"SUSTAINABLE APPROACHES FOR BUILT ENVIRONMENT IN DEVELOPING COUNTRIES"

PROCEEDINGS

SENVAR 2013 ACEH

The 14th International Conference on

SUSTAINABLE ENVIRONMENT AND ARCHITECTURE (SENVAR)

Banda Aceh 7, 8, 9 November 2013

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The 14th International Conference on Sustainable Environment and Architecture (SENVAR)

Sustainable approaches for built environment in developing countries"

Banda Aceh, 7-9 November 2013

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ISBN. 978-979-8278-97-6
Syiah Kuala University Press
Darussalam, Banda Aceh
23111

Organized by
Department of Architecture
Faculty of Engineering
Syiah Kuala University
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Darussalam, Banda Aceh, Indonesia 23111
Ph. +6282150704363
University Website: www.unsyiah.ac.id
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Learning from IJburg and Maasbommel Floating Houses: The Planning and Design Approach for Adapting Climate

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Abstract- Dutch landscape is currently highlighted by a new way of living on the water such as floating and amphibious houses to adapt to a sea level rise and floods. Ijburg in Amsterdam is one of the examples, building up 55 pile and floating houses on a surface water reservoir. In Gouden Kurst, Maasbommel another innovative approach was taken in 1998; twenty amphibious housing that stood on the lakeside were constructed, these houses were designed in order to float during high water.

This paper is aimed at analyzing and describing the innovative planning and design approach that have been implemented in these two projects. Particular issues will be raised on **1) the background of the project especially relates to urban design and planning; 2) its spatial pattern (connection with land and water); 3) building design and structure (buoyancy, materials, and utilities); as well as 4) construction and delivery.** Data were collected through field observations and literature studies. Maps, plan, section, and photos will be used as a major method to analize and illustrate the design and concept.

Output of this study is intended to inform the cities and regions in Indonesia that face the same problem with floods, yet have a strong connection with water for years. Banjarmasin is one of the examples, it is well-known for a city of a thousand rivers and tradition living on water in floating houses (Rumah *Lanting*), however, there has been no new approaches taken to develop *Lanting* into a modern and sustainable lifestyle living.

Keyword: floating houses, climate change, adaptation, Netherlands

I. Introduction

Every city is challenged to increase the capacity to adapt their built enviroment to the vurnerable impacts of climate change such us floods and sea level rise. Netherlands as a low-lying country that highly exposes to the sea and 24% of land is located below average sea level (N.A.P) is constantly dealing with these issues since thousand years ago. The 'war on water' has begun from more than 2000 years ago (around 800 AD), highlighted by the construction of dikes, polders, pump stations, dams, canals and land reclamations [1]. In addition, the population growth had pushed the country to provide new lands for urban development; especially for housing.

These conditions have brought to the changing attitude toward water in Dutch society and also to the strategies and actions dealing with water. Dutch landscape is currently highlighted by a new way of living on the water such as floating and amphibious houses to adapt to a sea level rise and floods. IJburg in Amsterdam is one of the examples, building up 55 pile and floating houses on a surface water reservoir. In Gouden Kurst, Maasbommel another innovative approach was taken in 1998; twenty amphibious housing that stood on the lakeside were constructed, these houses were designed in order to float during high water.

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II. FLOATING HOUSES: PLANNING AND DESIGN ISSUES

A. Living on Water & Spatial Planning

Water and scarcity of land for urban development become two major driven factors in developing floating houses in the Netherlands. Spatial planning that was initially separated from water management, since late 1990s has been integrated with and accommodated within the national spatial policy. “Room for the rivers (2005)” and “Working together with water (2008)” are the new campaign in current Dutch urban development. Rather than pushing the water back to the sea or protecting the low-lying lands with higher dikes, water is as much as possible be accommodated in urban areas and the surrounding landscapes [1][2]. While providing enough water storage, the water space also offers new land use for urban functions such as the establishment of water-based dwellings or 'dual space use' [3].

In 1988, Ministry of Housing, Spatial Planning and the Environment released Fourth Report on Spatial Planning Extra (**Vinex** - ***Vi****erde* ***N****ota Ruimtelijke Ordening* ***Ex****tra*). One of the policy output was to develop Vinex Districts - large outer city areas for massive new housing development during the period of 1995-2005 with 61% sites are located outside but close to a city (outlying sites) and 39% at inner urban sites. In 2005, the spatial planning memorandum was released and required the integration of water management into spatial planning; where the government has stipulate that new residential neighborhoods in Vinex districts must provide a minimum of 10% surface water for storage during high water [1][4]

De Graaf [5] adds the use of surface water for urbanisation, as floating urbanisation. He underlined that in 2005 the Minister of Spatial Planning has designated a 15 areas for innovative housing experiments (so called EMAB Locations). In these areas, constructing houses in the floodplain is allowed if innovative building methods are applied.

Although living afloat on boat houses has been a tradition in the Netherlands for thousand years as well as Dutch society has gained confidence in 'back to water' supported by Dutch Government policy in the Netherlands in general have positive attitudes toward living on water; a new typology of water-based dwellings such as floating house or neighborhoods remain a new entity in current spatial planning; it still exposes to difficulties in the future development due to the present laws and regulations that do not fit into this new typology of water dwellings [3].

Furthermore, Mutia [6] found that the geographical distribution of new water-based dwellings in the Netherlands, that range from fixed water-side living to floating houses, majority is distributed at the peri-urban areas, except for Borneo-sporenberg and IJburg which part of Amsterdam waterfront regeneration and one of the most urbanized Vinex district (IJburg). Since the location is in suburban area, preferable typology and design that have been developed mostly free-standing and semi-detached houses with one to three storeys.

Types of water in the Netherlands that become a possible locations for water-based dwellings are categorized into six, those are the sea, the lake, shallow lakes and channels, canals and waterways; and flood relief areas [3]. Due to its open location that exposes to the wind and tide, there is no permanent buildings allowed in seaside, especially on the dikes of North and Wadden sea. For the rivers, they are subject to frequent water fluctuation during heavy rain and drought, the river basins face a risk of flooding if there is no protection such as dikes. Moreover, the shipping transportation and strong currents carry risks for development along the riverbank. Floating and amphibious housing that give space for water are considered the alternative solution for the riverbed areas. Lakes are another preferable areas for developing floating houses. Lake water level is subject to seasonal variation, depended on the water supply from the rivers, precipitation as well as the government policy that regulate the required water level for fresh water supply. Water level in lake is highly controlled, so that, it is an advantage for floating houses and also recreation.

Shallow lakes and channels are usually dug by developers to make water surface and drainage. However, they tend to be just a few metres deep and mostly are not connected to rivers. This type of water can accomodate a small scale water-based dwellings. Canals and waterways in the Netherlands are men-made and managed; they linked to waterways network by locks and used mainly for transportation and recreational links. Many traditional boathouses in big cities such amsterdam are mooring along the canals with certain permitted zone, but not for water dwellings. The last type of water is flood relief area. It is usually located at rural are and subject to get overflooding from rivers only at exceptional cases [3].

Nillesen & Singelenberg [3] also divade the water-based dwellings and its relation to the water into three different relations [fig.1]: land-based houses (the house on the edge of bank and water), floating houses (entirely on water, connected by jetties or bridges) and amphibious houses (stood on the land, afloat during high water).

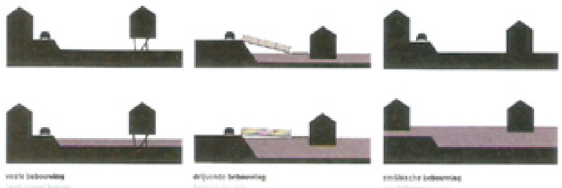

Fig.1 Houses and its relation to the water

B. Floating House Design

According to Olthuis & Keuning [7], floating houses have dual functions for adapting to climate changes (floods and sea level rise) and further as an alternative dwelling to reduce congestion in urban area. He highlights the main advantage of floating buildings is its flexibility for relocation and multipurpose use at different time. On the other hand, floating buildings also has drawback in stability, especially adapting building to the fluctuated water. The design of floating house usually is eqquiped with mooring posts (poles) from concrete or metal to keep the building on place when it glides up and down. The proporsion of building also contributes to its stability; the height of the building should be shorter than its length.

In developing modern floating houses, it needs to become equal to traditional house on land at every aspects, those are in comfort, quality and price. Comfort means that the stability and building physic are the same with those on land, availability of exterior space such as garden and parking and accessibility increases the comfort. In the term of quality, the materials and maintenance of floating house as well as durability and foundation resemble the common landed houses. Floating houses still has a niche market, the price is higher especially in a single poject. Therefore, in order to make it competitive with landed house, the project should be built in larger scale [7].

How the floating houses works on water is the same as a boat, it is based on the Archimedes rules, which said that an object in a fluid experiences an upward force equal to the weight of the fluid displaced by the object. Therefore the buoyancy and weight of the building become a critical considerations of floating houses. Currently the materials used for foundation are made from concrete, steel and polystyrene foam, each of them has advantages and drawbacks [7].

De Graaf [5] underlines that within the water regulation in the Netherlands that only allowed a 1.5 metres depth below water for floating houses make the application of concrete foundation limited to a smal scale house in canals or lakes. On the other hand the new polystyrene (flexbase) material which lighter and provide higher buoyancy offers more flexibility in form and size, yet higher in cost.

(a).Concrete (b). Polystyrene (flexbase)

Fig.2 Foundation materials for Floating house

III. IJBURG AND MAASBOMMEL FLOATING HOUSE PROJECTS

A. Floating Houses at IJburg, Amsterdam

IJburg is a residential and mix-used development built on artificial islands at IJmeer (IJ Lake), east part of Amsterdam. It is the most urban location of Vinex District in the Netherlands. Part of the development is Steigereiland Neighboorhood, which allocated for pile and 55 floating houses that make use of surface water reservoir, built during 2006 – 2011 (Fig.3). The water for the project is an enclosed water eqquipped with a lock to control the water level. The site divided into Waterbuurt Oost (Fig.4) and Waterbuurt West (Fig.5).

The pile and floating houses at west part is designed by an architect, Marlies Rohmer; and constructed by a boathouse builder ABC in Urk. The east side of the site is allocated for self-built plots on water, where individual can design their own floating house. This project is the only one floating dwellings that by government is regarded as a 'real estate' property, not as usual moveable property (boat), where the regulation on a landed house is also complied with this project such as safety, maintenance, utilities, public access and so forth.

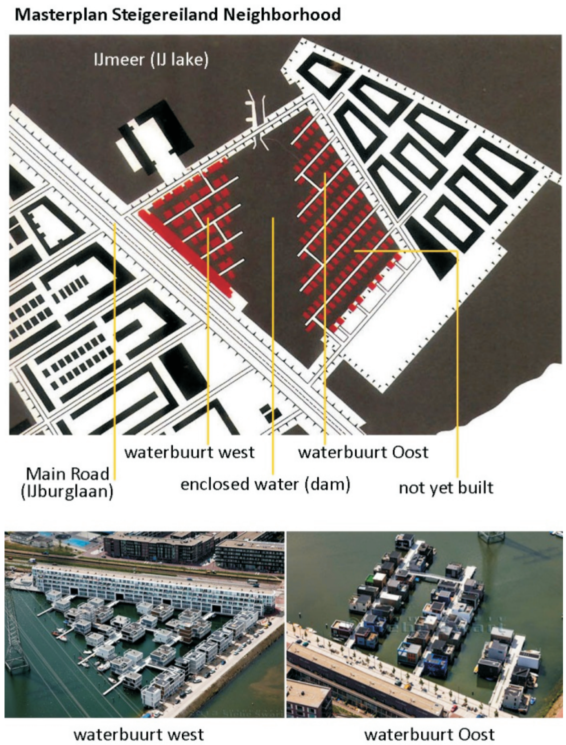

Fig.3 Masterplan Steigereiland IJburg Floating Houses

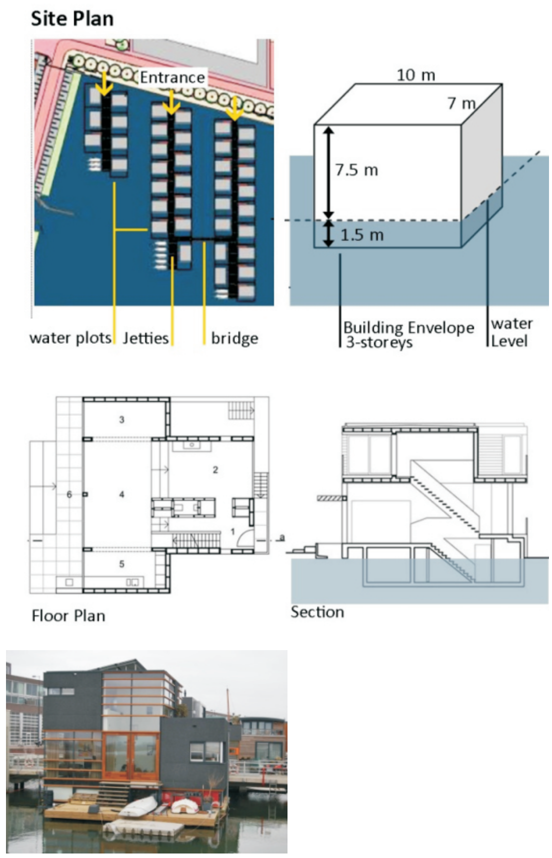

Fig.4 Design of Floating Houses (Waterbuurt Oost)

Currently, there are 36 self-designed floating houses occupied the water plots at the Waterbuurt Oost, the rest is still vacant. The connection to the house from the land (street) is linked by the jetties, in addition people also can get off from a boat on water that linked to IJ Lake. Besides used as a circulation and access to the houses, jetties also provide a link for utilities (fresh water, electricity, sewage) to existing infrastructure on the land.
At waterbuurst Oost, a building envelope measuring 7 by 10 metres, 7.5 metres above and 1.5 metres below water. This came from the water regulation and a size of the lock on water that limit the size of floating houses. The 3-storeys floating houses design to resemble the standard amenity of a landed house such as balcony and floating garden and terrace. However, according to Olthuis & Keuning [7] it is found that after the house sits on site (water), due to the size of the building makes it instable and needs extra buoyancy.

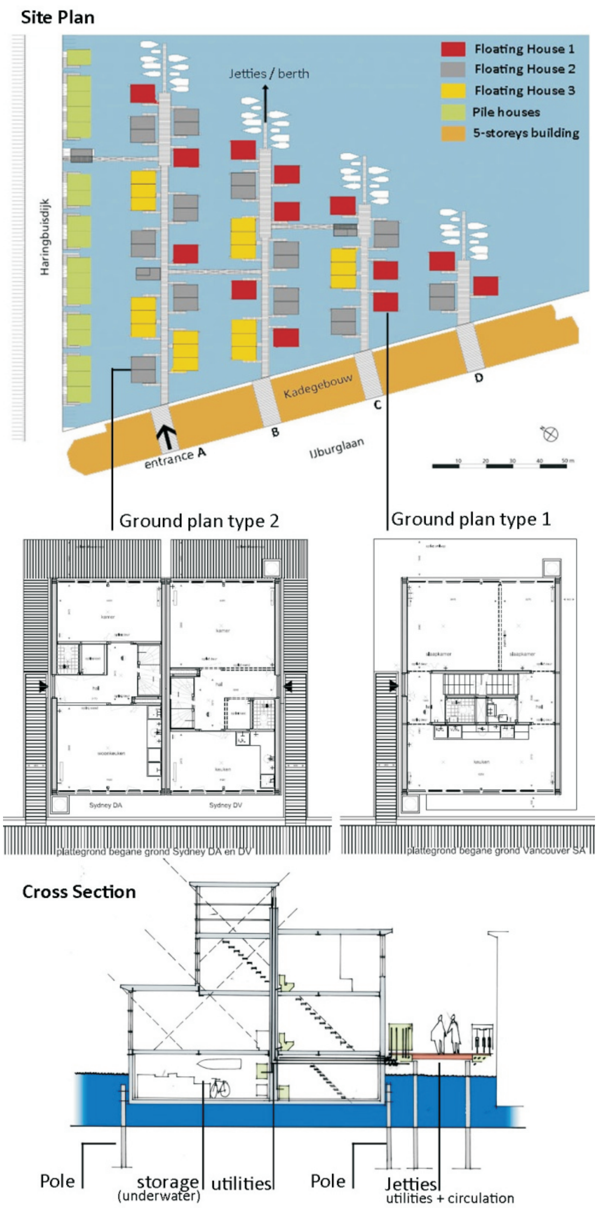

Fig.5 Design of Floating Houses (Waterbuurt West)

At Waterbuurst West, there are piles and floating houses built on water linked by jetties. Besides its similarity in design and materials , the architect provides 3 types of floating house to give choices, those are a single unit (Vancouver type), a double unit (Sydney type) and a triple unit (Seattle). All of them are a three-storeys floating house attached each other and that are accesible from water. the concrete jetties act as a public space and circulation and are fitted with cables and pipes for utilities. For safety standard, there are railings and fire walls; a bridge at perpendicular position to jetties functions as escape routes in case emergency (Fig.5).

B. Floating Houses at Gouden Ham, Maasbommel

Maasbommel is a rural area in Gelderland Province. The project is located at Gouden Ham, a recreational lake (flood relief) linked to Maas river; a river which is known for its seasonal flooding. The floating houses Gouden Ham is the first big scale amphibious houses project in the Netherlands; designed by Factor Architecten and built by DuraVermeer during 1998 – 2006.

There are 20 amphibious houses and 14 floating ones, under the EMAB project (experiments in adaptive housing). The site is located outside the dikes in area that was intentionally chosen for its regularly high level water. The houses will float during floods (NAP +5.10), they are built on concrete floating bodies with a coupling construction. At low water level (NAP +2.60), the houses rest on a concrete foundation. The Dutch have realized that building higher dikes to keep out the sea is no longer the solution. Here, the water gives more space by allowing the building to adapt during floods/ high water (Fig.6).

The design of the house used a hollow concrete foundation that supported by iron piers at the bottom. To maintain the stability of the building size and shape, the house contructed in a couple unit. Two mooring posts that attached to the buildings and platform allow the house to rise without drifting. And light timber construction helps to keep the house stable (Fig.6).

C.Stability and flexibility of design

Building the floating house on water needs to consider stability and flexibility of the construction, due to the fluctuation of water level and also the fixed (jetties) and unfixed (building) components that attached each other. From the case of floating houses in IJburg and Maasbommels, both design use two mooring posts for each unit to maintaince the stability so that the house keep in place when up and down. Other detail that also important is the connection between the jetty and the house as well as the pipes and other utilities that should be flexible following the movement of water (Fig.8).

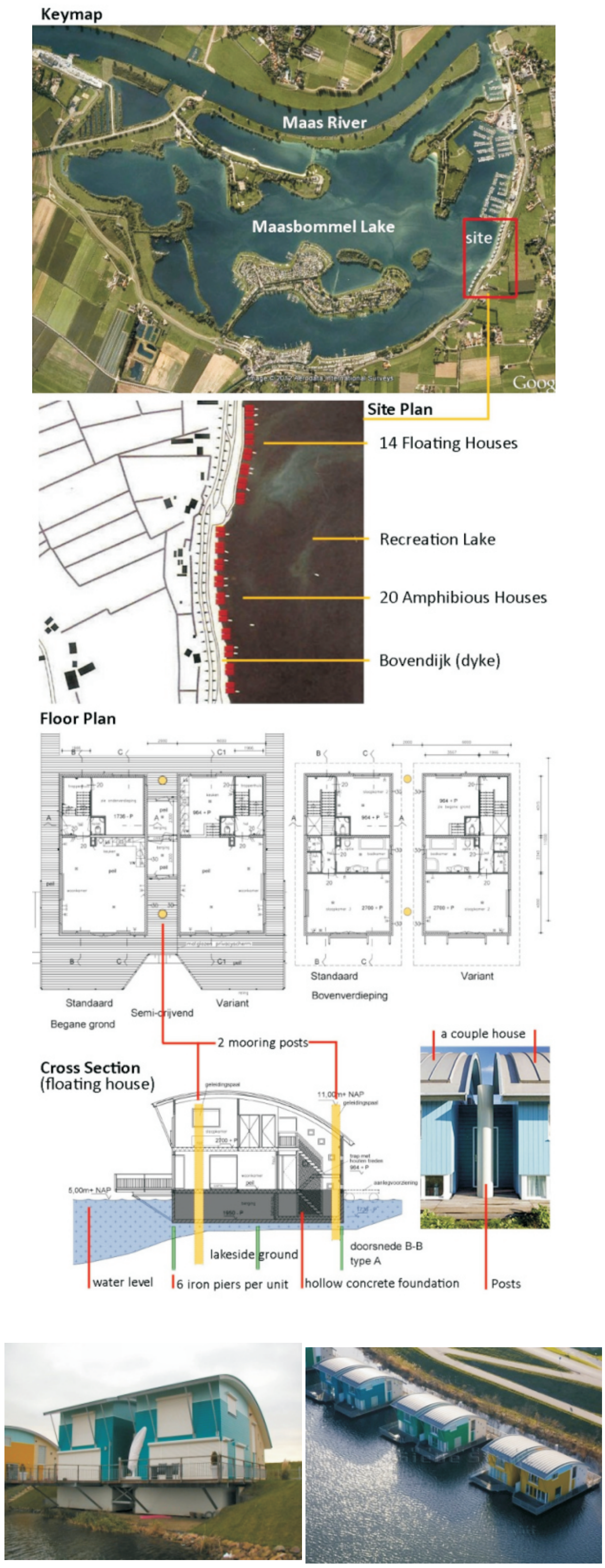

Fig.5 Design of Maasbommel Floating & Amphibious Houses

Fig.8 Flexible Design & Utilities

D. Construction and Delivery

The two projects (IJburg & Maasboomel) have a different method in construction and delivery of the floating houses. The ones in IJburg, they are entirely fabricated, built in factory; usually by the builders that have experiences in making boat houses. After finished, the houses towed by tug boat through the waterways from a small fisherman town in Urk to IJ Lake (IJburg). It becauses the house must pass through the lock of the water, which the size is limited to 7 metres, the width of building should follow this measurement (Fig.9). On the other hand, floating and amphibious houses in Maasbommel were constructed on site especially the concrete foundation and the posts, the buidling itself uses timber prefab materials (Fig.10)

Fig.9. Delivery through water (Floating Houses IJburg)

Fig.10 On Site Construction (Floating Houses Maasbommel)

IV. CONCLUDING REMARKS

Learning from IJburg and Maasbommel floating houses projects, the are some principles that can be underlined in order to develop floating houses and the built environment that can adapt to climate change, especially floods and sea level rise.

Firstly, there should be an integration of water management and spatial planning by national/municiple policy and strategic actions, thus, urban development can go paralel with the attampt to protect water and environment from the vurnarabilty of climate change. Water is as much as possible given space in our urban environment. In this case the policy that required Vinex districts to provide a minimum of 10% surface water for storage and a strategies to develop innovative housing provision (so called EMAB Locations) in Maasbommel are the example. Secondly, from both cases, the preferable location for floating houses is at the lake, the area where the water level controlled and predictable. Rivers and open seas that expose to currents, wind, and unpredictable floods are less encourage due to safety reason. It is also important in designing the site for floating house neighborhood to provide accessibility from water dan land as well as an emergency escape.

Third, there are some technical design that should be comply with the floating houses, especially about the stability and flexibility, include here the proportion of building, the materials, and utilities (pipes & cables), that will make the house resilient and float better. The last, light and frefab material such as timbel, steel, glass are commonly used for floating houses as they are easy and fast to construct and deliver everywhere. A hollow concrete foundation is used in these two projects, either for fabricated or on site construction, as it is still more economical for small scale housing projects.

ACKNOWLEDGMENT

The author would like to thanks Training Indonesia's Young Leader Program, The University of Leiden for the fellowship opportunity to conduct a library research and field observations in the Netherlands.

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E04 Abstract Reference Number

Making Sustainable Impact with Existing Buildings

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Abstract- Sustainability in built environment is an important agenda. It is now no longer a healthy trend but an obligation to future generation. For new buildings, sustainable ideas can easily be addressed as early as in the design stage. Simulating the performance of buildings before construction has been proven contributing further to attaining best sustainable solution. However, for existing buildings, sustainability has to be carefully treaded as any upgrading made may have adverse impact to existing structures and envelopes of the buildings. The existing buildings present greater challenge to sustainability as their ratios are much higher than new buildings. This paper shares innovative and novel ideas on finding new materials within reach locally that can easily be applied without major changes to the existing buildings. All attempts are with specific interest on providing good thermal performance and human comfort of existing buildings thus reducing need for mechanical cooling with conscious effort towards energy saving, low carbon emission and mitigating UHI. Three different studies are discussed. Each tries to reduce indoor air temperature with its own novel solution but yet interestingly straightforward, friendly application and economical. It is hoped that they can show that caring for existing buildings is also matter to us as we seek comprehensive solution in achieving sustainable natural environment and built form.

Keyword: Sustainability, Existing Building, New Material, Thermal Performance, Local

I. INTRODUCTION

Sustainability in built environment is an important agenda worldwide. It is now no longer a trend but an obligation to the future generations. For new buildings, sustainable ideas can easily be addressed as early as in the design stage. Simulating the performance of buildings before construction has been proven contributing further to attaining best sustainable solution especially for new building constructions. However, for existing buildings, sustainability has to be carefully treaded as any upgrading made may have adverse impact to existing structures and envelopes of the buildings including the cost factor. The existing buildings present greater challenge to sustainable designers and policy makers as the ratios of existing buildings to new buildings are much higher. This paper shares innovative and novel ideas on finding additional features or new materials within reach within the local context that can easily be applied without major changes to main structures of the existing buildings.

The three innovative applications:

Three different studies are discussed. Each tries to reduce indoor air temperature with its own novel solution but yet interestingly straightforward, friendly application and rather economical. These three are part of the current work of PhD candidates in the Faculty of Built Environment, Universiti Teknologi Malaysia. They show different solutions but with similar intention of reducing energy used in existing buildings.

ATTEMPT 1: PAU CHUNG LENG - SOLAR CHIMNEY

A Computational Fluid Dynamic (CFD) simulation has been conducted to compare the thermal performance of an existing terrace house in Malaysia. The experiment was conducted in a 2 level basement cum 2-storey terraced house with solar chimney in Bayan Lepas, Penang, Malaysia. The house was designed with a shaft, without functioning as the solar chimney which is useful for stack ventilation. The existing shaft was served as the ventilation shaft for bathroom. The terrace house is located at the hill slope, which facing north-south direction. The bedroom is facing north. The simulation date was set at 21 February 2012 17:00 with air temperature 34°C, which marked as the hottest hour of the year. In this case, master bedroom was selected as the case study to verify the functionality of the solar chimney as the ventilation tool. The bedroom is equipped with full height glass louvers opening with 230mm double brick party wall and 150mm single brick thick wall as internal partition. The master bedroom is located at the ground level, with enclosed floor area of 28.03m². The modification of the shaft into the solar chimney would be carried out through CFD simulation and verifying the solar chimney as the stack ventilation tool. The input data for the CFD simulations including the problem type, flow domain (material, type of flows and so forth), boundary conditions (building components, inlet and outlet and wall), and calculation method. [1] The calculation in this case, used the standard k-e epsilon turbulent model with 5000 iterations. The external walls and solar chimney were covered with adiabatic wall to avoid external heat calculation taken part in the simulation.

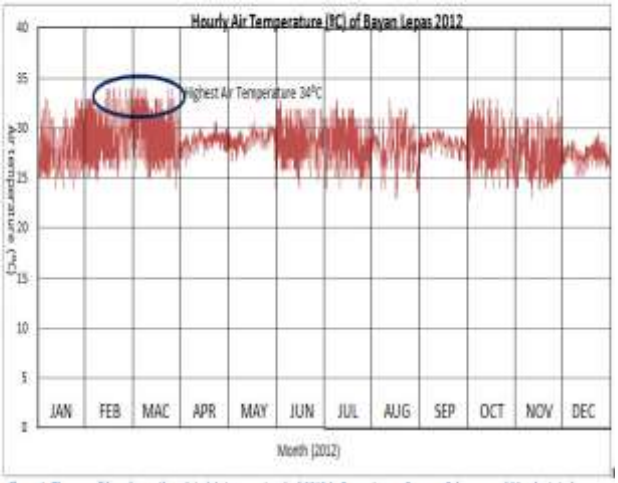

Figure 1: The overall hourly weather data (air temperature) of 2012 in Bayan Lepas, Penang. February and March stated as the month with most hottest day of the year 2012

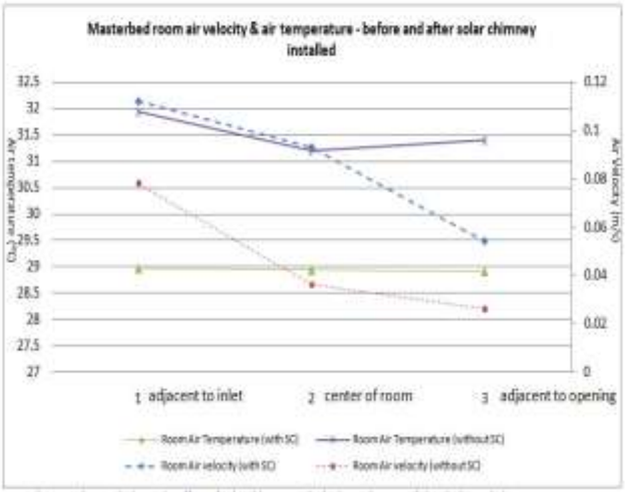

Figure 2: The graph shows the effect of solar chimney to the bedroom in term of air velocity and air temperature

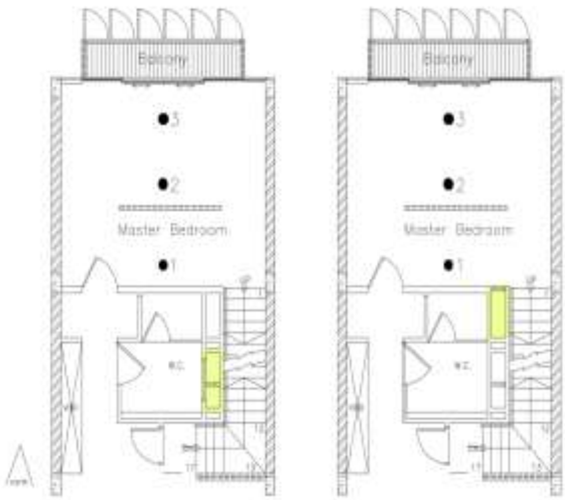

Figure 3: The black dots indicate the measuring point (1,2, & 3) of CFD simulation and the yellow shade indicates the location of solar chimney before and after modification has done.

The impact of the solar chimney as the natural ventilation tool that keep the internal building in ventilated and cool condition, could be influenced by various factors: the length and width of solar chimney, the outlet and inlet opening size, the material of the solar chimney, the window opening types and sizes of the room that connected to solar chimney and so forth. Thus, in modeling the geometry of solar chimney house, the measurement of the basic components does take into consideration and bound into the boundary condition set by simulation software. According to the results shown in figure 2, in overall the air velocity from external environment has increased from point 3 to 1 while the air temperature has decreased. This is due to the venturi effect, which increase the speed of the air from the huge opening towards smaller opening in the solar chimney. The opening of the window is set as 100% opening, with 100% wall to window ratio. The sizes of the inlet opening is 24 times smaller than the window opening, and thus the air speed pass through the bedroom from the window to the inlet and escape through the solar chimney is faster, compared to the existing room which not connected to solar chimney. The wind speed at point 3 to point 1, recorded as 0.054m/s and 0.112m/s respectively has shown the 48% of wind speed improvement, which is 0.058m/s differences. In term of air temperature, from point 3 to point 1, the air temperature has increased slightly from 28.91ºC to 28.96ºC, which is 0.19% of insignificant increase.

Compared to the existing room which is not connected to solar chimney or considered as single sided ventilated room, the air velocity from point 3 to point 1 only shows 33% increase, which is 15% lower than the room with solar chimney inlet. For the temperature aspect, the room without solar chimney posses high air temperature, which is 2.25ºC or 7.7% higher than the room with solar chimney inlet. The increase of the air speed could reduce the air temperature which increase the comfort level of the indoor environment. In figure 4, the effectiveness of the solar chimney in giving the thermal comfort for the indoor environment could be predicted by Predicted mean vote (PMV) indicator. For the master bedroom with solar chimney inlet, the predicted mean vote of the 3 points giving the satisfactory range, which are +0.48 to +0.53 while the room without solar chimney inlet shows the PMV range between +1.7 and +1.8. The effective range of wind speed which gives the positive and acceptable PMV range is 0.11m/s and above. The optimum room depth in respond to solar chimney geometry could be developed in order to obtain the better comfort range of indoor environment.

In this case study, solar chimney has proved that the thermal comfort of the indoor environment, especially the existing terraced housing in Malaysia could be improved without major changes. The long hour of solar radiation and high outdoor temperature enabled the solar chimney to function well, which could increase the performance of the ventilation in building during the hot afternoon and evening hour. The PMV evaluation shows that the natural ventilation performances could be enhanced by modified the existing terraced housing with the solar chimney. Further research needed in order to determine the best air temperature and wind speed for thermal comfort with optimum room depth and solar chimney geometry in hot and humid tropical climates.

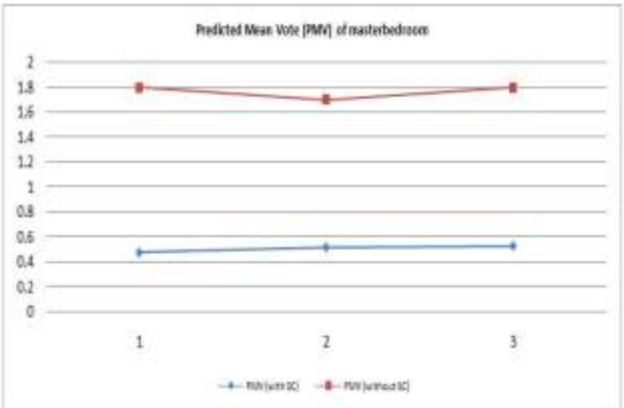

Figure 4: PMV of master bedroom with and without solar chimney

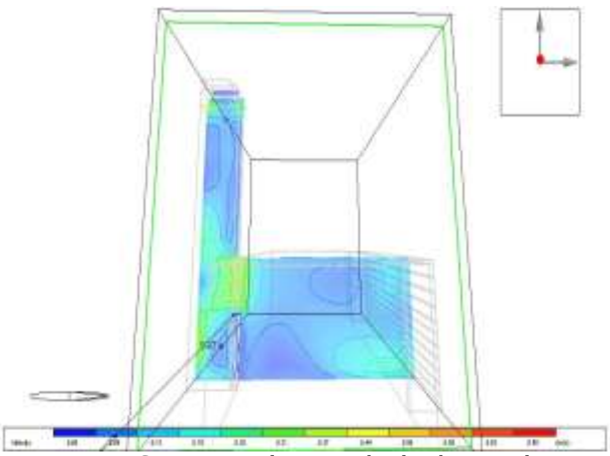

Figure 5: CFD countour diagram with solar chimney inlet

ATTEMPT 2: DANNY SANTOSO MINTOROGO - PAKIS BLOCK

Surabaya with latitude of 7⁰ 17-21' South, on year 1995 till now, a lots of business places are needed to develop. Middle-class businessmen or presenting business firms can't afford to rent office spaces on high-rise buildings. Therefore, single-houses, town-houses, shop-houses, and even dwellings along the main roads become favorite places for business. The Surabaya's city exhibits a lot of new towns, shops, and office-houses built to two or three stories with majority of flat concrete rooftops of around 12,400 m2 at Manyar Kertoarjo's business-zone (C), Putro Agung's zone of 5,900 m2 (A), Klampis Jaya CBD of 31,00 m2 (B) as well Galaxy's Shop houses of 24,000 m2. All of these flat bare concrete rooftops are not insulated on top or beneath the concrete roof deck. Less greenery rooftops and high trees are planted along the business zones. Concrete-block paving's are dominantly covered for walk-ways, and street-ways are built up of dark-asphalt. Could we imagine how much watt per square meters of out-going solar heat irradiance from those materials will bounce back to the built-up areas, and how much air temperature of thermal conduction, convection and irradiation will add up to the urban-business heat island?

By applying rows of pieces of Pakis blocks over the flat bare concrete rooftops mainly as external environmental friendly roof-thermal insulation, the reflected solar heat irradiation to build- environment will be controlled. Pakis blocks will absorb much of those heat solar irradiation to prevent too much reflected heat to the environment.

What are the pakis-stem blocks? Generally, knowledge of pakis-stem blocks are commonly sold by orchid flower shoppers, and flower users always attach the orchid on top of Pakis blocks. These Pakis blocks come from Pakis trees which could be found in the tropical forest; the Pakis tree's stems are then sliced into pieces of Pakis blocks (figure 6).

Figure 6. Pakis Trees, Pakis-Stem Blocks, and Orchid on Pakis Block (Source: Mintorogo, 2012)

Pakis Blocks in the market are sold in different sizes as shown in A & B (figure 7). Pakis Blocks small size (7A) in 1 m2 will have 33.3 blocks and weights 5.2 kgs for dry pakis blocks; in wet condition, small size pakis blocks in 1 square meter have weight of 7.3 kgs. Meanwhile for big size pakis (figure 7B), 1 square meter will be contain 20.83 blocks, and the weight = 5.2 kgs (dry condition), and 7.4 kgs (wet condition).

Figure 7. Pakis-stem-Block variances

The research is a field experiment which has been conducted at Petra Christian University's flat concrete rooftop. The global solar irradiation data were recorded hourly and were taken at least 2 to 3 days or more respectively and simultaneously on rooftops with digital data logger and pyranometer of HOBO.

Three unit of pyranometers are used to have a figure of global solar irradiance intensity; one unit is measured for the horizontal global solar irradiation, and two unit pyranometer are turned over to measure the reflected global solar irradiation (albedo) from different materials like grey rooftop concrete, stopsol classic dark blue glass, grey paving blocks, wooden blocks, lawn, soil, yumen board and white pakis blocks; meanwhile one flipped pyranometer is continuously placed on site to measure the brown pakis blocks respectively. In order to know the temperature and emission of longwave heat energy from brown Pakis blocks and white Pakis blocks (lighter color cooler surface)(figure 8).

The reflected global solar irradiation measurements were taken to compare to brown pakis blocks with other materials respectively; each measurement with different material to brown pakis blocks was measured between two to three days period. The major measurement on this research is to know how much the white pakis blocks reflect outgoing global solar irradiation to the space environment than the brown pakis blocks.

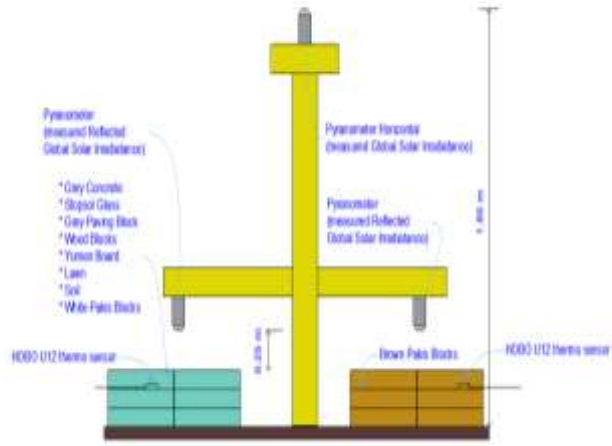

Figure 8.Ways of measuring Reflected Global Solar Irradiation and Longwave heat energy

The white pakis blocks could not only handle well the incoming solar irradiation but it also lessens the outgoing longwave solar irradiance by emitting much irradiation to atmosphere and performing as insulator to the flat concrete rooftop. The research is concentrated on the ability of brown Pakis-stem blocks to reflect less outgoing solar irradiation to space, to absorband and to emit as much possible of longwave heat solar irradiation. The results of brown Pakis-stem blocks have proven to reflect as low as 18.2 to 23.8 W.m-2 of outgoing global solar irradiance to atmosphere. The highest temperature of one piece brown Pakis blocks hold is around 46.9ºC with compare to 45.6ºC at white Pakis blocks.

The contribution of brown Pakis blocks to lessen an over-heated environment is as solar irradiation controller and as solar irradiation container. [2-11]

ATTEMPT 3: FERYAL– MSWI-BA RECYCLING PLASTERING

Malaysian buildings - especially existing buildings - need more feasible thermal insulation methods to reduce energy dissipation. Utilizing Municipal Solid Waste Incinerator – Bottom Ash (MSWI-BA) to produce a thermal insulator coating, appropriate for warm and humid climate is another novel attempt. The required BA was collected from town of Langkawi federal incinerator plant, while the waste composition of this island was studied to find out its composition. Later the mixture was undertaken and tested in the laboratory to identify the new material properties (figure 9).

Figure 9: .Materials and equipment to test the new material from Bottom Ash (MSWI-BA)

Furthermore, two test chambers were design and constructed on chosen site to test the application of the material as coating on building walls as shown in figure 10

Figure 10. Designed test chamber to test on the coating material

The most effective orientation of the wall should face the warming indoor environment or toward west. In principal, the two chambers, one as the testing room and another as the controller, were constructed in UTM Campus whereas three walls, roof, and floor have been insulated and the forth wall has been made by regular bricks in the west orientation. The temperature and moisture inside the designed chamber applied with new coating were monitored and compared with the reference chamber applied with regular coating, by utilizing these data, energy consumption to achieve the comfort zone has been calculated and analyzed. The results showed that by applying new component on the west walls in Malaysia climate, the waste of energy would decrease by minimum of 12%.

CONCLUSION

The three attempts above were academic and experimental in nature. However, they are very easily applied in real situation as part of caring for the existing buildings. Attempt by Pau Chung Leng requires the simulated solar chimney to be constructed to replace the existing bathroom shaft. We will need to monitor the effectiveness on site whether it will have great impact providing good natural ventilation and reducing indoor air temperature. Attempts by Danny and Feryal were about using natural and recycled materials respectively. However, since they both are thinking of patenting their product only part of the research can be made available. Most importantly the three attempts are part of current thinking towards caring for existing building. It is hoped that they can show that caring for existing buildings is also matter to us as we seek comprehensive solution in achieving sustainable natural environment and built form.

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