senvar 12th 2011

PROCEEDINGS

The 12th International Conference on Sustainable Environment and Architecture (SENVAR)

"Nusantara" (Local) Wisdom for The Better Future of Sustainable Architecture

10-11 November 2011
University of Brawijaya
Malang – Indonesia

ISBN 978-602-203-055-3

organized by :

Department of Architecture
Faculty of Engineering
University of Brawijaya

in collaboration with :

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Proceedings
The 12th International Conference on
Sustainable Environment and Architecture (SENVAR XII):
"Nusantara" (Local) Wisdom for the Better Future of Sustainable Architecture

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Published by
Department of Architecture Faculty of Engineering
University of Brawijaya (UB), Malang - Indonesia

ISBN 978-602-203-055-3

ISBN 978-602-203-055-3
9 786022 030553

FOREWORD

It is an honour for Department of Architecture, Faculty of Engineering, University of Brawijaya at Malang, Indonesia; to be the host of Sustainable of Environment and Architecture XII. Over the twelve year of the conference, many universities have been the host of the conference with each theme, namely ITS Surabaya, Undip Semarang, Atmajaya Jogjakarta *"Digital Architecture Application on Built Environment Design"*, Trisakti Jakarta *"Architecture and the Sun"*, UTM Malaysia *"Making Sense the Tropical Experience"*, ITB Bandung *"Digital Architecture"*, Petra Surabaya "*Sustainability in Sun, Rain, and Wind*", Unhas Makassar *"Water Friendly Architecture"*, UiTM Malaysia *"Technology and Humanity"*, Unsrat Manado *"Science and Engineering for Better Life"*, ITS Surabaya *"Innovation, Technology and Design of Architecture in Changing Environment"* and today, we are all here, meeting and gathering at University of Brawijaya with the theme of *"Nusantara" (Local) Wisdom for the Better Future of Sustainable Architecture".* The theme provides papers and presentations on a wide range of topics indicating the scope for both research and practice within the area of built environment and architecture.

These proceedings have been prepared from the papers provides by more than 50 presenters accepted from approximate 170 abstracts and 70 full papers from about 5 countries. We happy that there are enthusiastic response from many experts, students and researchers that come from various region in Indonesia as well as from Asian countries. Their topics presented ranges from the ideas to develop conceptual frameworks to the report of their practical experiences. From the conference we can learn that dialogue, networking, sharing, and cooperation within the multidiscipline approach are the keys to better future of sustainable architecture.

Finally, on behalf of the Department of Architecture, Faculty of Engineering, University of Brawijaya; we want to thank all contributors to the Conference: all sponsors (Semen Gresik, Niro Granite, Pancanaka Property, Kosa Matra Graha, FuturArc Magazine), all presenters and participants, and last but no least to all members of University of Brawijaya for their generous supports. Without them, this conference would not be possible.

Agung Murti Nugroho, ST., MT., Ph.D.

Chief Editor

INTRODUCTION

The concept of “local wisdom” can be seen as a response to the rationality of modernism. As we have seen since the post-World War II, the modernism gives more opportunity to the centers of Global Capital to dominate the value systems, the benchmarks, and the orientations of development in the "South" countries. Being aware of the deadlock of modernism, the local wisdom from Africa, Asia, and Latin America are explored. Various terms are used to formulate the concept of local wisdom as "knowledge". The terms such as indigenous, traditional, folk, ecological, people's science, community, local, non-formal, culture, indigenous technical, traditional ecological are used. Are there any changes then? Not necessarily. The local wisdom with these various predicates, turned out to be just “comparing" the system of knowledge. Even, the concept of local wisdom hardly changed "the body of knowledge". The outline of the paradigm is the same: only put all science from "a non-European" origin and all its praxis as a system of “alternative cognition”.

Is it true that "the non-European" have to be marginalized? Naturally, every locality in fact also contains universality. Meanwhile, the Eurocentrism, which dominates the World, also witnessess a chain of disaster, environmental and cultural damages. Our environment is deteriorating and losing its capacity to contain ecosystem and its ability to facilitate mechanisms of self recovery. Architecture cannot remain confined in conventional functions of designing and making good individual buildings here and there. In practice, architects and architect students immediately imitate what they have seen in the architectural media in the modern metropolis and they lose their local identity. In order to face these many challenges, integrated, multidisciplinary and holistic approaches are required. At the end, the expressions and the Aesthetics of future architecture will be based on the unique character of many tropical local wisdom. Local Southeast Asian Archipelago or Nusantara civilization must therefore contain universal values. In fact, every subject on earth, including its architecture, must contain unique local values and universal values that exists in one unit. Therefore, learning together and sharing the results of learning is a necessity.

AIMS AND SCOPE

The aim of the SENVAR 2011 (12^{th} International Conference on Sustainable Environmental Architecture) is to call for participation of researchers, professionals, academia, governments, NGO, developers and others who have interest in the development of environmental sustainability in the tropical region, particularly in Southeast Asian Archipelago or Nusantara. They are expected to overcome those environmental problems and to share and to exchange their knowledge and expertise in handling problems of changing environment; particularly those related to built environment as sub-themes category below. Many innovations and designs are put into practice and new technologies are developed to assist the efforts. Some are extracted from the past by tracing local wisdom, some are developed and prepared for the present by environmental friendly concept and the rest are challenging the future by tropical vision. The main focus of the conference will explore the tropical wisdom, synergizing the available potentials, social, culture and environment in the human built-environment in the tropic, local or specific place and global or universe sustainable development in balance and directed to the people welfare. This international seminar will explore new paradigms, which focus on “Nusantara” (local) wisdom as a basic philosophy of environmental friendly concept for better tropical architecture practice. These points represent as past, present and future sustainable environmental architecture. The study of “Nusantara” (local) wisdom is not only going back in the past time but preparing for better future. Therefore, we do expect the contribution of researchers from other geographical background to jointly develop a beneficial scientific comparative perspective. By integrating the system of knowledge (in cognitive domain) with the system of beliefs (in affective domain), a new vista appears, not only widening and deepening the understanding of self, but also the understanding of other. The scientific-politic-economical game subordinating Nusantara and the other parts of the world to the North (read: Eurocentrism) must be stopped by deconstructing its inner-axis: the science. Then, a second step is to reformulate science for the sake of the human as well as the nature. Otherwise, the suppressions of human being and the over exploitations of nature continue.

The conference discusses and critically examines the Nusantara (Local) Wisdom occurred in Built Environment and Architecture within Southeast Asia countries for Better Future of Sustainable Architecture. Sub themes might be related but not limited, to the following topics:

A. “Nusantara” wisdom as a basic philosophy for sustainable architecture in the Southeast Asian Archipelago context and other comparative context.

- Sustainable City
- Government cultural policy or strategy in environmental change and sustainability
- Harmony with nature in urban-rural environment
- Human Sustainability and contrasts of economic paradigm in Architecture
- Role of architecture as science and its education toward sustainable environment

B. Concept and Practice of Sustainable Tropical Architecture in Nusantara and other comparative region.

- The local wisdom of heritage, traditional and vernacular in tropical architecture
- Climate responsive as a basic concept of tropical intelligent building
- Convenience living space and people dimension in architecture development
- Comfort and quality of tropical indoor and outdoor space
- Green and energy efficient architecture
- Integrated design approach for human living in the Southeast Asian archipelago and other comparative region

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Sustainable Environment and Architecture
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Malang, 10-11 November 2011

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ISBN 978-602-203-055-3

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Pakis-Stem Blocks as Natural Heat Insulation Diminished Room Thermal in Surabaya

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ABSTRACT

In the era of sustainable architecture where global warming is happen every time and day in many countries, flat concrete rooftop heat insulation has to be installed to diminish the thermal heat piercing onto the room. The research is concentrated to the thickness of Pakis-stem block layers that could obstruct as low as possible of solar heat radiation piercing onto the room. By providing two flat concrete rooftop models, the bare rooftop thermal and Pakis-stem blocks rooftop thermal performances could be monitored. The outcome of the thermal performance of pakis stem blocks cover is crucial to lower the room temperature. The lower heat room thermal coming from rooftop will lead to energy saving domain.

Keywords: Pakis-stem blocks, natural heat insulation, room thermal

1. Introduction

Sustainable architecture buildings are the preferred topic to be discuss all the time now just because the world has been facing critical energy catastrophe. One of factors that causing great demand of energy in air conditioning buidlings is the solar heat sun radiation piercing through windows, curtain-glass walls and impacted on roofs in any place in the world. According to Nazar et al. (2003) that roofs on single buildings donate almost 36,7% of solar heat radiation into the buildings even to 50% of solar thermal heat comes from flat rooftop (Nazar et al. 1999). The roof will receive the greatest heat radiant impacted than other parts of the building façade. Flat concrete rooftop will receive an average of solar irradiation of 396 $Wh.m^{-2}$ on dry seasons and 363 $Wh.m^{-2}$ on wet seasons of Surabaya's climate (Mintorogo 2008). Sun's ray along with heat solar radiation will produce thermal heat on a surface that is absorbed or reflected by roof materials. Absorbed solar radiation will increase the outer surface temperature of the roof by 30 to 40°C (Adamson 1993). Based on Surabaya's weather station report that yearly average of outdoor maximum temperature and minimum temperature in 2008 are 33.9°C and 22.1°C (Weather Station of Juanda Surabaya 2008).

Source: (Mintorogo, 2010)
Figure 1: Town-houses and Shop-houses at Manyar Kertoarjo street

Surabaya with latitude of 7o 17-21'S, on year 1995 till now, lots of business placeses are needed but middle-class businessmen or presetting business firms can't afford to pay on high-cost rental space buildings. Therefore, single-houses, town-houses, shop-houses, and even dwellings along the main street become favorite placeces to choose. A lots of new town, shop, and office houses are to be built to two or three stories with majority of flat rooftop concrete of around 12,400 m2 at Manyar Kertoarjo street (figure 1). Nan of external insulations are put on concrete rooftop; only water proofing paint is aplied to those flat concrete roofs.

Applying rows of pieces of Pakis blocks over the flat rooftop concrete as external enveronmental friendly insulation, the room thermal will be controlled diminishly. Pakis-stem blocksl are used by orchid flower users that they attach the orchids on Pakis block and Pakis blocks are sold at flower shops. Those Pakis blocks come from Pakis trees which could be found at the jungle; the Pakis stem is then be sliced onto pieces of Pakis blocks.

Source: (Mintorogo, 2010)
Figure 2: Pakis Trees, Pakis-Stem Blocks, and Orchid on Pakis Block

2. Literature Review

Many researchers and scholars have researched and carried out many applications to block or diminish the impact of solar heat radiation to room thermal from flat concrete rooftop; the applicantions are: roofpond and its alteration, green roofs or rooftop gardens, cool roofs (insulation), and double roofs.

2.1 Roofpond

In accordance with Mintorogo and Wanda (2011) research, roofpond on tropical and humid climate of Surabaya could play a great role to diminish the room thermal on daytime mode all year round with compare to bare flat concrete rooftop; room thermal temperatures diffrent on critical months of March, June, September and December are 1,4oC, 1,1oC, 2,5oC and 1,1oC respectively. However roofpond room thermal performance become worse on nighttime mode, the water on roofpond could not cold repeatly with compare to bare concrete roof to cool night sky radiation; the room temperatures different to flat concrete roof are 0oC on March, 0,1oC on June and September, 0,3oC on December.

2.2 Green Roofs or Roof Gardens

Green roofs or Rooftop gardens have two kinds of greenery roof systems that are extensive and intensive green roofs. Extensive green roof characteristic is not to design for public excess, it is merely for aesthetic and ecological environment proposes, low-cost due to lightweight construction, low maintenance, thin layer of soil, and smaller vegetation (merely bushes). Contradictory to extensive green roofs, intensive green roofs are designed for public excess-way or roof garden-playground on rooftop parking buildings, high plants (scrubs or trees), thick substrate, heavyweight construction, and high maintenance (Wong 2006, Czemiel Berndtsson 2010).

Tested on intensive roof garden landscaping on low-rise commercial building, the maximum hard surface temperature (without soil and plants) at 2 pm is 57oC; the maximum bare soil surface temperature is 42oC. With the presence of vegetation that is totally depended on the Leave Area Index (LAI), higher temperature will be happened on meager foliages and lower temperature is on intense ones. The maximum temperature on all kinds of vegetation under foliages is about 36oC; and the maximum soil temperature with plants is 26.5oC (Wong 2006).

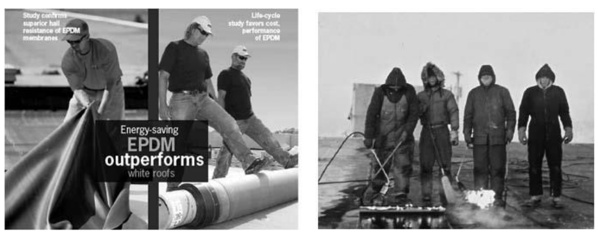
With extensive rooftop garden, the maximum temperature on metal roof is 60^{o} – 70^{o}C. By providing plants or vegetation, the maximum temperature below the dense plants is 35.1^{o}C. But the metal roof has the faster cooling effect at night among the other roof materials. Moreover metal roof is lightweight structure and has a low maintenance factor.

2.3 Coolroofs

Coolroof was invented by Dick Bourne in 1980, Davis, California. This system uses concrete roof as roof pond with impermeable floating insulation panels in water; the water is then pumped over the insulation during the night in order to have long-wave sky radiation cooled the water. The cooling water temperature could be around 1-2^{o}K above the average ambient WBT, and the ceilling temperature (exposed concrete) would have about 2^{o}K over the water temperature (Givoni 1994). An indoor temperature of 25^{o}C would be obtained with the maximum outdoor temperature of 37^{o}C during the daytime; the water pond temperature will fluctuate a round 5^{o}C (Givoni 1994).

2.4 Bittumen Roll Roofing Sheet

Single-ply Rubber Membrane Roofing. (EPDM): Ethylene Propylene Diene PolyMethylene is applied to flat rooftop concrete to give great protection to solar radiation through roof. It is great rubber roofing sheet but it is not environmental friendly insulation material (figure 3).



Source: (Internet, 2010)

Figure 3: Applying Single-ply Rubber Membrane Roofing. (EPDM)

3. Methodology

The research is an experimental work sited on Petra University's flat concrete rooftop. The data are recorded weekly and simultaneously on two models with digital logger of HOBO. The recorded data are: rooftop flat concrete temperature for reference model and Pakis blocks model (T1); room thermal temperature for both reference and Pakis blocks covered model (T2); shaded outdoor temperature and relative humidity.

3.1 The models

The models are structure with steel frame and covered with 3 mm of "Calsiboard" on outside walls then insulated with 2 cm of foams at four inside walls. The upper structures are composed of 6 cm of flat concrete as rooftop. The models are shaded horizontally with 1 meter length all around the model for minimizing thermal sun heat radiate through walls (figure 4).

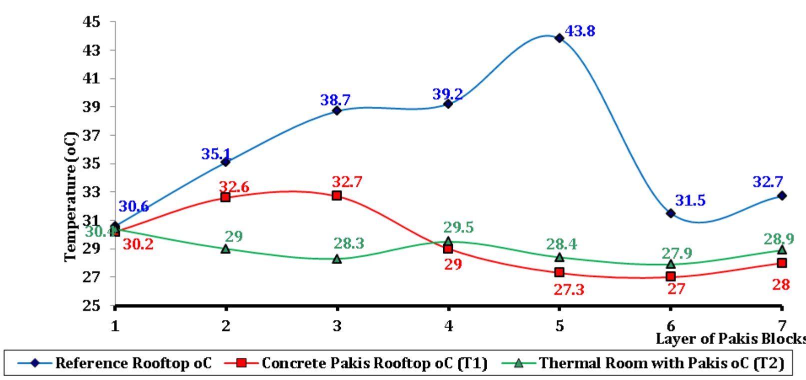
Source: (Mintorogo, 2010)
Figure 4: A. The model, B. Covered model with Pakis-stem Blocks

3.2 The Measuring Tools

The HOBO data loggers and sensors are U 12 type used for measuring temperatures and relative humidity; the maximum and minimum temperature ranges are 60°C to – 5°C.

4. Results and Discussions

The rooftop concrete temperatures at reference model fluctuate greatly from the lowest temperature of 30.6°C to maximum 43.8°C. Contradictory to the model covered with Pakis-stem blocks, the rooftop concrete temperatures vary slightly from 30.2°C on one layer of Pakis blocks to 28°C with 7 layers of Pakis blocks on flat rooftop concrete. The Pakis-stem blocks rooftop temperatures go up and down along with layers of Pakis blocks covered and the local climatic insolence. The room thermal performances (green line) happened contrary to Pakis blocks rooftop temperature (red line) ranging from one to four layers of Pakis blocks (for instant: 32.6°C to 29°C on 2nd layer Pakis blocks covered) (figure 5). With five to six layers of Pakis blocks covered (cooler rooftop temperature), room thermal goes above rooftop temperature; meaning that there are other thermal piercing through walls than roof. Applying with four layers of Pakis blocks (12cm), room thermal temperature gets almost even with rooftop temperature.



Source: (Mintorogo, 2010)
Figure 5: Divergence of Reference Model Rooftop, Pakis Covered Rooftop Temperatures and Room Thermal with Layering of Pakis Blocks

Look at table 1, the room thermal differences (T1 minus T2) vary with layers of Pakis-stem blocks covered on Pakis blocks concrete rooftop. The greater the room thermal (T2) intervals to Pakis blocks concrete rooftop temperature (T1), the better thermal performance of that layer of Pakis-stem blocks on flat rooftop concrete. The smaller the rooftop Pakis blocks concrete temperature, the better layers of Pakis blocks as heat insulation to prevent over heated on flat concrete rooftop. Applying five layers of Pakis blocks would be the better solution to minimize rooftop temperature.

Table 1: Thermal Differences for Flat Rooftop vs Room Temperatures

Layer of Pakis Blocks	**Outdoor^{o}C**	**Concrete Rooftop ^{o}C (T1)**	**Room^{o}C (T2)**	**Thermal Difference (T1-T2)**
1 (3 cm)	29.8	30.2	30.4	-0.2
2 (6 cm)	28.2	32.6	29	3.6
3 (9 cm)	27.7	32.7	28.3	4.4
4 (12 cm)	28.9	29	29.5	-0.5
5 (15 cm)	28.2	27.3	28.4	-1.1
6 (18 cm)	27.5	27	27.9	-0.9
7 (21 cm)	27.9	28	28.9	-0.9

Source: (Mintorogo, 2011)

Daytime rooftop thermal performances illustrate the rooftop received solar sun heat radiation on bare concrete roof (the reference model—default flat concrete rooftop) and insulated heat temperature on Pakis-stem blocks-cover flat concrete rooftop. Meanwhile thermal performances on nighttime indicate the responsive of concrete rooftop to radiate the roof thermal heat to cool night sky radiation "skytherm concept". Table 2 shows the room thermal performance on daytime and nighttime with different layers of Pakis-stem blocks covered. The room thermal performances are diverse slightly between the reference and the Pakis blocks covered model on nighttime mode. From 0.2^{o}C to 0.7^{o}C differences on one to seventh layers of Pakis blocks rooftop at nighttime, the room temperatures of Pakis-stem blocks rooftop model are hotter than reference model.

Room thermal performance with Pakis-stem blocks covered model is cooler than the room thermal on reference model at daytime; the temperature different between reference model with Pakis blocks model on daytime from layer 1 to 7 are 1.1^{o}C, 2.2^{o}C, 1.9^{o}C, 2.2^{o}C, 4.2^{o}C, 4.4^{o}C and 4.1^{o}C respectively.

Table 2: Depth of Layering Pakis-Sterm Blocks Room Temperatures

	REFERENCE MODEL (Default)			**PAKIS-STEM BLOCKS MODEL**	
Number of Pakis layering	**Daytime (^{o}C)**	**Nighttime (^{o}C)**		**Daytime (^{o}C)**	**Nighttime (^{o}C)**
1 (3 cm)	32,8	29,0		31,7	29,3
2 (6 cm)	32,2	27,3		30,2	27,9
3 (9 cm)	31,5	26,6		29,6	27,3
4 (12 cm)	32.7	28,1		30,5	28,2
5 (15 cm)	34,0	27,6		29,8	27,3
6 (18 cm)	33,8	27,0		29,4	27,0
7 (21 cm)	34,7	27,8		30,6	27,6

Source: (Mintorogo, 2011)

5. Conclusion

Flat rooftop concrete covered with layers of natural heat insulation (environmental friendly material) of Pakis-stem blocks have approved to diminish roof and room thermal significantly. Simply applying with four to five layers of Pakis-stem blocks, the room thermal temperature will be cut down to 2.2^{o}C with four layers) and 4.2^{o}C with five layers. Room thermal temperature is closed to tropical natural thermal comfort of 28.5^{o}C. Room thermal with rooftop Pakis blocks performances on nighttime is almost the same manner with bare concrete rooftop.

Acknowledgement

I acknowledge to the department of architecture, Petra Christian University for providing both measurement tools and fund to this research of natural heat insulation for flat concrete rooftop.

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