



The Studies of Ton Klum's Material Properties for Pathways in Mangrove Forest at Baan Klong Hia, Koh Yao Yai, Pang-Nga

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Abstract

This research aims to explore the potential to develop an architectural prototype from natural, cultural, and architectural resources found in Baan Klong Hia, Koh Yao Yai, Pang-Nga, Thailand, starting from an in-depth study of Baan Klong Hia such as local lifestyle, local wisdom, and local architecture. As a result, we found a common interest in Ton Klum, a type of flora which a natural material commonly used in a basketwork that is well-known for its strength and durability. Hence, a study of properties of Ton Klum includes analysis and experimentation in various ways to find out the appropriate properties that can further develop for a new architecture to support the lifestyle of local people, specifically in a community that lives in and around mangrove forest, in which villagers are mainly fishermen whose lives are a part of this unique micro-ecosystem. Our study focuses on the development of our prototype using a pathway which is an important architectural element that supports and facilitates the villagers and their fishermen lifestyle in Baan Klong Hia as our case study.

Keywords: *Architectural Prototype, Materials experimentation, Local wisdom, Community development, Fieldwork, Knowledge sharing, Baan Klonghia, Mangrove forest.*

1. Introduction

According to the objectives of the Faculty of Architecture, Rangsit University, it is essential to create a new generation of architects who are socially responsible, which is considered as a foundation for sustainable development. The project 4+1: Homeland Revisited started in 2010 with an intention to let the fourth-year and first-year architectural students to revisit their hometown and learn from local wisdom while trying to use their architectural knowledge as a tool to help their community and, at the same time, further developing Thai architecture.

The objectives of the project are to study and learn from hidden local wisdom, try to create a new architectural *prototype*, and, at the same time, create a process of knowledge sharing with the people in the community, starting from studying and understanding the details of the area from different angles, including physical context, cultures, social, and local knowledge and trying to identify a problem or a possibility from local wisdom throughout experimentation in various types to acquire the architectural design concept that are suitable for the context and a constantly changing era.

In this project, we focused on Ton Kulm, local vegetation, and how to use it as a construction material to further develop a prototype for architecture in a Mangrove forest in Baan Klong Hia, Koh Yao Yai, Pang-Nga.

2. Objectives

A study of lifestyle and local wisdom to create a new *prototype* of pathways through experimentation with the material.

1. To research on their lifestyle, find out the material and study its qualities.
2. To build on from the local wisdom and blend it with the context using the material, and find out the possibilities.
3. To develop an architecture to respond to the needs of local people, and its applications.



3. Materials and Methods



Figure 1 A study of *Ton Klum* parts.

According to the study of material, which is *Ton Klum*, the bark and tissue inside of the trunk are heavy. The researcher thought that it might be possible to take these pieces to the strengths and weaknesses test in the form of rope and basketwork. Meanwhile, the researcher also used Rubber Tree oil as *Ton Klum* treatment which is one of the local wisdom. Local people have been using it for a long time to repair their fishing boats and combine with herbs for medication (Thongkerd, 2018).

Afterward, it was found that it was possible to apply for architectural design. Then, we started to explore weaving techniques in various forms to find the strongest pattern that could be an architectural structure.

Analysis of the strengths and weaknesses test to find the properties of the material and results are in the following table.

Table 1 Shows the results of *Ton Klum* testing. The image display properties testing of material from Klum in different ways.

Experimental method	Tissue	Outer surface
Solarisation	This tissue shrunk and become brittle.	Outer surface are extremely brittle and color changes slightly.
Immersing in water/ Dyeing	This tissue shrunk and become brittle.	Outer surface flexibility and bending easily.
Rubber oil coating	Tissue remain intact strength more than Immersion in water and color is beautiful.	Outer surface is strong and has a beautiful color.



Figure 2 Solarisation



Figure 3 Rubber oil coating



Figure 4 Immersion in water/ Dyeing

Analysis of test result material used for knitting and weaving strength. By the weighted with bottled water. Knitting pattern tissue.



Figure 5 Knitting rope three lines when load water 2 liters pattern tissue start torn off.



Figure 6 Knitting rope four lines when load water 4 liters pattern tissue start torn off



Figure 7 Knitting rope five lines when load water 6 liters pattern tissue start torn off.



Figure 8 Knitting rope six lines when load water 5 liters pattern tissue start torn off and tear, when weighted 7 liters.



Figure 9 Knitting rope seven lines when load water 9 liters pattern tissue start torn off and tear, when weighted 11 liters.



Figure 10 Knitting rope eight lines when load water 7 liters pattern tissue start torn off and tear, when weighted 9 liters.



Figure 11 Knitting rope nine lines when load water 15 liters pattern tissue start torn off and tear, when weighted 17 liters.

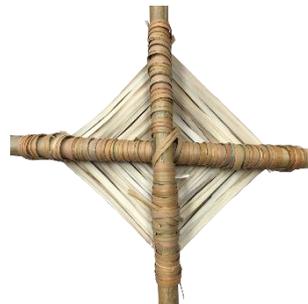


Figure 12 Weaving outer surface pattern 1 make the connection strength, unable to move.



Figure 13 The outer surface weave pattern 2, the connection is not strong and can be moved the strike has caused a short-term restrictions on the weave.



Figure 14 The outer surface weave pattern3 that mixed of thin klum stripes and tissue. This makes the connection very strong. When the membrane is dry and brittle, causing tissue contraction cannot take the weight.



Figure 15 The outer surface of the weave pattern 4. Connection by rope. Which provides a connection strength and was moving slightly.

4. Results and Discussion

From the experiments of knitting technique, we found that the technique of braided rope of nine lines is the strongest compared to the other types of knitting. Combined with the Rubber Tree oil coat, its strength is enhanced and its shape and texture are preserved. The researcher found it is suitable to be a rope replacement.

From the experiments of weaving technique, the weave pattern 1 shows the greatest strength and is suitable to be used in a joint structure, which can take a lot of weight and can be formed into the surface.

From the experiments of weaving technique by using Ton Klum's bark, shows weave pattern 4, take less space at joints while gives enough strength for a joint which does not carry a lot of weight. From the experimental, the conclusion is whether the technique of braided rope nine lines than other types of knitting including the traditional wisdom in the rubber oil coat to enhance its strength and remain the same, which is suitable to be used as the material instead of a rope.

The joint was designed with an intention to combine a knitting and weaving technique seamlessly together. After applying the joint, we developed an architecture that responds to the context using the Modular system. It contains many units which can combine as one. Each of them has a similar proportion to reduce assembly-disassembly time.



Figure 16 Mangrove forest at Baan Klong Hia, Koh Yao Yai.

Apply the local wisdom to architecture that responds to a change in context.

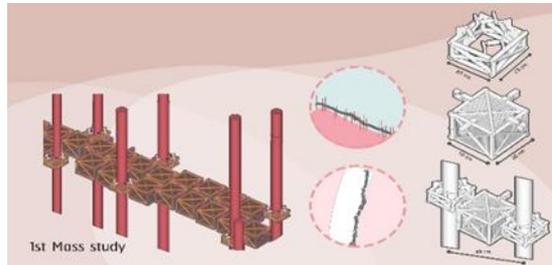


Figure 17 1st Pathways design

The pathways design that considered of flexible when it comes tidal phenomena by using weaving outer surface pattern 1 as a main structure which can be surface of pathways and using wheels for its movement.

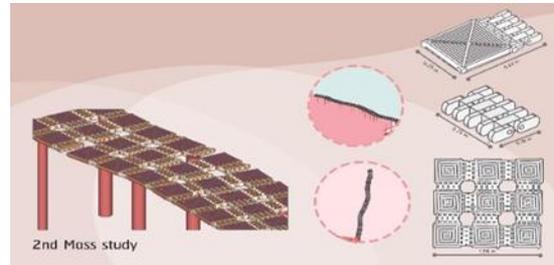


Figure 18 2nd Pathways design

The pathways design that considered of maintenance. So, it would be able to separate from each other with flexible joint that easily removed by using weaving outer surface pattern 1 as a joint to join the main structure which can be surface of pathways.

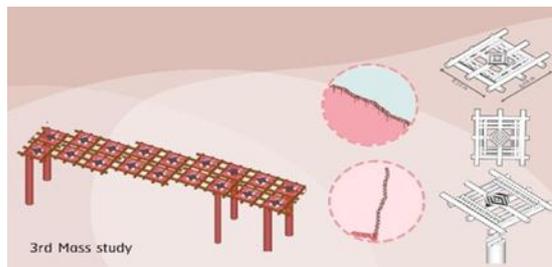


Figure 19 3rd Pathways design

The pathways design that considered of surface by using weaving outer surface pattern 1 as a main structure and pathways surface. Also, bring out the nine weaving stripes rope to cover the gap between structure.

According to the example above, the three types of *pathways* that were designed with a consideration of the context have a possibility to develop into an architecture that responds and fits into the ever-changing context.

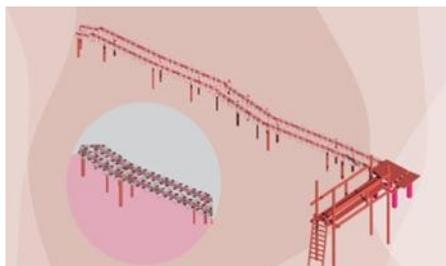


Figure 20 Model of pathways

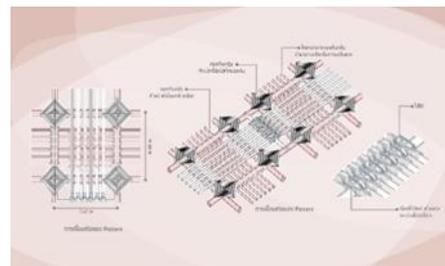


Figure 21 Detail of pathways

The architectural design takes into consideration the convenience to transform and the flexibilities of the Modular System with the ground condition and tidal phenomena inside the Mangrove forest. As a result, the pattern of pathways can be adjusted by removing or adding each of the modules and using the rope as a joint to join the wooden structure and additional wood joint together. The weave thin bamboo stripes in the pattern 1 are used as the main structure, the pattern 4 becomes a substructure, and the nine weaving stripes rope are used to cover the gap between structure.



Figure 22 Each modular of pathways

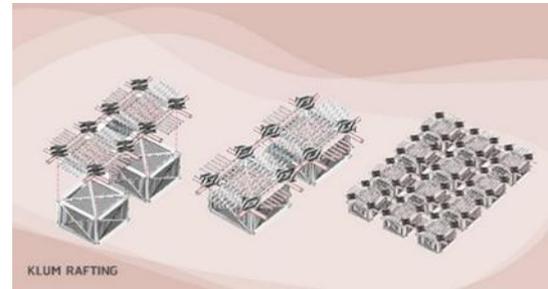


Figure 23 Detail of pathways

In conclusion, the *pathways* of Baan Klong Hia have been an important part of the life of the people in the village, a community of fisherman (Ngankhaeng, 2018). So, the researcher developed the modular system of a raft module as *pathways* for local people. According to the architectural design concept that is flexible to use, the user can remove or take a standard piece of it to attach with other things for any purpose.

The research studies the lifestyle of Baan Klong Hia that affects the context inside the mangrove forest, as well as learns from the local wisdom, including how Ton Klum is used by the local people for a basketwork and how Rubber Tree oil is used for repairing their fishing boats and combine with herbs for medication (Thongkerd, 2018). The research tries to better understand the material's properties and study of the possibility of pathways in mangrove forest that come from the interested from these local resources.

5. Conclusion

According to the research and understanding the local wisdom to develop into the prototype of pathways, the experiment divides into two parts.

At first, to find out the properties of materials that affect the context of mangrove forest, it starts from immersing in water, drying in the sun, absorbing color and coating by rubber oil. As a result, the first part of the experiment shows the properties of its which is appropriate with the area. Next part of the experiment is to find out a different technique to use with the materials to produce strength and loading support for structural elements. It started with knit and weave the materials into the various forms with an aim to use them as a joint. The *pathways* take into account the activities inside the mangrove forest and the main activity is to use water routes for fishing and as a thoroughfare.

To summarize, a new *pathway* of Baan Klong Hia that happens is the main architecture which can be adapted to multipurpose to link with the activities in forest mangrove.

6. Acknowledgements

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7. References

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