area, with different social background, education level, and economic activity. By green approach many economic opportunity evolve in the *kampung*. Green kampung create new tourist destination through eco-tourism development. Inhabitant in some *kampung* have regular garbage sorting to separate the organic and non-organic waste. Composter are provided to process organic waste. Trash banks developed to accommodate the collection of un organic waste. Some types of waste developed as craft to add the
economic value. The product of the solid waste recycle have been export to Japan with support by Unilever.

Figure 6. Green Kampung that Create Economic Opportunity for The Inhabitants

CONCLUSION

Based on the above description it can be concluded that exposure to green approach in creating sustainable settlements have a large impact on many aspects including:

a. Improved health and lower incidents of illness, fatalities and material losses, better labour productivity,
b. Better conditions for human development, employment, creativity and economic growth,
c. Improved efficiency and savings on the use of energy, water and other physical resources,
d. Better environmental protection and sanitary conditions,
e. Contribution towards climate adaptation and mitigation,
f. More sustainable and socially inclusive urban growth,
g. Improve social cohesion,
h. Improved quality of life and dignity of residence,

Besides these benefits, the city government still has the challenge to expand the implementation of green approach to the entire kampung. Through innovative efforts are expected to provide a sustainable kampung devastating impact on the realization of a sustainable city. Support of all stakeholders is needed especially the community as the owner of the city. Surabaya is expected to not only be a livable city but able to even become a sustainable city for future generations.

REFERENCES


Silas, J., et.al. (2012), *Kampung Surabaya Menuju Abad XXI: Kajian Revitalisasi Penataan Kampung Kota Surabaya*, Bappeko Kota Surabaya


UCLG (2010), *Inclusive Cities Observatory, Surabaya, Indonesia: Green and clean initiative*, The Committee on Social Inclusion, Participatory Democracy and Human Rights

TREND ON THE LACK OF PRIVATE OPEN SPACE IN SEVERAL CONTIGUOUS HOUSING IN SIDOARJO

CE. Mediastika
Department of Architecture, Petra Christian University
Jalan Siwalankerto 121-131 Surabaya Indonesia
Email: eviutami@petra.ac.id

ABSTRACT

Limited proportion between built area and open space of house-lots in housing district seems to become trend in some housing. Within period of occupancy, house-owners are continuously requiring more rooms. A common solution is to transform available open space in the lot into building. Several contiguous housing in Sidoarjo Regency, comprises of low-to-medium and medium-to-high housing types was studied to learn on the trend. The study concluded that definition of low-to-medium and medium-to-high class housing was a correct term here. In average, respondents had duration of occupancy of 15 to 20 years and most were undertaken housing extension. From 83 respondents out of 170 suspected houses of having insufficient open space was significantly proved that the extension leaved open space toward 0%. This means that lack of private open space is a factual trend here. When lack of open space is a trend, we may easily suspect that green open space is in similar term.

Interesting phenomenon was found that apart from good level of early and prior awareness on the necessity of open space, average respondents had significantly lower early knowledge on the importance of open space especially in term of providing rainwater absorption bed. Their knowledge increased gradually currently. However, their current knowledge was still lower than their awareness. This finding is expected to be useful in planning further stage of community outreach to give informal lecture among community due to actual procedure in fixing open space inexistence, especially to further generation.

Keywords: house-lot, house extension, open space

INTRODUCTION

Demand on more and bigger room within house has triggered house-owner to extend their house both horizontally and vertically. Unprepared building substructure to bear additional upper structure of two-storey or more buildings leads to horizontal extension as a trend. Horizontal building extension on limited house-lots of housing resulted in insufficient open space. This seems becoming trends in
Indonesian house-lots. The trend was suspected as a cause of limited awareness and knowledge among house-owners on the necessity of green open space or simply open space around houses.

House with sufficient open space will gain many benefits, such as day-lighting and natural ventilation for most of its inner rooms. When the open space is green, it will also provide absorption bed for rainwater harvesting which is constantly redundant during rainy season in Indonesia. House without sufficient open space has significant contribution to local puddle. When houses with insufficient open space are majority in a housing region more puddles toward flood are likely to happen.

Issue and discussion on green open space or open space within private property is very limited. We mostly discuss on the necessity of public green open space and slightly disregard the benefits of private green open space or just open space (OS). A green OS in a private lot is never been any bigger than that of public OS. But, a multiple effects of this insignificant dimension will play a role on the availability of sufficient open space for urban region. That is, a research to study the main cause of lack of private OS is reported here.

OBJECTIVE

The study was aimed to learn on how house-owners having decision on extending their house. In detail the study would see whether there is any correlation among buildings’ extension and duration of occupancy, economic class or income, awareness and knowledge on the necessity of private OS. The finding will be use to educate younger generation on the importance of OS through informal classes.

THEORETICAL APPROACH

Study by Lacy (1990) has reported that clustered houses with protected OS were appreciated higher by market than those of single conventional housing with larger private yards. This case might not be similar to that in Indonesia. It is suspected that housing with both public open space and sufficient private OS is more appreciated and expected here. This opinion is supported by Connel and Walls (2005) who revealed that OS values are case study–specific. Particular OS area or set of areas is unique to a particular region and time period. Notions of beneficial effects of nearby green space have persisted throughout history, especially to improve people's health and well-being by providing restoration from stress and mental fatigue (Groenewegen, 2006). A research comparing residents with a view of urban greenery to residents without such view showed that those with view gain better well-being (Kaplan, 2001). Moreover, a research has shown that views of nature can improve feelings of neighborhood safety and even lead to decreases in aggression and crime rates (Kuo and Sullivan 2001 a and 2001b). With these so many benefits, it is expected that house-owners are aware and possess knowledge on how OS shall be provided within house-lots. Awareness and knowledge is expected to be effective instrument to fix the trend.
METHODS

The study was conducted as quantitative field survey. Questionnaire was developed as an instrument to collect the data. Respondents were limited to house-owners of several contiguous housing in Sidoarjo, Indonesia. It was Wisma Beringin, Kemendung Indah and Citra Harmoni (Figure 1, Figure 2, and Figure 3). The first two housing was expected to represent low-to-medium class housing, whilst the last was for medium-to-high class housing. The housings were selected based on the constant issue of the existence of local puddle during rainy season. Borderless-contiguous mixed of low-to-medium and medium-to-high class housings was also an issue to determine the research site. Richness of housing types will benefit the study to learn whether monetary factor exists toward decision on building extension.

Figure 1. Research site.

Figure 2. Contiguous housing of research site.

The questionnaire was developed using Likert’s scale-like method, as the Likert’s might not be use in full term. Likert’s scale is a widely used method to study people’s opinion on such issues. It usually scores from nethermost to
uppermost, such as from “very disagree” to “very agree”. It may be scaled from 1 to 5 or 1 to 7 for more detail. As this study was not merely learning on people’s opinion, but more of studying on the causal effects of an action, the Likert’s was modified to fit the expected data. However, the modification was developed as close as possible to the Likert’s.

![Example of house in Kemendung Indah Residence with full-front roofing. The roofing exaggerates on to the street kerb side.](image)

**Figure 3.** Example of house in Kemendung Indah Residence with full-front roofing. The roofing exaggerates on to the street kerb side.

There were dependent and independent variables prior constructing the questionnaire refer to Table 1. The dependent was building extension on the house-lots, whilst the independents were duration of occupancy, monthly income, and early and current awareness and knowledge on the necessity of green OS. These variables were generated within a set of questions. Answers options were constructed based on easiness, as questionnaire was not interviewed but self-filled by respondents. Comprehensive instruction to fill and pick answers was written before the question lists and delivers orally during distribution. The self-filled method was selected upon time availability of the respondents. Most respondents spend their time working elsewhere and thus very limited time for enumerator to conduct interview. That is, self-filled method was considered more appropriate to gain as many as possible respondents. Checking for errors or bias answers were carried out during collection of filled questionnaires, so as to be directly confirmed to the associated respondent. It was 100 questionnaires distributed, and 83 were returned.

It is written on the questionnaire that the questionnaire was suggested to be completed by family-head to minimize error. In Indonesia, family-head usually husband/father or wife/mother. Options of answers were designed so as to be perceptible by various knowledge backgrounds. Prior to the main survey, pre-survey was conducted by distributing 5 questionnaires to those who were not respondents to be. From here some correction were made toward perfect questionnaire. The questionnaire was constructed sequentially. First was to gain personal data consist of position in family, age, income, and duration of occupancy. Second was to gain data of housing-lots consist of housing-lots dimension, early building dimension, and current building dimension. Current housing-lot was not asked considering that expansion of housing-lot was very rarely to happen. Third was confirmation on
whether any expansion was done by respondents or by previous occupants. Forth was awareness and knowledge on the necessity of OS and the procedure to allocate it.

Variables of respondents’ economical background was asked in term of respondents’ monthly income, scaled from average of Indonesian lowest income to the possible highest income of the site. Age and duration of occupancy were constructed as opened-question to gain actual data rather than a closed question. Question of lot and housing dimension were also asked as opened questions for similar reason. The answers collected were then to be stratified in the analysis. Awareness and knowledge were asked as closed-question with option of answers was “was not aware” and “aware”; “do not possess knowledge” and “possess knowledge”. Those who possess knowledge should continue to the next opened-question on how rainwater to be channeled. Each was scored 0 to 3 respectively. Information on questionnaire concepts and how variables were elaborated within questionnaire is presented in Table 1.

Table 1. Concept and variables determination.

<table>
<thead>
<tr>
<th>No.</th>
<th>Concept</th>
<th>Variables</th>
<th>Term</th>
<th>Answer options</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“OS” determinants (X1)</td>
<td>Duration of occupancy (X1)</td>
<td>n.a.</td>
<td>a. 0-5 years</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b. 5.1-10 years</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>c. 10.1-15 years</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>d. 15.1-20 years</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>e. 20.1-25 years</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>f. &gt; 25.1 years</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Building extension (X2)</td>
<td>Building extension</td>
<td>n.a.</td>
<td>a. Extending with no remaining “OS”</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b. Extending with remaining “OS”</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>c. No extension</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>“OS” to building ratio (X3)</td>
<td>“OS” to building ratio</td>
<td>n.a.</td>
<td>a. &lt; 40%*</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b. ≥ 40%</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Monthly income (X4)</td>
<td>Monthly income</td>
<td>n.a.</td>
<td>a. &lt; 2 million IDR</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b. 2-5 million IDR</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>c. 5.1-10 million IDR</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>d. 10.1-15 million IDR</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>e. &gt; 15.1 million IDR</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Awareness (X5)</td>
<td>Awareness</td>
<td>Early</td>
<td>a. Was not aware</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b. Aware</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Current</td>
<td>Current</td>
<td>c. Was not aware</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a. Aware</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Knowledge (X6)</td>
<td>Knowledge</td>
<td>Early</td>
<td>a. Do not possess knowledge</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b. Posses Knowledge</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Current</td>
<td>Current</td>
<td>c. Do not possess knowledge</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a. Posses Knowledge</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: *40% was set as benchmark due to generally used of ideal OS to building ratio.
The questionnaire was distributed half randomly, as this was intentionally studying houses with suspected insufficient OS within lots. In the low-to-medium housing, it was found that from the entire 150 houses; 90 house-facades indicated that open space was insufficient. Fifty two of the “insufficient OS” were surveyed. In the medium-to-high housing, questionnaires distribution was narrowed to housing block of small lots, as those with large lots appeared to have large OS and thus did not fit the research scope. From the entire 160 small-lots houses, it was found that 80 houses indicated insufficient OS within lots. Thirty one of the “insufficient OS” were surveyed.

RESULT AND DISCUSSION

It was 100 questionnaires distributed proportionally among selected housings, and 83 were returned. This was also in good proportion between the low-to-medium and the medium-to-high class housing. That is 52 of low-to-medium cost housing and 31 of medium-to-high class housing. The data extracted from questionnaire result was reviewed statistically and the result is presented in Table 2. Data’s validity was tested using correlation test, and was found that 2 questions were not valid and should not be used for further analysis. The reliability was tested using Cronbach’s alpha and was resulted 0.43 which is considered quite reliable (Urdan, 2010).

Table 2. Summary of Data’s Statistical Review

<table>
<thead>
<tr>
<th>Statistical term</th>
<th>Duration of occupancy</th>
<th>Building extension</th>
<th>Early OS to building ratio</th>
<th>Current OS to building ratio</th>
<th>Income</th>
<th>Early awareness on OS necessity</th>
<th>Current awareness on OS necessity</th>
<th>Early knowledge on OS necessity</th>
<th>Current knowledge on OS necessity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>2.27</td>
<td>0.81</td>
<td>0.75</td>
<td>0.03</td>
<td>1.42</td>
<td>0.82</td>
<td>0.86</td>
<td>0.11</td>
<td>0.43</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.22</td>
<td>0.04</td>
<td>0.05</td>
<td>0.02</td>
<td>0.12</td>
<td>0.04</td>
<td>0.04</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>Median</td>
<td>2.00</td>
<td>1.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Mode</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>1.98</td>
<td>0.40</td>
<td>0.44</td>
<td>0.15</td>
<td>1.06</td>
<td>0.39</td>
<td>0.35</td>
<td>0.31</td>
<td>0.50</td>
</tr>
<tr>
<td>Variance</td>
<td>3.90</td>
<td>0.16</td>
<td>0.19</td>
<td>0.02</td>
<td>1.12</td>
<td>0.15</td>
<td>0.13</td>
<td>0.10</td>
<td>0.25</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>-1.55</td>
<td>0.53</td>
<td>-0.68</td>
<td>38.73</td>
<td>-0.05</td>
<td>0.88</td>
<td>2.29</td>
<td>4.69</td>
<td>-1.97</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.16</td>
<td>-1.59</td>
<td>-1.16</td>
<td>6.30</td>
<td>0.59</td>
<td>-1.69</td>
<td>-2.06</td>
<td>2.57</td>
<td>0.27</td>
</tr>
<tr>
<td>Range</td>
<td>5.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>4.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Maximum</td>
<td>5.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>4.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Sum</td>
<td>188.00</td>
<td>67.00</td>
<td>62.00</td>
<td>2.23</td>
<td>118.00</td>
<td>68.00</td>
<td>71.00</td>
<td>9.00</td>
<td>36.00</td>
</tr>
<tr>
<td>Count</td>
<td>83.00</td>
<td>83.00</td>
<td>83.00</td>
<td>83.00</td>
<td>83.00</td>
<td>83.00</td>
<td>83.00</td>
<td>83.00</td>
<td>83.00</td>
</tr>
<tr>
<td>Largest(1)</td>
<td>5.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>4.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Smallest(1)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>
By Table 1 and Table 2, we may learn that average duration of occupancy is 2.27. Converted to answer’s options, this value is duration of occupancy between 10.1 to 15 years. Discrepancy of duration of occupancy between low-to-medium cost housing and medium-to-high cost housing is presented in detail by Figure 4. As the medium-to-high class housing was relatively newer in operation (15 years later), residents were also mostly newer than those of the low-to-medium class housing, which was inhabited approximately 28 years ago.

By Table 1 and Table 2 we learn that monthly income variable should be disregarded for further analysis in association to other variables as it is not valid, but by Figure 5, we learn that what was suspected as to be low-to medium and medium-to-high class housing was correct by factor of income.

![DURATION OF OCCUPANCY](image)

**Figure 4.** Duration of occupancy between low-to-medium and medium-to-high cost housing
By Table 2, we learn that current OS to building ratio is not valid in statistical term, this was suspected to be caused by the 0 score which was spread evenly throughout the data. This term is supported by Figure 6 that describes the average and the mode of early OS to building ratios were 0.75 and 1.00 (associated to Table 1) which is toward sufficient OS. On the opposite, both average and mode of current OS to building ratios were 0.03 and 0.00. This is made clearer by Figure 7 that presents factual data of OS to building ratio in percentage (%). Within earlier occupancy, it was 50% in average which then sharply descend to 0% all.

**Figure 5.** Monthly income between low-to-medium and medium-to-high cost housing

**Figure 6.** OS to building ratio of early and current.
On the awareness point of view, we may be happy to learn that in average, respondents were having good score toward awareness on the necessity of OS (Figure 8). However from knowledge point of view, we learn on something slightly worse. Both early and current knowledge was of lower score than the awareness. The average of current knowledge ascends from early knowledge, but the mode was constantly at 0 score (Figure 9).

![AVERAGE “OS” TO BUILDING RATION IN %](image)

**Figure 7.** OS to building ratio of early and current in actual percentage.

![AWARENESS](image)

**Figure 8.** Respondents’ awareness of early and current.
Relationship of duration of occupancy and other variables may be studied using Table 3. In total, we see that building extension occurred more to those with longer occupancy period. From early OS to building ratio point of view, we learn that those with shorter occupancy period having lower ratio. This may mean that duration of occupancy do not always correlate to insufficient OS. From current OS to building ratio point of view, we see that insufficient OS happened in all period of occupancy. Early awareness and current awareness remain similar in all period of occupancy. From knowledge point of view, those of shortest period of occupancy seemed to be not having early knowledge due to necessity of OS. Later, the knowledge seemed to be evenly developed, with the highest point is at those of 15.1 to 20 years duration of occupancy.

Table 3. Duration of occupancy associated with other variables.

<table>
<thead>
<tr>
<th>Duration of occupancy (years)</th>
<th>Building extension</th>
<th>Early OS to building ratio</th>
<th>Current OS to building ratio</th>
<th>Early awareness</th>
<th>Current awareness</th>
<th>Early knowledge</th>
<th>Current knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>0.62</td>
<td>0.58</td>
<td>0.04</td>
<td>0.73</td>
<td>0.77</td>
<td>0.00</td>
<td>0.27</td>
</tr>
<tr>
<td>5.1-10</td>
<td>0.60</td>
<td>0.40</td>
<td>0.01</td>
<td>0.90</td>
<td>0.90</td>
<td>0.10</td>
<td>0.30</td>
</tr>
<tr>
<td>10.1-15</td>
<td>0.78</td>
<td>0.89</td>
<td>0.11</td>
<td>0.78</td>
<td>0.89</td>
<td>0.11</td>
<td>0.44</td>
</tr>
<tr>
<td>15.1-20</td>
<td>1.00</td>
<td>0.80</td>
<td>0.00</td>
<td>1.00</td>
<td>0.90</td>
<td>0.20</td>
<td>0.70</td>
</tr>
<tr>
<td>20.1-25</td>
<td>1.00</td>
<td>0.90</td>
<td>0.00</td>
<td>0.90</td>
<td>0.90</td>
<td>0.10</td>
<td>0.60</td>
</tr>
<tr>
<td>&gt; 25.1</td>
<td>1.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.78</td>
<td>0.89</td>
<td>0.22</td>
<td>0.50</td>
</tr>
</tbody>
</table>
By Figure 10, we may learn that there was some disparities existed between low-to-medium and medium-to-high class housing. In most issues, those of low-to-medium class possess higher score than those of medium-to-high class housing. However, the disparities is insignificant, with issue of early OS, early knowledge and current knowledge are exception. Figure 10 reveals that medium-to-high class housing possesses significant lesser OS than medium-to-high class. The low-to-medium class housing also possess significant higher early and current knowledge.

Figure 10. Disparities between low-to-medium and medium-to-high class housing.

CONCLUSION AND RECOMMENDATION

This study concluded that definition of low-to-medium and medium-to-high class housing was a correct term here, based only on respondents’ monthly income. Disparities between the two were existed regarding issue of early OS, early knowledge, and current knowledge. Eighty three respondents out of 170 (almost 50%) houses that were suspected having insufficient OS also proved here. This finding may lead to further finding that housing expansion with lack of OS is a trend here. When lack of OS was a trend, we may easily suspect that green OS was of similar term.

Interesting phenomenon was found that apart from good level of early and prior awareness, average respondents were having significantly lower knowledge. Their knowledge increased gradually currently. Sadly, their current knowledge was still lower than their awareness. This finding is expected to be useful to plan further action of community outreach to informally educate communities due to actual procedure of fixing OS inexistence, especially to further generation.
Due to disparities between low-to-medium and medium-to high class housing on respondents’ early and current knowledge, further research is recommended to study this issue.

REFERENCES


RESIDENTIAL COMFORT LIVING ON FLAT FOR URBAN COMMUNITY/ FAMILIES LOW INCOME

Luluk Mawardah*, FetiMayasari*, BriantitoAdiwena*, Happy Ratna**

*) Master Student, Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
** Lecturer and head Laboratory of Housing and Human Settlement, Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
e-mail: happyratna@yahoo.com, news4lm@yahoo.co.id

ABSTRACT

Dupak Bangunrejo Area located in Kelurahan Dupak Bangunrejo, Kecamatan Krembangan was a slum area. There were a lot of problems in this slum area started from less security, flood, means and facilities, lack of attention to health up to the resident bahavior tended to not care to the environment in its surroundings. Dupak Bangunrejo Flat was built in 1989 in order to accommodate the resident who lived in slum area. In this new residential location, they get better facilities and environmental quality that much better than before. Maslow theory about hierarchy of needs and SHE city concept become the basis used to show to what extent the comfort obtained by the occupant by the existance of the new resident using vertical pattern. The objective of this research is to know to what extent the residential comfort of Dupak Bangunrejo Flat will be known.

Keywords: Comfort, Environmental Quality, Flat, MBR (low Income Families).

INTRODUCTION

The development of Flat is one of the alternatives to solve the problem of housing and settlement especially for urban area having population rate that continue to increase, because it can reduce the use of land, create legal open spaces for city and may be used as a method to renew the city in slum area. The low cost apartment development provided for weak economic category need a proper architectural design in order to get physical design for fulfilling the need of house that not only
cheap but also proper to be occupied and human as well as improving environmental quality.

The development of Rented Apartment of Dupak Bangunrejo was built on the state property land. In the past, this land was a kampung settlement having dense population rate and unhealthy environmental condition. From economic point of view, most of the resident of Dupak are categorized as community having low income and impermanent who work in informal sector. The system of this flat development is provided for the resident of kampung whose house was demolished due to city renewal (Wiwik, 2003).

The development of Rented Apartment of Dupak Bangunrejo was initiated by the Regional Government of Surabaya Municipality in cooperation with expert team of ITS Surabaya. At the time of developing the building, the resident whose house was demolished was provided boarding house in another place. This development was performed in two stages (Wiwik, 2003), namely:

1. 1st (First) Stage (1988/1989), built 2 (two) blocks, namely A Block and B Block. Every block consisted of 3 (three) stories accommodating 25 flat units with size of 18m² (3.0 m x 6.0m), the number of unit in every block was 9 (nine) for Ground Floor/1st floor and 8 (eight) for 2nd and 3rd floor.

2. 2nd (Second) Stage (1990/1991), built 4 (four) blocks, namely C Block, D Block E Block and F Block. Every block consisted of 3 (three) stories accommodating 25 flat units with size of 18m² (3.0 m x 6.0m), the number of unit in every block was 10 (ten) for Ground Floor/1st floor, and 8 (eight) for 2nd and 7 (seven) for 3rd floor.

According to Abraham Maslow (1973), human beings have 5 (five) levels of life needs that always be fulfilled throughout their life. 5 (five) levels differentiating
every human beings based on life prosperity point of view. According to Maslow, 5 (five) levels of basic needs are as follows:

1. Physiological Needs
   These include the biological needs, such as the need of oxygen, food, water and body temperature that is relatively constant. They are the sturdy needs because they must be fulfilled in order to find satisfaction.

2. Security Needs
   When all the physiological needs are satisfied and not taking control the mind and behavior, security needs may become active. Adult has little awareness about their security except for emergency or at the time of disorganization period in social structure (such as wide riot). Children usually show unsecured signs and need sense of security.

3. Belongingness and Love Needs
   When the needs for physiological safety and prosperity are satisfied, the next level of needs for love, affection and belongingness may emerge. Maslow stated that people need it to overcome the feeling of loneliness and alienation. These include the two and accept love, affection and give sense of belonging.

4. Esteem Needs
   After the first three needs have been satisfied, esteem needs becomes increasingly important. These include the need for things that reflect on self-esteem, personal worth, and appreciation from other people. Human beings have a need to be firm, based on high level of self stabilization and respect from other people. When this need is fulfilled, people will feel confidence and worth in the world. And when the frustration comes, people feels humiliated, week, powerless and unworthy.

5. Self Actualization Needs
   When all the needs above are satisfied, the self actualization needs will be activated. Maslow described the self actualization as what a man can be and do what a man can do. The separation of needs does not mean that each of them work exclusively, but overlapped so that people are motivated by two needs or more. There are no two persons whose basic needs are 100% satisfied. Maslow predicted the satisfaction of person in general (Table 1), (Lisa, 2001):

<table>
<thead>
<tr>
<th>No</th>
<th>Needs</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Physiology</td>
<td>85%</td>
</tr>
<tr>
<td>2</td>
<td>Security</td>
<td>70%</td>
</tr>
<tr>
<td>3</td>
<td>Belongingness and Love</td>
<td>50%</td>
</tr>
<tr>
<td>4</td>
<td>Self Esteem</td>
<td>40%</td>
</tr>
<tr>
<td>5</td>
<td>Self Actualization</td>
<td>10%</td>
</tr>
</tbody>
</table>

Source: Lisa, 2001
METHODS

This research uses qualitative method and data is collected by in-depth interview. The researchers perform direct observation to location to get written or verbal data that further will be used as analysis materials related to Maslow theory. The theory limitation of this research is Esteem Needs. The following details the methodology undertaken by researchers based implementation phases are as follows:

1. Doing literature review of studies for research reference
2. Doing field surveys (field observations and conduct depth interviews with occupants), includes:
   - Observation conditions and infrastructure in Rusun Dupak Bangunrejo
   - Observation of the psychological and social aspects of environmental changes that occurred be physical and non-physical
   - Observation of the changes in home design and completeness of the supporting infrastructure which affects the psychology occupants
3. Qualitative analysis based on Maslow's theory (about the level of basic needs) to determine the level of satisfaction of the needs of residential Rusun viewed from the occupants Dupak Bangunrejo
4. Give the conclusion as the analysis of the object of observation

RESULTS AND DISCUSSION

Based on field observations indicate that the initial conditions in the Rusun Dupak Bangunrejo is a slum area with a low economic level of the occupants and the location is in the river banks. It is necessary to repair with ‘vertical housing’ system in order the occupants get a livable housing with representative number of units to accommodate all the occupants. In principle, the development of Rusun Dupak Bangunrejo is a slum improvement efforts with the following concepts:

1. Ownership housing units in Rusun Dupak Bangunrejo adjusted with an area of land plots owned by the villagers
2. Design of Rusun Dupak Bangunrejo adapted to the activities and social conditions of occupants
3. Most of design and material RusunDupakBangunrejo also consider the concept of Green Building

In accordance with purpose of the study, performed some analysis related to changes in the level of housing needs due to repairs the physical and non-physical environment that have been made in the construction of Rusun Dupak Bangunrejo, such as:

The Changes of Residential Comfort in Flat Due to Living Means and Facilities Services Improvement

Based on the theory of hierarchy of needs made by Maslow started from lower level, there are physiology, safety, social, esteem and self actualization needs (Haryanto, 2010).
1. Psychological Aspect

Psychological aspect can be seen from the human behavior in making self adaptation to its surroundings, psychological aspect is related to social change and condition. The observed psychological aspect on this Dupak Bangunrejo Flat is how the way of individu in making adaptation and interaction with its surroundings. This aspect can be seen from the satisfaction of occupants living on Dupak Bangunrejo flat to all means and facilities, infrastructure related to comfort. The change of flat residential comfort can be seen from the condition before and after the development of flat.

The condition of physical environment before the development of flat can be seen below:

a. Limited means and facilities supplies
   Before the development of this flat, this area was slum kampung that a part of it was swamp. This condition made them feel uncomfortable. The slum condition as such situation of course will cause bad health.

b. Not very much water supply
   Most of the resident of this kampung use well water, even they use water from river for personal needs. This will disturb the comfort. The clean water was not distributed evenly.

c. Flood Prone
   There are a lot of resident behavior that often throwing the garbage carelessly. Such habit will cause flood due to clogged pipe. This make the condition more uncomfortable for resident living on the surrounding of this slum area. Many diseases will invade this settlement.

d. Less healthy environment
   As explained before, this area was slum settlement, of course, the residents were forced to live in this area with minimal facilities.

Physical Environment

a. Availability of flexibility
   At the time of occupying slum area, they have more freed flexibility because the residential location that not to close as in flat unit.

   The following shows the condition after the development of flat consisting the physical aspec. The condition that happen at present time shows better condition therefore the occupants feel more comfortable living on flat area.

b. Sufficient means and facilities and utilities supplies
   Since the Dupak Bangunrejo flat was built, the means and facilities availability are more completed. This is to facilitate all occupants, so that they feel comfortable with the limitation they have, especially from the economic aspect. Most of flat occupants work in informal sector such as driver, merchant and et cetera.

c. Drainage facility supply to control flood/ puddle in Dupak Bangunreja Flat and its surroundings
This flat was supplied with drainage for rainfall pipe completed with 2 water doors (at present, they can not be functioned). This pipe is functioned to drain the water from rainfall runoff discharge from some areas in the surrounding of flat, so that the significant flood will not be happened as before the development of flat. (Fig. 2).

**Figure 2.** Illustration of Rusun Dupak Bangunrejo location that become the rainfall runoff discharge for its surrounding area.

d. The settlement environment that become clean and health free from wild resident and untreated vacant land.

At the time of developing this flat, the swamp was filled up in order to improve the environmental quality of flat, therefore all wild house along the swamp and shore were demolished and cleaned away. For more clear explanation about the change of settlement environmental quality in Dupak Bangunrejo flat see Fig. 3.

**Figure 3.** The change of settlement environmental quality of Rusun Dupak Bangunrejo.

But, there is negative aspect in relation to the development of the new flat that cause discomfort because of building design. Patent flat design that can not be adjusted to the wish of occupants may cause discomfort. The stair layout of flat, namely A block and B block that first built in 1989 adjoining
to the residential unit may disturb the comfort of the occupant who lives close to stair. The material of stair that from iron cause high noise. (Fig. 4).

![Figure 4](image.png)

**Figure 4.** stair area causing discomfort for the occupants

Non Physical Environment

a. The simplicity of flexibility area living in flat is different with the flexibility of living in its house. This will influence the habit/ activity of the occupant that must be adjusted to the condition of its living at present time. The system of a good set of values and layout by paying attention to the need of flexibility will make Dupak Bangunrejo flat as a home for the occupants by applying a smart concept (Silas, 2012) in organizing the layout of a room.

b. The change of Attitude and Behavior

The simplicity of process in obtaining basic facilities, such as water, sanitation, drainage, public bathroom and, public kitchen and trash processing make the occupant must change their old habit and adjust to the present condition at the time of using the basic facilities together. This is in the SHE city concept (Silas, 2012) that is in relation to environmental ecology with economical consumption pattern in using energy.

2. Safety

Besides the comfort in the matter of psychological and social needs above, the existence of Dupak Bangunrejo flat cause the change of comfort in the aspect of security. The means and facilities to guarantee the security of the occupants of this flat are completed, eventhough the quality of it needs to be improved and increase, such as drainage pipe, water door, security post, flat building is a permanent building having quite strong construction.

3. Social

When the physiolgical and safety needs are satisfied, social needs related to belongingness and love needs will emerge. This need is related to sense of
relationship, sense of high toleration between neighborhood, sense to be loved and affected and desire to help each other.

Before the development of flat, social aspect related to physical and non physical environment do not support them to get belongingness and love needs especially between the neighborhood.

a. Physical Environment
   The old settlement is not completed with public facilities, so that no place for them to make social activity together. Before becoming a flat, the house yard in the kampung is not used as communal activity with the neighborhood, because they tend to make activity in the house.

b. Non Physical Environment
   They rarely to come together and make social activity with the neighborhood. After doing their respective daily activities, they make their own activity together with their family in the house. The behavior of teenage and children are less directed to positive matters, because the resident has a poor sense of toleration and tend to ignore each other.

After the development of flat, some changes happen that can be seen from the physical and non physical aspects. The development of flat that completed with public facilities make the resident have the place to do social activity started from old age up to children.

After the development of flat, the significant changes happen, especially in relation to social relationship among the occupants, such as:

a. Gathering of men
   By developing this flat, the residents, especially the flat occupants may gather up to late. This thing surely gives positive effect to make the kampung secured.

b. Family atmosphere that getting increase among the occupants
   After Dupak Bangunrejo flat was built, the family atmosphere among the occupants gets increased. On every unit of this flat is provided with terrace, this place becomes area for the occupants to chat and communicate each other.

c. High sense of toleration among the occupants
   Unit provided in every flat is adjacent each other. This surely make them have high sense of toleration in order to not disturb each other.

d. Resident gathering or meeting
   The occupant hold a routine meeting once a week, PKK (twice in a month), pengajian (once a week), cooperative, TPQ (every day for children and adult).

e. Reading interest improvement for children through colportage.
   The colportage in area of Dupak Bangunrejo flat that was built become one with pavilion may improve the reading interest of children and direct the children to have more positive activity.
The Changes of Residential Comfort in Flat Due to Living Means and Facilities Services Improvement

Besides the comfort in the matter of psychological and social needs above, the existence of Dupak Bangunrejo flat cause the change of comfort in the aspect of security. The means and facilities to guarantee the security of the occupants of this flat are completed, even though the quality of it needs to be improved and increase, such as drainage pipe, water door, security post, flat building is a permanent building having quite strong construction. The comfort of security aspect in Dupak Bangunrejo flat includes:

1. Physical Security
   a. Safe from natural disaster (fire, flood)
      The condition of Dupak Bangunrejo flat at present time may be free and safe from flood (in the past, before being revitalized to be flat, this settlement was rainfall runoff discharge which cause flood and puddle). This happens because Dupak Bangunrejo flat is completed with drainage pipe system integrated with its surrounding area, such as completed with tertiary drainage pipe having quite big capacity to collect the rainfall runoff discharge from its surrounding area. For more detailed explanation see the picture below:

   ![Figure 5. Drainage Pipe](image)

   b. Safe from animal attack/physical disturbance from outside
      Flats Dupak Bangunrejo also safe from animal attacks/physical disturbance from the outside because the material has a permanent home, so as to protect the occupants from heat, cold, wild animals and so on.

2. Non-Physical Security
   a. The security of social conflict (internal and external)
      During this time, Dupak Bangunrejo flat is free from significant social conflict happened in flat (between occupant or its surrounding resident). This happens because the occupants have quite high sense of toleration, besides it is a comfortable living for its occupants. In this matter, Dupak Bangunrejo flat is completed
with socialization room/ space for tightening the relationship between the local residents in the form of pavilion and hang out place. But, the flat needs to be completed with psychological clinic to anticipate the social conflict happen in future.

b. Safe from crime
Dupak Bangunrejo flat is completed with security post that may guarantee the security of the occupants from crime, especially the act of stealing. Besides, sense of family relationship and togetherness between the occupants have become the factors causing the establishment of security for the occupants against crime action happened internally and externally.

The occupants have sense of secured to have activity and creation, in this matter, Dupak Bangunrejo flat is also completed with means and facilitates that may guarantee the security of the occupants non physically to develop the local potential and actualization as well as community expression, such as facility in then form of pavilion, reading room and library, musholla completed with TPQ and also commercial place. So that some facilities are used by the occupants as a place to have social activity and make creativity especially for children and productive age.

The Improvement of Identity of the Occupants Due to Residential Environmental Quality Improvement in the Flat

The relocation from slum settlement to Dupak Bangunrejo flat has also influenced the identity improvement of the occupants especially recognition from its surrounding residents and the Government of Surabaya City to the existance of the occupants.

1. Before Being Relocated to Dupak Bangunrejo Flat
Before being relocated, this slum settlement have negative image as slum, poor, dirty and unhealthy area, social gap and limited means and facilities. Based on the result of interview with the residents, it is known that the image has influenced the social status and self confidence crisis of the local residents. Besides, the attention of the Government of Surabaya city concerning the need means and facilities is less, because the problem of this slum settlement is very complex that need a quite complex solution with the aid from all stakeholders. This condition make the resident of this slum settlement feel pessimistic to survive in the big city area such as Surabaya.

2. After Being Relocated to Dupak Bangunrejo Flat
After being relocated, the image of this settlement has become positive as clean and health area that have high harmony and solidarity between the occupants and completed with settlement means and facilities based on the occupants’ needs in
developing the quite big potential owned by the occupants to help the improvement of family economic.

Based on the result of interview to the occupants of A Block up to F Block, it is gotten information that the formed image has influenced the improvement of social status and high self confidence. Besides, the attention of the Government of Surabaya city to the needed means and facilities is quite good, this happens because the management of flat has made optimal monitoring to the operational of Dupak Bangunrejo flat. The occupants of the flat feel the benefits of some available facilities such as worship place (musholla in flat and mosque), polcoltrage, pavilion as health post and other social activity, interaction room in every block of flat. There are also some special social aid for the occupants of flat, such as free medicine, basic food allowance for elders, and et cetera.

This condition improves the status and self confidence for the occupants of flat that finally may cause sense of optimistic to survive in the big city area such as Surabaya.

CONCLUSION

The existence of Dupak Bangunrejo flat that become one of the efforts of relocating slum settlement by the Government of Surabaya city cause positive effect for the occupants of Dupak Bangunrejo flat who categorized as Community having Low Income of Surabaya city, such as in the form of comfort of living for the occupants of flat from physical, social or psychological aspects.

One of the theories used in this research is theory of hierarchy by Abraham Maslow showing the priority level of needs concerning residential will form hierarchy started from lowest up to highest level, in this matter, there are 5 (five) levels, namely: physiological needs, security needs, social needs, esteem needs (self recognition from other people), and self actualization needs. Based on the approach, this theory shows that relocation of slum settlement to Dupak Bangunrejo flat cause the changes of hierarchy of needs for the occupants of flat. When the occupants lived in slum settlement, the fulfilled needs only in the lowest hierarchy, namely physiological needs (the basic needs concerning residential located in settlement environment having limited means and facilities). But, when the occupants live in Dupak Bangunrejo flat, they get comfort from the level of physiological needs, security needs, social needs up to esteem needs. The priority level of needs for the occupants of Dupak Bangunrejo flat happens due to the improvement of means and facilities completeness in flat and construction of flat that is adjusted to social culture of the occupants so that the occupants will feel not only comfortable and secured but also to be recognized and noticed by the surrounding resident or government of Surabaya city toward the status of the occupants of flat that altogether will cause the improvement of means and facilities of flat and improvement of prosperity for the occupants of flat.
REFERENCES


THE APPLICATION OF THE CONCEPT OF ECO GREEN-TOURISM IN DEVELOPING THE TOURIST VILLAGE THROUGH THE LOW IMPACT DEVELOPMENT

Wiwik Setyaningsih*, Tri Yuni Iswati**, Sri Yuliani***
*) Department of Architecture, Sebelas Maret University, Indonesia
**) Department of Architecture, Sebelas Maret University, Indonesia
***) Department of Architecture, Sebelas Maret University, Indonesia
e-mail: wiwikhermono@yahoo.co.id

ABSTRACT

The concept of green eco-tourism is a concept of regional development for environmentally sustainable tourism activities. Tourism activities have a significant effect on the development and improvement of the economic, social, cultural sectors and the quality of the surrounding environment which subsequently causes the global issue of World Tourism Organization (WTO) to emerge. It is then relevant to apply the concept of eco-green tourism in developing the strategic areas intended for tourism in line with the program of the government of Surakarta city which aims at developing the city within the concept of eco-culture city.

Some tourist villages (kampung wisata) with local wisdom potentials as the historical areas in Surakarta city are still not handled optimally. This trend can be seen in some of areas which have begun to lose their original characteristics and have even changed function. This phenomenon will slowly and certainly erode the local wisdoms of the historical villages which will eventually cause the unique characteristics as the local potentials of the city to disappear. Therefore, one of the right and integrated actions to handle such a problem is the research model of development of the tourist villages through LID (Low Impact Development) by having the concept of eco-green tourism.

The objective of this research is to formulate the model of development of the tourist villages through LID (Low Impact Development) in bringing eco-green tourism into reality. This formulation is based on descriptive explorative method. This research was conducted in the historical area of Kauman tourist village which still has the authenticity of potentials of the value of characteristics of high local wisdoms which are still in existence and development.

The results of this research are the model formulation for policy in developing Kauman tourist village. Such a policy model is expected to be able to become the pilot project of the development of the tourist villages not only in Surakarta city but also in other tourist cities in Indonesia in general through the implementation of eco-green tourism on the basis of the concept of green architecture which will not
only conserve the tourism, cultural, and environmental assets, but also empower the prevailing local wisdoms.

**Keywords**: eco-green tourism, tourist village, and low impact development

**INTRODUCTION**

WTO (World Tourism Organization) is a world organization which takes tourism issues into account in increasing the economic, social and cultural sectors and environmental dimension. The tourism of Indonesia has an opportunity to empower the existence of tourist village with the domestication of local wisdom as a valuable asset in moving toward eco-green tourism. The comprehensive development of tourist village is conducted by integrating various stakeholders influencing the increase in local wisdom potentials. At present people still tend not to take into account and comprehend the existence of local wisdom potentials of the tourist villages which can be put in a package as the high-value asset of green tourism.

This research used descriptive explorative method in which the study on the local wisdom potentials in the public space arrangement of the city, the mapping of the characteristics of social, cultural, and economic potentials, and the behavioral setting with eco-green tourism approach. Up to the present there has not been any research which recommends a model formulation on the concept to develop tourist village on the basis of low impact development as the realization of eco-green tourism. Such a condition causes any policy of the government and concern of the public on the local wisdom potentials not to emerge yet in the realization of eco-green tourism within the historical area of tourist village. Therefore, the objective of this research is to obtain the formulation on the development model for the tourist villages as the realization of eco-green tourism through the exploration of the potentials of the characteristics of local wisdom domestication (physical and non-physical).

This is a research study urgent to conduct due to its variable of green tourism. Thus, the potentials of the local wisdom domestication of the area can be conserved, developed, and packed to be an eco-green tourism asset in the development of a proper, unique, and original tourist village. The Unit of Study on Architectural Heritage (USAH) of the Faculty of Engineering of Sebelas Maret University is obliged to take action and conduct research as a realization of concern. So, the research team in USAH raises the theme for research in accordance with the Research Masterplan and Roadmap of Sebelas Maret University in the years of 2009-2020 on the making of conservation, domestication, and preservation. The results of the research as the guideline for integrated and comprehensive policy as well as the new findings to enrich the treasure of knowledge and science will be recommended, socialized, and promoted to the stakeholders to be able to be brought into reality and implemented in an integrated way.
LITERATURE REVIEW

Development of Urban Tourist Village

The elaboration of the vision of tourism development in developing tourist destination is aimed at developing the active role of the people. The people have strategic roles and positions as the subjects and recipients of benefits of development, and the stakeholders in the tourism development (Stupa, 2010). Meanwhile, Kostof (1991) puts forward that village is a form of urban settlement located in the important part of the function of the city, inclusive of the area of Central Business District (CBD), center of government, shopping center, and social center. As for urban village, it is a settlement area which has already aimed at being urbanized in which several types of urban service have been available and the characteristic features of a city have already been had.

Urban village is a dynamic and important economic system in such a way that it needs to be integrated with a comprehensive city system, physically, socially, and economically. Thus, urban village can be seen as one living, growing, and developing organism and it becomes the center and event for various productive activities of its inhabitants or home-based enterprises (Setiawan, 2010). In addition, urban village can also support urban economic activities. The diversity, uniqueness, and persistence of the inhabitants of the urban village will determine the uniqueness and even the soul of the cities in Indonesia (Sullivan, 1980).

Suhartanti (2000) states that the characteristic features of the life of Indonesian people is unique indicated by a kind of life which regards other people more or less like the members of one’s own family, commensurate level of living, religious harmony, and motivation for mutual cooperation and shared expediency. Therefore, such characteristics are expected to support the growth and development of tourist villages in Surakarta. There are three principal components as the basic foothold for the growth and development of urban village which include: access, resources, and motivation. The different levels of ability of each component will contribute to the formation or phenomenon which is different as well to the urban village.

Lane (1994) contends that tourist village is a series of tourism activities taking place in the area of a village. The idea of tourist village comes from the demand of tourists to visit some villages regarded to have special uniqueness. The atmosphere, life, and tradition of the people living in the local village are the main assets in the development of tourist village (Bramwell, 1994). The local wisdom potentials in the village are assets of eco-green tourism in the tourism sector which have to be preserved and packed as a unique and original tourism products with high value (Sharpley, 1993). Therefore, the active role support of the people highly determines the sustainability within the tourism village destination (Ganon, Agness, 1992).

Tourist village is theoretically defined as an area or village with the potentials of high uniqueness value and local wisdoms as unique tourist attractions either in the physical characteristics of natural environment or the social and cultural life of the local people managed, packed, and presented attractively with the development of the facilities to support tourism in a harmonious environment system and good,
integrated, and well-planned management so that the village is ready to receive the visit of both domestic and foreign tourists (Sharpley, 1997; Bromley, 1994).

A conclusion is drawn out of the theories mentioned above that tourist village is a form of tourism with the concentration on the local wisdom potentials supported by other unique potentials which have become the unique characteristics of a village. The object and attraction of the life of a village with the unique characteristics of the local people (both physical and non-physical) which have an opportunity to become the commodity assets for visitors or tourists to enjoy as well as everything generated from the activities of the village will bring benefits to the local people.

![Figure 1. Eight Components to Establish Tourist Village](Source: Setyaningsih, 2011 reanalyzed in 2013)

**Low Impact Development (LID)**

The basic concept of LID is the sustainable management of drainage with environmentally friendly public space arrangement system (able to filter pollution, control the volume of rainwater, and maintain the base flow which flows to the body of water). Meanwhile, sustainability is the utilization of natural, human, artificial, and social cultural resources with wisdom and under control to achieve high level of economic security and bring the ecological security into reality in all aspects of their life (Pirages, 1996).

Sustainable development essentially aims at improving the quality of life of human beings in all aspects, including religious, physical, spiritual, and cultural aspects without wasting the available natural resources. Furthermore, there are 9 (nine) principles of adaptation in sustainable development in *City of Gold Coast*, namely: respect for and maintenance of life community, improvement of the quality of life of human beings, preservation of the vitality and diversity of the earth, prevention from the squander of non-renewable natural resources, efforts to avoid doing any act which exceeds the supporting capacity of the earth, change of attitude, lifestyle, and behavior, support for the creativity of the people to take care of one’s
own environment, provision of comprehensive to integrate the effort of development and that of preservation, and creation of global cooperation.

Eco-green Tourism

The term ‘eco-green tourism’ emerges in a WTO meeting in Bali which is described as friendly and everlasting tourism development without the accompaniment of negative impacts against the environment (physical and non-physical). The success of tourism development based on eco-green tourism is highly determined by the quality of the natural and cultural environment as well as the behavior of the people. Tourism development has to take the harmony among the need of tourists, tourist destination, and local people as the host into account all the time (Nuryanti, 2010).

Thus, the development of tourist village based on eco-green tourism has to take the environment into by growing the awareness of the tourists to the characteristics of local wisdoms of the area. Such development of tourist village has to fulfill some criteria as follows: a) the existence of tourist village; b) the location has to possess the potentials of attraction of unique local wisdom; c) there is high motivation of the local people; d) there is enthusiasm of community development; and e) there is a sustainable system of partnership collaboration among the government, the private sector, and the local people.

METHODOLOGY

This research was conducted by using descriptive explorative method which is an integration of the study on the local wisdom potentials in the urban space arrangement and the mapping of the characteristics of social economic and cultural potentials as well as the behavioral setting with the eco-green tourism approach.

This research was conducted in the historical area of Kauman tourist village of Surakarta on the basis of the dominant factor of potentials of domestication of local wisdoms of historical values related to the existence of Surakarta Palace as the symbol for the center of culture which still exists. The samples of this research, including the key informants, were taken by using purposive sampling technique and snowball sampling technique. The data of this research were gathered through participatory observation (SWOT - Strength, Weakness, Opportunity, and Threat analysis on the physical mapping of the characteristics of the area related to the potentials of domestication of local wisdoms), in-depth interview (the mapping of social economic and cultural characteristics by using survey through interview), questionnaire, documentary study, map reference, Focus Group Discussion, and Participatory Rural Appraisal (PRA) to gather the needs and aspiration of the people.

The data were then analyzed by using SWOT analysis on the area, descriptive statistic analysis technique, and interactive analysis technique as well as the behavioral setting which is related to the eco-green tourism approach.
RESULTS AND DISCUSSION

Development of Tourist Village through Low Impact Development (LID)

The change in space arrangement from a historical area to a tourist village in Kauman village will cause the quality of the environment to degrade due to the increase in pollution and waste. This is related to the problems in planning, building, and managing the drainage system of this area which has to refer to the techniques in Low Impact Development (LID). The implementation of LID in the space arrangement of Kauman village can set off from the implementation strategies as follows:

1. Selection of plain materials with soft structure
   
   The implementation of this technique in LID is done by using materials with soft structure, such as concrete, stone, local plants, soils, and gravels since such materials can get fused into the condition of the surrounding area more easily and give more natural view than the conventional technique. The natural characteristics will probably raise acceptance and willingness to use and maintain this system as well.

   Soft structure can be applied in the arrangement of circulation line within the area of Kauman village by taking into account the characteristics of the roads specified typically in accordance with the local wisdom. Based on the on-field data the roads in Kauman village are divided into two classes, namely:

   a. Five roads of main environment/tertiary road, which consist of:
      - Kalimasada road, built from asphalt, 3.5 meters in width, two-way circulation
      - KH Hasyim Asyari road, built from asphalt, 5 meter in width, one-way circulation
- Wijaya Kusuma road, built from asphalt, 4 meters in width, two-way circulation
- Trisula road, built from asphalt, 4 meters in width, two-way circulation
- Cakra road, built from concrete, 2 meters in width, two-way circulation

Figure 3. Condition of Five Main Roads in Kauman, Surakarta
Source: Setyaningsih, 2013

b. The names of the roads in Kauman were given by the kings as the toponym of some heirlooms owned by Kasunanan Palace which become the symbol for glory and greatness and are regarded to have magical/sacred power. Such toponyms are as follows:
- Kalimasada road (the name of an amulet at the time of King Pakubuwono V)
- Trisula road (the name of an amulet at the time of Kings Pakubuwono VI through VII)
- Cakra road (the name of an amulet at the time of King Pakubuwono VIII)
- Wijaya Kusuma road (the name of an amulet found by Ketib Trayem IV from Nusakambangan Isles at the time of King Pakubuwono.

Figure 4. Main streets of Kauman tourism village, Surakarta
Source: Setyaningsih, 2013
LID is conducted by selecting and making LID units in accordance with the local need as follows:

1. Bioretention
   It is an area of soil heap under the surface of plants with the characteristic of ability to release water and a drainage which pushes infiltrated flow as the water filter and prevents any addition of breadth and height. The method used is a combination of filtration with physical process and biological process.

2. Infiltration Well
   It is a small pits refilled with aggregate, usually gravel or stone, which functions as infiltration system to control the flow of surface from the roof of the building and to make catchment of the inflow which takes the form of direct surface flow. Infiltration well provides the main treatment with the same process as the infiltration of ground water in which there is binding, filtering, and decomposing bacteria.

3. Vegetation Filter Land
   Vegetation filter land is usually adjacent to vegetation area filled with grass.

4. Buffer Vegetation
   It is buffer vegetation planted with plants, either those that grow on their own or those that is planted on purpose, around the sensitive area. Vegetation helps to hold sediment carried by the rainwater.

5. Grass Canal
   It is contained in a conventional simple drainage canal with grass canal which mainly functions to helps the rain water get through and away from the road. The urban planner can plan dry canal which provides both quantity and quality by facilitating the infiltration of rainwater flow.

6. Rainwater Tub
   It is a method to reserve rainwater with easy, cheap, and effective maintenance and suitability to be used in settlement area. Rainwater tub works by resisting the initial volume of rainwater flow whereas the run-off pipe operates as the water run-off after the rainwater flow exceeds the capacity. The tub has to be designed in such a way that it is easily transferable and safe for children. As well, the tub has to have mosquito filter fitted in the area surrounding the inlet hole.

7. Infiltration Trench
   It is a kind of trench refilled with stone to form a tub under the surface. The rainwater flow is deflected into the trench and reserved until the water can be infiltrated into the soil, which usually takes several days. It has to be taken into account to prevent the trench from getting plugged. Therefore, the incoming water has to be processed first through grass canal or vegetation filter land.
The methods which can be used to minimize the flow of water cycle dumped are as follows (they can also be used in combination):
1. Building narrower/smaller road (reducing waterproof area)
2. Maximizing plant conservation
3. Minimizing nuisance
4. Building open drainage canal
5. Keeping the soil with high infiltration
6. Placing the flow of water cycle on the land with high infiltration

Figure 4: Permeable Paving
Source: Analysis of Hermono, 2010

Figure 5: Infiltration Trench
Source: Analysis of Hermono, 2010

The following steps in the management system of LID are to keep the concentration time (Tc) like the predevelopment time. The techniques usually used to keep the concentration time are as follows:
1. Keeping the length of flow line
2. Increasing the surface roughness value (such as providing area for plants, using vegetation canal)
3. Resisting the water flow (by using such as open canal and bioretention)
4. Minimizing nuisance (such as by minimizing compaction and change in the available vegetation)
5. Making as little tilt as possible in the development area

Figure 6: Effort of Technical Design in Arranging Kauman Area toward LID
Source: Setyaningsih, 2013
6. Eliminating waterproof area  
7. Connecting the water escape area and the vegetation area

The drainage through closed pipe in LID would better be avoided. Open canal has to be designed by following a procedure as follows:

1. Raising the surface roughness to retard speed
2. Creating a condition of shallow water flow
3. Using network system in wide and flat canal to avoid fast canal movement
4. Raising canal track
5. Reducing the tilt of the canal to reduce speed (minimum slope of 20%)
6. The canal has to pass through water escape ground in order to increase the absorption to reduce surface flow.

---

**Figure 8.** Drainage in the area of Kauman village  
Source: Setyaningsih, 2013

---

**Bringing Planning on Multifunctional Area into Reality**

LID offers an alternative of innovation in the approach of urban management of rainwater flow integrated with the planning on settlement area where the surface flow can be managed in small scale dan controlled in each source of pollution. Every city park or any other infrastructure (roof, street, parking lot, and green belt)
can be designed to become multifunctional by having an environmentally sound retention pond by utilizing it as the detention, retention, and filtration of water and it can be used to accomodate the water flow.

Meanwhile, garden city concept and urban linkage system are needed in the management system in the following time. This system defines the area structure and its space clearly through the arrangement approach of urban landscape design on the basis of the concepts of garden city, greenbelt structure, and green in the area spaces/intersections/junctions passed by greenbelt or called greenbelt area in an integrated unit of landscape design for public park with amenity as an effort to preserve environment sustainably.

![Figure 9. Public area of Kauman village Source: Setyaningsih, 2013](image)

**Implementation of Eco-green Tourism in Arranging Kauman Tourist Village**

The concept of green tourism is aimed at keeping harmony among its elements, such as the need of tourism development, the continuity of environmental, social, and cultural functions, the quality of tourism products, human resource professionalism, and tourist satisfaction. The balance of the various elements has to be kept to prevent conflict between one element and another one. This is a concept of insight of sustainability of the elements as the maker and manager of tourism area in the future. Green tourism is done by making efforts in the change of culture and attitude in arranging the environment, behavior pattern, and lifestyle to support the sustainability of the tourist area as well as to form new attitude in the interaction between people and tourist area (Fundamentals of Green Tourism, 2010).

Green tourism as a complex and multifaceted activity includes environment as well as tourism to accommodate conservation education and recreation which grows rapidly by showing the authenticity of behavior of the local people and variety of uniqueness owned in such a way that communication can be built through the activities of interpretation and appreciation toward the local wisdom potentials.

The development of eco-green tourism principally emphasizes the wise utilization of natural and cultural resources by prioritizing the sustainability of existence and local wisdom and minimizing the negative impact of tourism against
the environment. This concept should be comprehended for the agreement of all related parties in such a way that there will not be any contradiction among various interests in the application of eco-green tourism (Jatmiko, et al. 2011). Such an agenda brings benefit as the follow-up of green tourism to give direction to apply the sustainable development of tourist village which pays attention to the environmental needs and local people.

The same thing is put forward in the idea that the development of eco-green tourism has to pay more attention to the environment by growing the awareness of the tourists of the characters of local wisdom of a region. This is a process which involves various related parties to emphasize more on the utilization of the potentials and resources of local wisdom at hand for the importance of the wider community. Bringing eco-green tourism into reality with the sustainability from the past to the future generation and the right, creative, and sustainable ways of development without leaving the local image and characters behind eventually becomes our shared duty which has to be followed up immediately.

It is concluded out of the description above that the growth and development of tourist village toward eco-green tourism have to fulfill some criteria, such as the existence of tourist village, the potentials of attraction of unique local wisdom owned by the area/location, and the strong motivation of the local people to be creative in developing eco-green tourism by minimizing the negative impact toward green tourism as well as the enthusiasm of those involved in community development and sustainable partnership collaboration system among the government, the private sector, and the local people as the motor. Setyaningsih (2013) found that the community needs to turn its attention to the loss of character of the buildings in Kauman, if the Kauman area is further developed considering only economic activities and not conservational issues. In the meantime, local communities in Kauman have not yet understood and realized why it is important to maintain local identity, and that unique value is an important asset.

The development of the area of tourist village toward the planning on eco-culture city has to take into account the environmental handling, namely: keeping, protecting, and preserving the existence and condition of the nature and environment. Such a handling consists of the concepts as follows:
1. First, recycling. It means the utilization of technology, behavior of the people, and planning which enable to reprocess the waste products into the materials which can be reused without any negative impact against the environment.
2. Second, sustainability. It means sustainable development with long-term vision and mission; and
3. Third, balance between artificial and natural environments, such as greenbelt, park, city forest to provide shady areas, O₂ (oxygen), anti-pollutant to absorb CO₂ (carbon dioxide) and plumbum content of the air as well as aesthetic elements and water conservation.
a. Village lane in shade circulation decoratively presented combined with green elements.

b. Space divider village using green elements as district cooling, green belt and paired with a decorative street furniture.

**Figure 10.** Effort of design and technique of the arrangement of Kauman area toward eco-green tourism

Source: Setyaningsih, 2013

The implementation of design of eco-green tourism in Kauman village in more integrated way can be specified as follows:

**Tabel 1.** Implementation of eco green-tourism-based model design at Kauman Village

<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>Strategy</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Access to the village</td>
<td>Strengthening the façade of the village with local identity, entrance through a uniquely shaped gate, and free and spacious and communicative direction of the entrance.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Circulation path</td>
<td>Facilitating a circulation space within the area of the village through providing safe and comfortable vehicle and pedestrian tracks, parking space, and freeway track.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Drainage</td>
<td>Building environmentally friendly canal for waste water by improvising the green elements (green drainage) through building drainage canal for smooth-going water flow and catchment area which has dual function as village park as well.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Aesthetic elements</td>
<td>Providing architectural touch on each component of area management through providing such supporting facilities as rest area, litter bin, information board, and shade breezeway.</td>
<td></td>
</tr>
</tbody>
</table>

Source: Setyaningsih, 2013
Development Model of Kauman Tourist Village with the concept of LID toward Eco-green Tourism

In every area development the elements of sustainability and multiplier effect are always taken into account by causing the positive impact to be greater and eliminating the negative impact which such a development may create. Resting on such a point of view, the basic concept of integrated and sustainable area development can be developed, particularly in the sustainable development of Kauman tourist village which has to be based on the dominance of local characteristics and able to fulfill the present needs without neglecting the ability of the future generation in fulfilling their future needs.

A sustainable economic condition, which is an economic activity which keeps on maintaining the basis of the natural resources used through improving knowledge, accomplishing the management of the governmental organizations and private institutions, technical efficiency, and policy determination based on mutual interest, is expected to be achieved by implementing sustainable development.

Sustainable development is essentially aimed at improving the quality of life in all aspects, inclusive of religious, physical, spiritual, and cultural aspects without wasting the natural resources at hand (particularly the natural resources with unrenewable characteristics, those without environmental and supporting capacity.

Eventually the development of Kauman tourist village considers low impact development by establishing the multifunctional development of the area into the destination of religious tourism and cultural history on the basis of eco-green tourism with the mapping on the area as follows:

![Mapping on the Potentials of Tourism Viewed from the Local Wisdom Potentials](image)

**Figure 11:** Mapping on the Potentials of Tourism Viewed from the Local Wisdom Potentials

Source: Setyaningsih, 2010 reanalyzed in 2013
CONCLUSION

LID has excellence in its problem-solving pattern with more environmental insight, aesthetics, and safety. Environmental management in small scale enables people to contribute more, to have low-cost environmental handling, and to implement settlement area development with low impact. The concept of settlement area development needs a particular approach in such a way that it can take more into account and maintain the condition of natural local characteristics due to the change in spatial pattern, building and environmental arrangement pattern.

The implementation of LID (Low Impact Development) strategy in maintaining and optimizing the historical area as a tourist village with the qualities of eco-green tourism, particularly in Kauman area, can be achieved through the stages as follows:

1. The identification of the dominance of potential characters as a tourist village to develop tourism sector which includes physical and non-physical aspects (building artefact, social, economic, and cultural aspects);
2. The empowerment of the non-physical potencies to raise the active role of the local people rooted in local wisdom;
3. The area space arrangement on the basis of eco-green tourism in the management of circulation track, natural resources, active motivation in the involvement of the people, and sustainable and environmentally-friendly physical development of the area of the tourist village.

REFERENCES


International Conference
Green Concept in Architecture and Environment

Sub Theme:
Theory and History of Architecture

Department of Architecture ITS Surabaya, September 2013
ABSTRACT

Architecture is always faced with the problems of the world (like global warming) and should always refer to the sustainable development. But on its way to search for identity towards sustainable development, conflicts are often occurs in it. This study aimed to explore how panopticism principles can assist in disciplining people for better sustainable development. Michel Foucault's disciplinary power is a mechanism to regulate the behavior of individuals in society. This discipline can be done by adjusting the organization of space (through architecture, urban planning, etc.), time, human activity and human behavior and requires a complex surveillance system. Foucault asserts that the discipline is not power, but discipline is an easy way to apply power and connects this with the discipline of history, the origin of society and space. Furthermore, panoticon expressed by Foucault is not a prison, but it is a model that summarizes the characteristics of the community based on the discipline of power. Foucault wrote principles of supervision and disciplinary powers with utilitarian logic of early capitalism called panopticism. Panopticism space is based on Foucault's ideas about space that emphasizes the power of discipline and the power of human influence. The method used in this study was the method of criticism and logical arguments. The discussion begin from the panopticism discussion in the history of architecture followed by discussion sustainable development, then a critique of society and sustainable development, and ultimately how this panopticism entered as a principle that can be applied in the sustainable development. The result for the society to be more discipline and concerned about sustainable development, it is necessary to have discipline panopticim in sustainable spatial development.

Keywords: panopticism, architecture, sustainable development
INTRODUCTION

Architecture has the responsibility to engage in role in responding the environmental global issues. Sustainable developmental concept proposed as one of responses to the global environmental degradation. The sustainable developmental concept is facing implementation of each of developmental aspects, both in international and national scopes. Three sustainable developmental pillars are ecology, social and economic. Ecology, for the ecosystem wholly and balance, supporting power, biological diversity and global environment. Social, for the empowering, participation, social mobility, social cohesion, cultural identity and institutional matter. Economic, for the growth, even distribution and efficiency. The three goals have to be considered as the main factors in the sustainable development. The balance consideration of all three ones as the thorough approach in development is highly needed (Kusumarini, 2011). Therefore, a holistic sustainable development approach involving ecological, social and economical aspects are needed to be included in the architecture.

Discipline power that has been introduced by Michel Foucault is a power mechanism to regulate the behavior of individuals within a community agency. This discipline can be done by adjusting the organization of space through architecture, urban planning, time, human activity, human behavior and architecture of control. Discipline is not power, but discipline is an easy way to apply power. By using discipline power, then we can control society without force. In the disciplinary society, Foucault linked this disciplinary power with history and origins of society, so people do not discipline by force.

This discipline power linked with architecture especially space, because Foucault considered that the space could be as a demarcation of the institutional structure of power and authority. In his book Discipline and Punish, Foucault wrote about a principle to improve supervision, discipline and power at the same time at the beginning of the utilitarian logic of capitalism. This principle was later called Panopticism. (Foucault, 1977). A space based panopticism by Foucault, is a discipline that emphasizes the power and influence mechanism of human power. Using the panopticon prison by Bentham, Foucault reveals examples of space is one of the characters of power. Panopticon expressed by Foucault is not a prison, but it is a model that summarizes the characteristics of society based on power disciplines. (Leach, 1997).

Panopticism space power can be used to improve discipline society in sustainable development. Panopticism space power can be regarded as the space formed by the architecture deterministic and architecture of control, in which a ruling here shape the behavior of people in it to get a better sustainable development. Using the combination theory of panopticism and architecture deterministic which believes that human behavior is determined by environmental proxies, the sustainable development can be improved. This architecture deterministic theory explained that the human in this position no longer have control over the behavior of the representation of the body. Stimulation from the environmental received by the body as cause certain behaviors automatically without the need of cognitive processing. (Halim, 2005). Therefore, we can assist
disciplining people from the panopticism theory for a better result in sustainable development. This paper will assist for a better theory development of panopticism exploration in sustainable development in the context of architecture as space.

RESEARCH METHOD

Method in this research study is critical descriptive and interpretative methods and logical argumentation. Both of the method theory can give the power of critical and logical persuasion about a case (in this case is panopticism and sustainable development in architecture context). Discussions conducted by giving a descriptive and interpretative criticism about the theory of panopticism and sustainable development in architecture context. Data obtained from books, writings, journals, theses that have been publicized through both real and electronic library.

THE PANOPTICISM EXPLORATION

Power and Knowledge

Before understanding about the principles panopticism, we should first understand how Foucault's view of power / authority in philosophy and the social context. What is power? (1). Power is not guided by the will of the individual subjects. (2) Relations of power always occur between people, as opposed to quantum owned by the people. (3) The power is not concentrated in a single individual or a class. (4) Power flows not only from the more to the less powerful, but more on that coming from below. (5) Power has its own dynamics and deliberate. The relationship between powers can be expressed in the relationship between parents and children, lovers, employers and employees (Foucault, 1977). And in every human interaction, power is subject to negotiation, every individual has a place in the hierarchy and no matter what the relationship will be, as flexible as the hierarchy.

Foucault has some theories and ideas about the power. The first, Foucault thought that the concept of power is not a 'thing' or a 'capacity' that can be owned either by the state or a particular individual, but rather a 'relations' between different individuals and groups who only appears when run. Foucault was initially put forward a hypothesis that expanded the power of the social body. There is no freedom that escape from power relations, but the resistance emerging power wherever it is done. This refusal appears everywhere, on every level, including at the lower level. This was called power and resistance. (O'Farrell, 2006)

The second, Foucault reveals the power by the state from the idea of critiquing models that was shown entirely within the power of the state or the administrative and executive body that ruled the country. Power is not owned by the state. In fact, the existence of a state depends on the operation of the thousands of complex micro-power relations at every level of the social body. Power is not owned by the state. (O'Farrell, 2006)
Third, Foucault means that the power is not as simple to say 'no' and oppress individuals, social classes or natural instinct, but the power is productive. By this he means that the power of generating the kind of knowledge and structuring specific culture. In Foucault's view, power and oppression cannot be reduced to the same thing. Power is productive. (O'Farrell, 2006)

Besides the three meanings of the power that has been mentioned above, another important thing is the mechanism of power that shape the types of knowledge of different aiming to investigate and gather information from human activities and its states. Knowledge that gathered in this way will form the power exercises. This is not the knowledge that on the one hand and the state of society or science or being on the other side, but it is essentially a hybrid form of power-knowledge. Power and knowledge to operate almost interchangeably. Foucault often discuss the relationship between power and knowledge without using terms that are written with a hyphen, and it creates more of a difference between these two categories.

Foucault always reflects and diagnoses what is happening now by studying what has happened in the past. Everything was assessed in accordance with the framework of knowledge that will continue to change forever. (Leach, 1997) In terms of power, the present power is reflecting Foucault's disciplinary power form of the past. Since the first disciplinary body has existed as an attempt to make individuals more docile, so they can be used to carry out specific purposes. In this case the body served as object and target of power.

Foucault propose the existence of a series of historical configurations vary according to the general relationship between power-knowledge and in sequence: disciplinary power (which replaces the old form of the history of sovereign power, and focus on the creation and control of the individual through the exercise on the body and behavior ), biopower (focus on the life, death and health of the whole population) and then governmentality (allows the incorporation of power into the mechanism by which this mechanism shows the way to the behavior of people in the social body) (O'Farrell, 2006).

To study the theory here will be focused on the form of disciplinary power, because panopticism is the mechanism of disciplinary techniques and principles. Disciplinary power was first developed in the late 18th century, and replaces the old forms of power (sovereign power). In the system of sovereign power, which occurs in feudal society, no individual authority figures such as kings, priests or fathers designated as the holder of the power and loyalty can be bought (O'Farrell, 2006). Foucault argued that the form of the sovereign power as a way to regulate the behavior of populations in Europe efficiently.

Based on Foucault’s record, there are some techniques or principles that facilitate the mechanism of this power. (O'Farrell, 2006). The first was organized in such a way. Space is fundamental in any exercise of power if (Rabinow 1984). Foucault thought about this a technique originated from Foucault thought associated power, knowledge and space at the end of the 18th century. In the context of the concept of power and space, architecture became a part of the politics and power of government at the end of the 18th century (Rabinow 1984). Architectural space at the end of the 18th century has always been associated with the power of the
government has an important role in the expression and practice of a government. It is associated with the need for control of territory and the establishment of a town. Government and politics as it assumes that the distribution pattern formation in the space to the architectural arrangement of the city's most private, is the most efficient in the control of a city and its territory. Therefore, the space and the power generated is controlled and organized by the government.

Still according to Foucault, in the 19th century, with the development of technology (especially in the field of railways and electricity) and urbanization, the formation of space in the city and state is no longer the domain of the power of government and the architects, but there are engineers, technicians and builders who can control the territory, communication and speed. (Rabinow: 1984) This leads to the power no longer on the government; relationship between power and space created by the community, is no longer at the state or government.

Power-Knowledge and Panopticism

Organizing principle of space begins with an 'enclosure' where people locked in the institutional space (eg criminals in jail, the kids at school). In the 'enclosure' is created partition as small as a classroom or a cell. Then in the 'enclosure', man 'are rank' and divided into 'classes' of his. All of this division requires a physical architecture design to keep these social spaces remain organized.

The second of disciplinary techniques are associated with organizational activities and behaviors. First, develop a schedule for a group of people to be present at the same time for a task. Then this form of organized group activity, people are trained to display the same movement at the same time. Third, the method of training and refining the body and gesture. The goal is to make the body become more efficient at the activity being performed (O'Farrell, 2006). Success of disciplinary power technique is more secure with the addition of surveillance technology.

Panopticism is an oversight mechanism for modern society (O'Farrell, 2006). Panopticism is part of the disciplinary techniques of power. In addition there is also a normalization (testing against the 'normality' of the body) and test / examination (testing the effectiveness of disciplinary power). Panopticism also will not succeed without the support of the organization of architectural space and the organization of activities and behaviors that are also present in the architecture. The implementation of power efficiency in disciplinary techniques, as efficiently panopticism, necessary for designing organizational architecture and organization of space activities and behaviors. The next paragraphs will explain in more detail about panopticism.

The Meaning of Panopticism

After understanding Foucault's view of power and its connection with politics of the 17th century in the context of philosophy and social, then we try to understand the views of Foucault on power and its relation to the disciplinary knowledge and the concept of space. According to Foucault, space is fundamental / essential in the
Foucault's thinking on this matter was originated from Foucault thought associated power, knowledge and space at the end of the 18th century. In the context of the concept of power and space, architecture became a part of the politics and power of government at the end of the 18th century (Rabinow 1984). Architectural space at the end of the 18th century has always been associated with the power of the government has an important role in the expression and practice of a government. It is associated with the need for control of territory and the establishment of a town. Government and politics as it assumes that the distribution pattern formation in the space to the architectural arrangement of the city’s most private space is the most efficient in the control of a city and its territory. Therefore, the space and the power generated is controlled and organized by the government. Still according to Foucault, in the 19th century, with the development of technology (especially in the field of railways and electricity) and urbanization, the formation of space in the city and state is no longer the domain of the power of government and the architects, but there are engineers, technicians and builders who can control the territory, communication and speed. (Rabinow: 1984)

This leads to the power no longer on the government; relationship between power and space created by the community, and no longer by the state or government. With the change of power from government to the people, caused the formation of mixing between power and knowledge (it is in the power of the subject, and using science as a source to power) (Hirst: 1992).

Here, Foucault introduces a discipline that relies on supervisory power to change the subject. In conjunction with the science related to the system and the human as an object of disciplinary fields of science, Foucault introduces panopticon (which is a reference to the history of the imaginary project from Jeremy Bentham and cited to explore the concept of power-knowledge) (see figure 1). Panopticon prison circular summarizes the characteristics of the people who founded discipline. This is embodiment from a prison system where supervision system has an important role and knowledge united and inseparable from power.

**Figure 1.** Panopticon Prison by Jeremy Bentham
In this Panopticon prison, the concept for monitoring and observing the user and generates a highly effective surveillance. Panopticon also is an experimental mechanism for changing behavior and to train people to be good and true. Panopticon scheme can be used as a way to change the thinking and behavior of people effectively and efficiently, and increase one’s knowledge. Not only physical behavior, but also psychologically and knowledge.

Panopticon is a mechanism that allows supervisors conduct a thorough observation of the object is supervised. Meaning panopticon allows the application of a certain kind of view. With panopticon, supervisors can observe them constantly and rapidly. As expressed by Foucault, a constant vision ensnares the subject in the many "cage" and many small theaters in which each actor alone, rather individualized and look constantly. (Foucault in Ritzer, 2003: 103).

Foucault also saw panopticon created as a principle of relationship between inmate, observers and architectural space. The Prisoners, as an object of science disciplines, are expected to show a certain behavior models, are seen by observers to be controlled and reformed behavior (Hirst 1982) by structuring the right room to meet the terms of the behavior of the control and overhaul. The room is set to take hold disciplinary power, and knowledge to supervise. It is an effective method to show the power-knowledge in panopticon from its configuration or arrangement of space. It is used to make sure a bunch of people that are in the specified space, canalization of their circulation, and the coding of their reciprocal relations. And it is not only considered as an element of the space, but especially in the field of social relations that can give some specific effects (Ranibow 1984).

This can be concluded that Foucault argues architecture patterns through spatial planning can shape the activity through allocation, canalization or coding and their relationship through the mechanism presented in panopticon project. Spatial planning could bring the existence of the power to accommodate that activity. Spatial planning for activities that may require a sequence order into a hierarchy of spatial planning in architecture with a clear power to the people and embodied with their culture.

Power is implemented control between individuals. Oversight in this case serves to eliminate all forms of chaos that may arise because of the characteristics of different individuals meet each other. Panopticon be a form of surveillance system which allows obtaining compliance and regularity with minimizing unpredictable actions. In principle, the surveillance can be done discontinued, the effects of continuous supervised consciousness. Strength of the system lies in the ability panopticon encourages the supervision from the inside. Object of power into a potential carrier dominance situation. This system is a model of the functioning of the enforcement of discipline that can be applied in all areas. He became a form of control that does not require further physical violence. So if it is associated with space, surveillance systems called panopticism. This affects the shape of space, which can psychologically affect human psychology.

In conclusion, panopticism, is the discipline mechanism: a functional mechanism that must improve the exercise of power by making it lighter, more rapid, more effective, a design of subtle coercion for a society to come.
movement from one project to the other, from a schema of exceptional discipline to one of a generalized surveillance, rests on a historical transformation: the gradual extension of the mechanisms of discipline throughout the seventeenth and eighteenth centuries, their spread throughout the whole social body, the formation of what might be called in general the disciplinary society.

**Panopticism and Architecture**

Still relevant to the discussion panopticism and its connection with space, in the theory of architecture and the built environment, there is a fundamental theory about the human relationship with the environment. There are four main theories that reveal the relationship, namely, integral theory, stimulation theory, control theory and behavior settings (Kopec, 2010). Among the four major theories, deterministic architecture (which is part of the behavior setting theory) is a theory that is directly related to the formation and control of one's behavior through the fabric of space.

According to Alex Marmot (2002), architecture deterministic has a sense of the concept that a building environment can directly affect a person's behavior. While Deddy Halim (2005) also stated that the deterministic architecture believe that human behavior is determined by the environment and human proxies no longer have control over the behavior of the representation of the body. The deterministic architecture more wins than the architectural environment with human behavior. In addition to the theory of deterministic architecture, there are also other theories about the relationship of the built environment on human behavior, the theory of the built environment possible (where more winning human behavior) and the theory of the built environment probable (where it won a theory of the built environment and human behavior). So in this study, the most suitable theory is a theory of deterministic architecture which won the built environment, because it is always associated with panopticism philosophy of science and power, and in this case the power settings that affect the behavior of a man in the room.

There are five key issues that the physical connection between man-made architectural side by side the mental aspect of human psychology (including psychology and human behavior). These five key issues it is personality, archetypes, physical anatomy, character gender, and psychophysical. So archetypes are part of the picture of human mental aspects contained in the physical building architecture. (Halim, 2005). Physical space in the church building, the psychological archetypes universal form of thought that exist in every person at all times so as to have a particular meaning. Therefore in approach and interpretation of the church building discipline panopticism power, then a church building built environment and the importance of understanding the influence of psychological meaning that there are universal to everyone. So the most important thing of this architecture is deterministic surrogate environmental factors and variables emphasis on building a very pressing and influence human behavior in it. Psychological archetypes here are an overview of the incorporation of aspects of human physical and mental aspects of building. So combining these two theories of architecture and space can help understanding and influence panopticism’s philosophy in a space.
THE SUSTAINABLE DEVELOPMENT

Sustainable development is a concept that approach to respond to global environmental issues, implicated as a macro perspective to all areas of development. The concept of sustainable development that emerged and developed in their respective studies underwent a process of adjustment in terms of emphasis and detail terms to discuss for each of its aspect. Sustainable development concept consists of 3 main pillars which are ecology (environment), social and economy. The three pillars are balanced with equal circles. All three pillars are ideally discussed and applied in balanced. In reality, the economic pillar becomes the discussion and consideration of the most dominant large circle, followed by a social pillar and the smallest one is the environmental pillar. The composition works mainly on the reality of the global capitalism. In the discussion of changes needed for the future, the three pillars are the same balanced in a large circle. Pillars need to be considered in the context of environmental improvement and conservation, so that it will affect the economic and social pillars in order to approach the balance consideration. (Yusita, 2011). This is where the panopticism and architecture can help balancing the environmental pillar. By creating a panopticism method in architecture to discipline society, then the environmental pillar can be balanced.

CONCLUSION

The connection between panopticism, architecture and sustainable development, can be summarized as such. The panopticon was a design for a prison produced by Jeremy Bentham in the late eighteenth century which grouped cells around a central viewing tower. The panopticon is an ubiquitous form of monitoring and disciplining human behavior, a kind of invisible fence that provides simultaneous surveillance and disciplinary power over certain groups of people, notably prisoners and students. Panopticism is a mechanism for the practice of panopticon. While architecture deterministic is a concept for the built environment which can directly affect dan discipline the person’s behavior. Using this two connection (panopticism and architecture), we can create a better sustainable development especially in environmental area. Panopticism is the principle to discipline the human behavior, architecture deterministic is the concept in build environment to discipline the human behavior. The mechanism of panopticism allows supervisors conduct a thorough observation of the environmental pillar is supervised. Beside the supervision, there are also organization of space dan behavior. By organizing the architecture design space to keep these sustainable development spaces is also important. Organized and ranked the space begins with an 'enclosure‘ where people locked in the space. The organization, are include the organizational activities and behaviors. Success of disciplinary power technique is more secure with the addition of surveillance technology. By using the principle in the panopticism in the architecture deterministic, can create a better build environment in disciplining the human behavior for better balance in sustainable development.
ACKNOWLEDGE

This study was supported by Petra Christian University and Institut Teknologi Sepuluh Nopember, Surabaya-Indonesia and family. The authors are grateful to this support.

REFERENCE


MARKET AWARENESS IN SUSTAINABLE HOUSING: PAST, PRESENT, AND FUTURE RESEARCH

Ricca Agnesia Alamsyah*, Purwanita Setijanti**, Sri Nastiti N. Ekasiswi***

*) Master Student, Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
e-mail: riccagnesia_lam@hotmail.com

**) Lecturer, Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
e-mail: p_setijanti@yahoo.com

***) Lecturer, Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
e-mail: nastiti@arch.its.ac.id

ABSTRACT

Sustainable development has been widely discussed since 1970s. Efficient use of energy and preventing the pollution is two of many factors which can keep the sustainability. However, these factors are mostly ignored by some industry and it can impact the environment gradually. Construction industry is one of three uppermost factors initiating the global warming. Subsequently, non-profit organization in many countries attempt to create a policy controlling sustainable development for building, such as LEED, ENERGY STAR, BREEAM, Green Mark, and GREENSHIP. These policies give appreciations for buildings which qualify the criteria of the assessment. Focused in Indonesia, the appreciation of GREENSHIP is still dominated by office, commercial, and education buildings while the largest development in property sector is residential, concerned to housing.

This research attempts to describe the aspect of sustainable housing in market side by reviewing the literature and analyzing the theories.

A previous research about energy efficiency indicator in one of sustainable building certification results that qualified homes are sold more profitable than non-qualified homes. Another research explains sustainable buildings commanded higher rental income and investment returns. Link to saving value for sustainable housing, market can save around 20% of their savings over a period of 20 years. Learning from those statements, market should be aware about sustainable development in their neighborhood.

Result of this theoretical analysis describes the future research about the role of market awareness that can encourage the development of sustainability.

**Keywords:** market awareness, sustainable, housing, building certification
INTRODUCTION

The emergence of market demand for living and working places influences the quantity of real estate development specific in housing property. Market also decides the increase in property values which are developed by developers. Therefore, developers frequently conduct the exhibition as the event of to promote and educate the segmented market. It can encourage market decision to purchase the property.

Market tends to concern about the economic and social influence of the purchased property. Furthermore, the interest of environment begins to be considered by the market as the aspect of property purchasing. These three aspects—economic growth, social equity, and environmental protection—are the important characteristics that determine the development of sustainability (United Nations, 1987).

Sustainable development has been widely discussed in varied seminars and conferences since 1970s. The well-known Bruntland Commission (1987) in the United Nation Conference formerly declared, “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” Turcotte and Geiser (2010) concluded that the definition is more useful when relating to the concept of housing. They developed the principles of sustainable housing by interviewing 15 key housing informants from the list of participants of American Institute of Architects Roundtable on Sustainability.

Besides the principles, non-for profit organizations in some countries established the guidelines as a policy controlling sustainable development for housing. The organizations made rating tools to measure sustainable housing, for instance LEED, ENERGY STAR, BREEAM, Green Mark, and GREENSHIP. These tools can be briefed in some criteria. Each is reviewed by some researchers as the part of sustainable housing aspect.

This paper attempts to review the response of market about housing development which is led to sustainability. It suggests the future research describing the role of market awareness on sustainable housing development.

RESEARCH METHOD

This paper is aimed to review the previous research about how aware market about sustainable development in their area. Awareness identifies by the behavior of the respondents to response the applied concept of sustainability.

Sustainable building certification is the real project to investigate market response of sustainable development. Only few studies that relate market response to sustainable in residential property. An actual case, Addae-Dapaah (2011) distributed questionnaire to Singapore residential market and surveyed if they know the purpose of Green Mark as sustainable building assessment in Singapore. It started asking residential consumer if they know about sustainable concept in for private apartments.
This study adopts the research method to determine the result of market response of sustainability as the previous research for the awareness and conclude the decision for future research. It concerns to housing property as the highest demand in residential property.

**REVIEW AND DISCUSSION**

**The Importance of Market Awareness in Housing**

Market awareness should be seen as the part of consumer behavior, particularly in housing property. However, in sustainable development for housing, developers take more part to promote their projects than involve the market to decide which housing is more sustainable.

Market decision to purchase a house is mostly seen by physic attributes and non-physic attributes (Anastasia, 2005) or marketing mix (Siagian, 2012). Summarized from some researches, factors of market purchasing decision are image of developers, environment, developer’s service, building quality, price, location, project master plan, housing facility, promotion, added value, society participation (Anastasia, 2005; Brahmano, 2010). One case of Citra Raya Surabaya housing (Anastasia, 2005), six highest factors for purchasing decision are price, housing façade (physic attribute), thematic housing concept (added value), transportation infrastructure (housing facility), image of developer, and location.

Environment aspect was not mentioned as the main factors for purchasing decision. This reason makes developers promoting their price, infrastructure, location, or house design rather than the environmentally friendly aspect.

This study encourages market awareness about the enhancement of environment quality by understanding sustainable development from prior research. The result can be developed as prospect researches.

**Concept of Sustainable Development**

Kates, Parris, and Leiserowitz (2005:11-12) describes that sustainable development implies linking “what to be sustained” with “what to be developed”. “What to be sustained” identifies three major categories – nature, life support system, and community – with intermediate categories for each, such as Earth, environment, and cultures. This literature is emphasized on the life support systems which defined environment as a source of services for utilitarian life support of humankind.

The original intent of sustainable development included concerns of social equity between generations, basic global living standards, non-exploitation of others, and reducing the rate of consumption of non-renewable resources (Austin, 2012).

Based on the descriptions, it can be analyzed that sustainable development is about the way of today’s people to care about the present life aspects for the continuity of future generation.
Sustainability is no longer a new phenomenon in the real estate industry; it has become a common enough phrase. However, some wonder about the meaning of the word, as it is almost an oxymoron in the context of real estate (Lorenz, Truck, and Lutzkendorf, 2007 in Warren-Myers, 2012:177).

For humankind, sustainability is the long-term maintenance of well-being, which has environmental, economic, and social dimensions, and encompasses the concept of stewardship, the responsible management of resource use. In ecology, sustainability describes how biological systems remain diverse and productive over time, a necessary precondition for human well-being. Long-lived and healthy wetlands and forests are examples of sustainable biological systems.

Human need to rate the building effect to its environment, technically it called “environmental loading”. First issue that should be done is determining the building aspect which can change the environment significantly and how long that aspects can be used. Second is determining the method to control and estimate the transformation result of environmental loading (AIJ, 2005: 18).

Past and Present Research

Housing projects from planning, construction, until it has been occupied are one third of the average citizens’ total environmental impact, mainly because of direct consumption of energy (Berger, 2012). In some developed nations, approximately 20-30% of energy use in housing construction and operation (Rahman, 2006). These facts should be concerned by the market as the end-user of a home.

The principles of sustainable housing development are described in the way of incorporating green design, providing safe internal conditions, encouraging affordable and equitable distribution/consumption of housing resources, supporting financial viability for housing producers, promoting occupant-neighborhood linkage, maximizing access to healthy environments and support services, supporting worker well-being, preserving cultural and housing heritage, fostering participation and harmonious decision-making, and increasing adaptability and flexibility (Turcotte and Geiser, 2010). Another researcher focused on the efficient use of energy valued by ENERGY STAR® Homes in Fort Collin, Colorado. Homes using and non-using ENERGY STAR were compared to analyze the sale prices per square foot. It indicated that ENERGY STAR qualified homes are sold $8.66 more than non-ENERGY STAR qualified homes (Bloom, 2011). At the same time, the research concluded that energy efficiency is 15% more in home designed and built by ENERGY STAR standards than homes built by the 2004 International Residential Code in Europe and 20%-30% more than standard homes.

In Singapore, a research determined that rating tool of sustainability in Singapore commands the premium range. Different tiers of Green Mark in Singapore have different average of premium. It was surveyed to 300 people in Singapore and resulted that buildings valued by Green Mark have a higher average premium for each tiers than standard buildings (Addae-Dapaah, 2011). However, only 33.67% of the surveyed respondents had heard of the Green Mark rating system although this system has been operated for more than five years.
GREENSHIP rating system in Indonesia was developed by the Green Building Council Indonesia in 2009. It has a number of certified buildings in commercial and office segments. However, the rating systems for homes and housing have not established yet (Green Listing Indonesia, 2013). GBC Indonesia formerly designed a checklist assessment for sustainable homes. It is planned to be self assessed by the residents of housing. It makes the importance of market awareness to concern about each criteria of sustainable housing.

**Future Studies**

Concerned to the development of sustainability, developers have designed and built a lot of sustainable housings to decrease the impact of global warming. In Indonesia, even though the rating system (GREENSHIP for Homes and Neighborhood) has not been launched, numerous housings were awarded by a company as green properties in some categories. Green properties are related to sustainable use of energy and supported by technology use. Developers are the most involved role to promote the sustainability, but market also determines the process of sustainable housing development.

This research suggests the future research specify to market responses about the criteria of sustainable housing. Focused in Indonesia, markets should be surveyed and interviewed about their opinion for the principles and criteria explained in the sustainable building certification as the standard of sustainable housing. It needs to be explored by the specific characteristics of consumer as the segmented market of sustainable housing.

**CONCLUSION**

Most of sustainable housing researches concerned to the efficient use of energy and the implementation of the sustainable concept by the developers. However, those researches infrequently noticed the market as the decision maker of sustainability process.

This research attempts to encourage more researches exploring the market as the main role of sustainable development, particularly in housing property. In Indonesia, GREENSHIP assessment can be used as the guidelines for the future research linked to the segmented market characteristics.

**REFERENCES**


THE UNIQUENESS OF MAYANGKARA HOUSE ROOF CONSTRUCTION AS PART OF THE TROPICAL CLIMATE RESPONSE IN INDONESIA

Rabbani Kharismawan*, Angger Sukma Mahendra**, Andy Mappajaya***

*) Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
e-mail: rabbani@arch.its.ac.id

**) Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
e-mail: angger@arch.its.ac.id

***) Department of Architecture, Institute of Technology Sepuluh Nopember, Indonesia
e-mail: mappajaya@arch.its.ac.id

ABSTRACT

The work of an architect was always tried to break boundaries and stylish look of a certain era, so his work was unique or even the only one ever built. Architects were also encouraged to design buildings that could survive in all factors; time, climate and natural disasters.

Mayangkara House is one of the building heritages in Surabaya which built in 1921 by Job en Spreej with Art Deco style. Begin functioned as a house for the Director of De Javasche Bank. Mayangkara House located at the junction of an artery toward the center of the city that has a strong appeal from the roof shape. The size of the roof intentionally scaled up, and when compared to the wall then the proportion is about 6:1. The roof has a basic shape resembles a star that later became the identity of this building that is Mayangkara which means star. With a star-shaped plan, the architects chose a very complicated roof design that is square hip roof or pyramid roof with 12 hip rafter and 8 valley rafter. This unique shape has a complex roof structure and consist of design combination between Mansard and Joglo roof shape. Such a house roof construction is important to be studied.

This paper aim to explain the uniqueness of Mayangkara House roof construction that never been done before. To answer the questions, how engineers came up with solution to built a roof with 30 meters span and 20 meters high at that time? In addition, also to explain the architectural elements intended to maximize ventilation in the roof. This study used a survey method, both primary and secondary of collecting data, includes working drawings, measuring, video and photo documentation. This architectural masterpiece also shows the creativity and talent of an architect in the construction of engineering science which also succeeded in combining eastern and western styles to achieve genius loci.

Keywords: Hip Roof, Mayangkara House, Art Deco
INTRODUCTION

The building at Taman Mayangkara St. no.6 in Raya Darmo area was once called Woning voor Agent van Javasche Bank, means the house for director of De Javasche Bank (change it’s name to Bank Indonesia at 1953). Raya Darmo area located at Wonokromo District are close to the Surabaya Zoo.

The “Woning voor Agent van Javasche Bank” building was build and designed by architecture bureau Job en Spreij in 1921 (see Figure 1). In 1975, this building was used for museum, commonly known as Museum Mpu Tantular. But since 2004, it handed over to the Bank of Indonesia and the Mpu Tantular Museum relocated to Buduran District in City of Sidoarjo.

![Figure 1](image)

**Figure 1.** (top) original drawing of west elevation; (bottom left) picture from 1920; (bottom right) recent condition, 2012.

Source: collection of Laboratory of Architecture Development, ITS

The Bank of Indonesia is now the legal owner of Rumah Mayangkara, stated by ownership sertificate no; 301/1974/Ś/70, date 12-7-1970, based on land sertificate no: 775, date 10-27-1953. Ownership data before 1953 were not found. The site area is 4140 m2 based on measurement no: 572 date 9-10-1920 with eigendoom-acte date 7-1-1912 no: 448.

Mayangkara house display an architectural style transition from the Dutch Colonial style to the modern stream at the beginning of the 20th century. The appearance shows the influence of modernism in the early 20th century in the
Netherlands due to the technology, materials and climate. Architectural design in overall was influenced by the architectural style of *Amsterdam School*, which was an expression in the presence of the individual architect idea and attention or adopting to the tropical climate of Indonesia as well as the use of local materials that already existed at that time. The effects of Amsterdam School style can be found from:

1. Cubistic mass form and the look are very expressive. Roof design became the main aesthetic form of the building.
2. The box shape of the building body with a brick wall, the effective interior design, little ornamentation, finishing and neutral color and clean.

The Amsterdam School’s architects often collaborated with artists, and the artists touch was also found in the building. The Art Nouveau and Art and Craft and Art Plasticism (de Stijl) Influence on the building art detail, both on the exterior and interior. The art product can be seen from:

1. Merging of the construction elements with decoration as Art Nouveau characteristic which is the baluster shape in all veranda made from bending steel bars into shaped like a human figure.
2. Art and Craft Arts influence on the window grille motif, door handles, and decoration on the finial (crown on the roof) and door hinges.
3. Plasticism art (de Stijl) influences can be seen at the geometric shapes and colors composition and stained-glass windows and doors.
4. Nieuwkunst influence (an art movement in the Netherlands at the beginning of 20th century) is quite visible in rooms decoration. Linear lines and broken or curve lines and abstract motifs appear in the doorway decoration and building pillars. (see Figure 2)

*Figure 2. Architectural Details in Mayangkara House*

Source: collection of Laboratory of Architecture Development, ITS
RESEARCH METHOD

In conducting research on the building ex Museum Mpu Tantular (Woning voor Agent van Javasche Bank Building) the research method and the steps are as follows:

1. Preliminary Site Investigation
   
   This first stage required secondary data from the owner of Museum Mpu Tantular especially working drawings showing the building location (site plan) and the building detail (floor plans, elevations, sections) as the starting point.

2. Physical Investigation
   
   Survey was done in this second stage on the existing condition (general checklist) on site to collect any information that available and checking on building documents and elements to be studied further, especially the roof.

3. Measurement
   
   Measurements on the roof was carried for the outline roof shape and structure of the roof trusses. Outdoor measurement used a theodolite tool with the starting points on every corners on the roof. For the indoor measurement of the roof trusses structure, executed in manual way using a digital meter (Distometer), tape measure, millimeter paper and stationery.

4. Video and photo documentation
   
   Taking pictures/photos and video documentation done on any part of the building and roof elements that will be studied.

   ![Figure 3. Documenting process of the roof structure](Source: collection of Laboratory of Architecture Development, ITS)
RESULT AND DISCUSSION

Mayangkara’s Parcel Timeline

Mayangkara House has a triangle shape of parcel with orientation to the south. It is purposely set as the entrance to downtown of Surabaya at the time and the south building’s orientation strongly dominated the landscape.

![Figure 4. Mayangkara House site location](image)

Source: collection of Laboratory of Architecture Development, ITS

The building was originally came with complementary building (pavilion) overlooking Diponegoro St. (Diponegoro street may have first built from the Darmo boulevard, it was confirmed with 1918 map). Unfortunately this secondary building was torn down and can no longer tracked it’s trail, replaced with a new building for additional facilities of Museum Mpu Tantular (approximately 1975). Now the rear side have a new building with a new architectural style from the 70’s era (see Figure 4).

The building oriented to south with the symmetrical axis (the building axis) of the building at north - south adjust the shape of the land and add the value as the entrance to the city. The building floor plan is a square. The north wing (pavilion) in the rear is facing Diponegoro St. The main gate (double entrance) located at south corner of the land, while the second gate (service) is on the side of Diponegoro St.

The assumption is Mayangkara House had a role as a gate (landmark) to the city, because of the shape and building orientation, which at the time, the downtown were located on north side of Surabaya.

Floor Plan Design

In the main building, the rooms were organized symmetrical and divided into east and west wing, separated by corridor called *Vetbula*. There were 9 rooms. Each side (East and West) consists of three inter-lined up rooms and connected by galleries (lobby) facing outside (north and south). Gallery not only serves as a circulation space but also serves as a place to enjoy the outside atmosphere of the building.
The front side of the building has a spacious terrace which can be reached from the courtyard below. This terrace is connected with the front veranda, which has a large entrance doors with 8 (eight) door leaf that could be fully opened as connector into the front hall (voor gallery). Front hall is connected to the front room on either east and west side by doors. From this front hall, occupants can enter a small corridor which connected the living rooms on east and west side and also to the rear hall. The living room is small compared with other rooms, but it is the center of the house with a higher ceiling. Each front room has a door that connects to the living room on either east and west side. Living room east and west side, each equipped with 2 bathrooms that juts into the hallway outside. Each of the rear room has a door that connects directly to the rear hall and another door leading to the living room.

If this plan was associated with level of comfort and ventilation design, the galleries (front and rear) have the highest score of comfort. Although located between two bed rooms, but this room served as a relaxation area which were having both mountain view and an open side. Today are hard to proof but some decades ago, when there were no neighbours. There were a mountain view on this south edge of Surabaya that can be seen in morning. And today, on some spot, this mountain view still can be enjoyed.

Beside the front veranda, there are also one in the back, but smaller. In addition, there are also verandas on the east and the west side. Both verandas are neither comes with terraces and stairs that can be reached from the courtyard. On the rear side, a lobby is connected with the rear hall by doors. The rear hall has a roof terrace, but smaller than the front terrace. It is also comes with doors as same as the front doors that could be fully opened.
Roof Design

The uniqueness of this building lies in the roof form with a steep slope. The roof form is similar to the type of roof from France, “Mansard” which has a double slope on all four sides. The roof equipped with finial (crown on the roof) that additionally serves as an aesthetic element which strengthens the value of the roof architecture. Pyramid-shaped finial with an octagonal pedestal that tapers upward. Dormer as accessories from Renaissance roof style also found in this building. The presence of dormer in this building gives the whole image or silhouette (gestalt) and become one of the character of this building.

The roof has a basic shape resembles a star that later became the identity of this building, “Mayangkara” which means star (see Figure 6). With a star-shaped plan, the architects chose a very complicated roof design that is square hip roof or pyramid roof with 12 hip rafters and 8 valley rafters.

The first assumption when see the size of the roof of Mayangkara House is a wide span of roof truss construction that carried by brick walls which was separated about 30 m. The size of the roof intentionally scaled up, and when compared to the wall then the proportion is about 6:1. But in reality, after an investigation from the working drawings and observations on the ceiling, it turns out that the roof construction is so complex and has a clever structural solution.

Mayangkara roof had a unique structure, due to the size of width and height that exceed the size of local roof houses at that time which generally were 1/2 or even a 1/3 the size. So at that time, Mayangkara House was a remarkable structural achievement. The roof size made its own problems that was the structural roof span was too large, reached about 30 meters (see Figure 7).
If using a single size of roof truss, it could cause problems in the load distribution on trusses connection points. To overcome this problem, Job en Spreij have a solution by dividing the load distribution on the roof. Due to the pyramidal shape of the roof, then the principle of load distribution is the concentrated load’s distribution (peak of the roof). So there were loads on the inner perimeter (half body...
of the rooftop or peak) which was greater than the load on the outer perimeter (half body of the lower rooftop) (see Figure 8).

The structural solution was with separating roof load into two sides, using two types of roof truss in different sizes, but both were in the same ridgepole pathway. The uniqueness lies in the extension of the structural bearing wall to support the small roof truss (Figure 9, Top) so as to create a stable load distribution. The small size’s roof truss (truss type 1) being the main supporting truss to the load of east-west ridgepole (inner perimeter). Roof truss type 1 consists of 6 truss supporting the east-west ridgepole and 2 truss supporting the north-south ridgepole. The big size’s roof truss (truss type 2) act to support two trusses of the truss type 1, for supporting north-south ridgepole. Finial and ridgepole is a whole combination made of iron. Such components were rarely found in tropical climate’s houses.
Europeans who came to Indonesia in the colonial era, had to adapt to the way they lived. By combining western technology and knowledge about asian architecture, they attempted to respond to the tropical climate, but do not leave the trail of subtropical architecture. Tunas (2013) writes:

In tropical architecture one of the most important elements of a building is its roof. In the region which is characterized with strong sun radiation and high rainfall, the roof is essential element that makes a house a shelter. When the Europeans reached the tropical countries and settled in various places of these regions during the colonial expansion period, they built themselves houses that purportedly designed to be climate responsive. In order to anticipate the sweltering heat and torrential tropical rain, their houses were built with big sloppy roof with wide eave that is commonly known as the hip roof.

The dominated feature of climate response in Mayangkara house, besides veranda and wide eaves are the dormer. There are several types and forms of the dormers, and it is located about quarter part below the roof. Dormer is a structure projecting above a sloping roof, usually housing a vertical window. It is not part of the roof structure but is framed separately, and often provides daylight and ventilation for a room located in a garret or loft space. At Mayangkara house, rooms inside the dormers are not occupied but only empty space above ceilings, so the function is only for air circulation inside the roof.

Figure 10. Types of Dormers and details indicated an Art Nouveau influences
Source: collection of Laboratory of Architecture Development, ITS
Concern on ventilation and lighting as well as matters related with the local climate were mainly considers. It could be found at:
1. Slope of the steep roof for solving heavy rainfall problems in Surabaya.
2. Eaves throughout the building for creating shades that could minimize the entry of sky light into the building.
3. Veranda (galleries) along the outer side of the building serves as the rooms protection from direct sunlight and rainfall.
4. The building lay-out also leads north-south in an effort to avoid direct sunlight.

Response to the climate condition of Surabaya were done with doors and windows that surrounding the outer walls to enter natural light into the rooms. Ventilations were lined up on entire upper walls even between rooms. Ventilations were also used at the lower rooftop in the middle hall, for air flow so that the heat radiation can be reduced. In addition to ventilation, design of hip roof that big and tall, and has Dormer on four sides was a solution to the Surabaya hot-humid conditions. The existence of veranda that surrounding the building was also as a thermal insulator so the heat of the sun was not directly spread into the rooms.

**CONCLUSIONS**

Mayangkara house is an example of buildings from the Dutch colonial era that respond to the tropical climate. Mayangkara house has given a lot of knowledge about what a good tropical architecture should be. The large size of roof and the steep slope of the roof are appropriate for tropical climate, considering heavy rainfall. The use of verandas and eaves also need to be applied to reduce the sun rays and creating large shading. On architectural engineering point of view, it was a masterpiece of art and engineering construction. Splitting up the roof load into two roof truss was a brilliant solution. Both architect and structural engineer, had to construct such a unique roof shape with very high consideration for structure that could withstand for decades. Today's modern buildings should implement this features and even improve a better design responses.

**REFERENCES**


Von Faber, G. H. (1906), *Oud Soerabaia: de geschiedenis van Indië’s eerste koopstad van de oudste tijden tot de instelling van den Gemeenteraad*. 
EFFECT OF CEILING HEIGHT IN THE COMPRESSED EARTH BLOCK WALLED BUILDING ON EMBODIED ENERGY DAN HEAT ENERGY CASE STUDY SIMPLE HOUSES IN SURABAYA

Vincentius Totok Noerwasito
Department of Architecture, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia
E-mail: totoknoerwasito@yahoo.com

ABSTRACT

One of the factors that influence the use of volumes of material in the building is a ceiling height in the building. Ceiling height also affects to the comfort inside the building. Materials usage in building is closely related to the energy used for the process of making the building materials or the so-called embodied energy. Minimum ceiling height does not always lead to embodied energy is low. Therefore, the optimal of high ceiling to be important for efficiency embodied energy building. As a case study in this research was the use of a simple building with Compressed Soil earth Block Walls. This material has a lower embodied energy than bricks and concrete blocks. The purpose of this study was to obtain a ideal high ceiling that has embodied energy and heat energy efficient building. The method used was the optimization to embodied energy building with the height of the ceiling and heat energy into simple building. Wall building used compressed earth blocks. The research variable used area of buildings and high ceiling.
The result is the building that has embodied energy and heat energy building efficient with a high ceiling ideal. The building uses compressed earth block walled.

Keywords: embodied energy, heat energy, high ceiling, simple building, compressed earth blocks.

INTRODUCTION

The need housing for the low and middle-income class in Indonesia today is huge, so many modest homes built with various types of building area are adapted to the consumer. Design problems in the building for a modest home when not accompanied by a study of the Green building design, as a result impact on the sustainable environment are not taken into account. This will cause serious environmental problems in the future.
The depletion of natural resources influence the emergence of the concept to reduce the world’s consumption of natural resources. So it appears the green building concept of the 3 R, namely reduce, reuse and recycle. In support of this concept to save the earth, building design must implement the concept. Energy also had a role in the process towards designs that make the building energy efficient.

One of the energy saving and the use of building materials is by knowing embodied energy of building. The embodied energy is the energy requirement to construct and maintain the premises (Richard Haynes, 2010). A good building is a building that has a relatively low embodied energy.

Different ways to reduce the value of embodied energy building among others by reducing the volume of materials, reduce the size of the building, using building materials that have low embodied energy. In this study, embodied energy efficient is done with volume reduction the building materials by reducing the height of the ceiling. Similarly, the materials used into building. Walls of the building using compressed earth block, ie a block in the manufacturing without using combustion process. Therefore this material has a low embodied energy.

The problem that arises is that the low ceiling pose a problem of heat energy in the building, and how far the optimal height for the ceiling to the heat energy and embodied energy in the tropics. The end result of the study is to get a building type has an optimal height ceiling to embodied energy and heat energy.

METHOD

The samples used in this study were a simple house buildings that is widely used in Indonesia. The construction of the building using the simple and affordable by the standards of the middle class down. The sampling plan is kept simple plan of existing buildings. Floor areas of the building are 21 m$^2$ to 54 m$^2$.

The variables used were high ceiling and floor area building. Variables ceiling height were determined by ceiling height in general. Each sample building had the same variable ceiling. Embodied energy calculation was done by multiplying the embodied energy per unit area or volume of materials. While the material per unit calculation was done with using the analysis of the calculation of materials SNI (National Indonesian Standard). The selection of the sample that has the lowest embodied used graphs.

Calculation of heat energy using archipak program and the focus value is overheated. The selection of the samples with the lowest overheated using graphs. Optimization was done to determine the sample that have efficient embodied energy and heat energy. This study uses the following mindset (see Figure 1).

The building area and the ceiling height reflected in the type of building is a major factor in this study. So the combination of those two factors need to know the value of embodied energy and heat energy. Of all the samples building that used having embodied energy and heat energy are different or the same values. To determine the value of the sample that has optimal or efficient energy needs in an analysis. Of The optimization of both the energy. Buildings that have optimum
energy that is building the selected. The building is efficient embodied energy and heat energy to the floor area and height ceiling.

![Figure 1 Research mindset](image)

**DISCUSSION**

This study uses a simple building both in plan view and in terms of construction. What distinguishes this building with a simple building in Indonesia as general is the use of materials on the walls of buildings. Wall of building samples using compressed earth block earth, ie, materials that have a low embodied energy. The following plan of the building (Figure 2).

![Figure 2 Plan of sample research building](image)

Figure 2 shows a simple building sample used in this study. Sample floor plan of the building is a type of building plans are widely applied to low-cost housing in Indonesia. Determination of the types of buildings based on building type built to simple house now. In this study the building area and height of the ceiling is a major concern. Ceiling height and floor area influence to the embodied energy and heat
energy. Therefore, each building sample has different variable ceiling heights. Variables of ceiling height can be seen in Table 1.

**Table 1 Variables in the research**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sample code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building area m²</td>
<td>Plafond height m</td>
</tr>
<tr>
<td>21</td>
<td>21T2.8</td>
</tr>
<tr>
<td>21</td>
<td>21T3</td>
</tr>
<tr>
<td>21</td>
<td>21T3.5</td>
</tr>
<tr>
<td>21</td>
<td>21T4</td>
</tr>
<tr>
<td>36</td>
<td>36T2.8</td>
</tr>
<tr>
<td>36</td>
<td>36T3</td>
</tr>
<tr>
<td>36</td>
<td>36T3.5</td>
</tr>
<tr>
<td>36</td>
<td>36T4</td>
</tr>
<tr>
<td>45</td>
<td>45T2.8</td>
</tr>
<tr>
<td>45</td>
<td>45T3</td>
</tr>
<tr>
<td>45</td>
<td>45T3.5</td>
</tr>
<tr>
<td>45</td>
<td>45T4</td>
</tr>
<tr>
<td>54</td>
<td>54T2.8</td>
</tr>
<tr>
<td>54</td>
<td>54T3</td>
</tr>
<tr>
<td>54</td>
<td>54T3.5</td>
</tr>
<tr>
<td>54</td>
<td>54T4</td>
</tr>
</tbody>
</table>

Ceiling height in this research was determined by ceiling height conditions used in building a simple house in general. Determination of the height of each building is currently dependent on the occupants. But in general they do not pay attention to the energy problem is just a matter of beauty interior of the building. In general, the ceiling height of 4 m are usually found in large buildings as examples of type 54. While the ceiling height of 2.8 are found in homes with small type that is type 21. ceiling height of 3.5 m 3 and is prevalent in all types of buildings.

**Embodied energy**

In this study, there are two types of embodied energy, mainly the total embodied energy and embodied energy per unit or average. Embodied energy total (EEtot) is the energy calculations all material contained on the materials used in the building in total. Embodied energy per unit or average (EEav) is calculated EEtot each unit floor area of the building. EEav demonstrate the efficiency embodied energy of the building. Building that has a relatively small EEav is an embodied energy efficient building. This shows that the building is efficient in the use of building materials, which have an impact on natural resource savings. So that the building can be considered a green building design. EEav and EEtot condition can be seen in figure 2 and 3.
Figure 3 shows the embodied energy of the total of all the samples. In this figure it can be seen that all 21 samples of building type has the lowest embodied energy than other buildings sampled. Type 54 has the largest floor area in this study had the largest total embodied energy. This shows the tendency that the larger the floor area of the building has the higher value of the total embodied energy (Etot).

At the height of the ceiling type 36 with a ceiling height of 4 m has EEtot relatively higher than the type 45 with a ceiling height 2.8 m and 3m. Whereas type 45 with 4 m high ceiling has EEtot higher than type 54 with 2.8 m and 4 m ceiling height. This shows a tendency that the ceiling is very high compared to determine EEtot floor area. So EEav can be determined based on building area and height plafondnya. Embodied energy than average buildings with different heights can be seen in Figure 4. Notation sample can be seen in Table 1.
EEav difference at all with the type of ceiling heights shown in figure 4. In general EEav highest buildings are those of type 21. This building type has the smallest floor space compared to other building types. EEav most small buildings is in type 54, this type is the type that has the largest floor area. In general, this suggests that the type building with an area larger has a smaller EEav.

The building has a low EEav is a building with a low ceiling height. As an example can be seen in the type of building 21. In this group of buildings that have the lowest EEav is building 21T2,8 with a ceiling height 2.8 m. Whereas 21T4 building is a building with the highest EEav. Thus these cases occurred in all types of buildings both in type 36, 45 and 54.

Of all the types above that do not have efficient in embodied energy is a type of building 21. This suggests that efficient embodied energy is not always present in the building with floor area of the lowest. In this study type buildings that have efficient embodied energy actually contained in the building with floor area of the highest ie building type 54, the building has an area of 54 m². Judging from the high ceiling there are some buildings that have EEav low at building 36T2,8 in the group of type 36m; building 45T2,8 and 45T3 in the group of 45, while in the group of type 54 are building 54T3 and 54T2,8. These buildings have EEav between 600 to 700 MJ/m².
EEtot and EEav on all samples note to determine the extent to which the level of efficiency of planning a building area with high plafondnya. Figure 5 shows that type 21 has a composition that is very sharp between EEtot and EEav of all samples. While EEav owned was the highest among the other samples. Similarly, the type 54 also has a composition between EEtot with EEav, but this type has the most EEav low compared with other samples. This suggests that use of the material in the building is relatively smaller does not always produce energy efficient materials. Likewise the use of a relatively large materials that can produce energy efficient. It required a careful calculation of the material energy.

**Heat Energy**

Building an ideal addition to having a low EEav the building should also have a low heat energy. Therefore some buildings that already have a low EEav have been building towards optimum of EEav and heat energy. The buildings have a low EEav and expected to have a low energy heat are building 36T2,8; building 45T2,8; building 45T3; building 54T3 and 54T2,8. Based on the calculations overheated building on above was obtained the following results (see figure 6), calculations were performed using the Archipak program.
Figure 6 shows the overheated from the selected building because they have a low EEav. Overheated difference is attributable to the high ceiling and floor area of building. High overheated found in buildings 38T2,8 and 45T2,8. All these buildings have a ceiling height 2.8 m. This suggests that the low ceiling has heat energy is higher than the high ceiling. Building that has low overheated is building type 54. On the building type is the lowest overheated building that has a high ceiling 3 m. Building Type 36 despite having a low floor area, the building still has the highest overheated value.

**Optimization**

Optimization is done because of the discrepancy between the composition of each sample. There are samples that have low embodied energy but it has high overheated. And vice versa. It is therefore necessary to find the composition of the two factors are balanced. The main criteria in this study is the embodied energy. The following image optimization can be seen in Figure 7.
Optimization is performed to select the ideal building sample. The main criteria used are the building should have a low embodied energy, after this the building has a low energy heat anyway. In Figure 7 the building that has the lowest average embodied energy (EEav) is building 54T2,8. While the building which has the lowest heat energy is building 54T3. Both buildings were a group of type 54.

Based on the criteria in the optimization, building 54T2,8 is a building that has a lower embodied energy and also have a lower energy heat anyway, so the building is the optimal to the embodied energy and heat energy. Therefore, the ideal building in the research have been building 54T2,8 or building which has an area 54 m² and 2,8 m high ceiling.

**CONCLUSIONS**

Simple buildings with floor area and ceiling greater have a total embodied energy (EEtot) is greater. Building with lower ceiling and a small floor area have a lower average embodied energy (EEav). It was shown in this study on building Type 36 with the lowest ceiling, the building has the highest average embodied energy (EEav) among other buildings.

Average embodied energy (EEav) possessed by the of the lowest building with larger floor area. This is caused by the increase of total embodied energy (EEtot) is not directly proportional to the floor area. In this study the increase in total energy embodied (EEtot) in the building with larger floor area did not appear.
Lower heat energy in this study was on the building type 54 with ceiling height of 3 m. The building has the highest floor area. Although the building has a low heat energy, it is not an efficient building to embodied energy and heat energy.

Building selected for the optimum building embodied energy and heat energy in this study were not the building that has the lowest heat energy, but instead building has lower embodied energy and lower heat energy.

Planning for efficient building to the embodied energy and heat energy is not seen only in a relatively small area of the building, but must look at the influence of the reduction of embodied energy and heat energy due to the high ceiling plan.

REFERENCES