

Roof Covering Design Based on Bamboo

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Abstract: In constructing a building, roof is one of the important structures that complete the building requirement. Materials such as tiles, ceramics and zinc are chosen by many people, but the cost for this kind of materials are quite expensive. Due to that, some people choose the cheap materials in the development of roof. So, this study has been conducted to identify the significance of bamboo in order to solve this problem. The purpose of this project is to use bamboo as a material for a roof. Hence, the bamboo is designed and the best method of curing has been reviewed. Thus, bamboo can be used to replace other materials in constructing the bamboo. From those methods, the effectiveness of bamboo as the roof structure has been analysed. A questionnaire has been collected among the UTHM students and Pagoh residents. The limas roof design is chosen as the design of the roof for bamboo roof. As for the curing, boric acid and borax has been used in order to prevent the bamboo form the insects. Thus, the findings found that 80% of the respondent agree that bamboo can be used as the roof structure. As a conclusion, the construction of bamboo-based roof design can be adopted as one of the new innovations in Malaysian industries.

Keywords: Bamboo, Roof, Design, Curing, Construction, Structure

1. Introduction

Roof is one of the important structures that complete the building requirement. Roof is used to protect the occupants from the weather such as sun heat and rainfall. Choosing the right materials for the roof is important to make sure the roof can sustain in a long time. Bamboo is one of the materials that can be used in many ways including construction. The characteristic of bamboo is lightweight material suitable for roofing materials [1]. This will increase the use of bamboo in construction especially on roofing.

The purpose of this project is to produce roof design based on bamboo, identify the method of curing bamboo roofs for last in long time for outdoor use and analyze the effectiveness of bamboo roof on building sustainability. This project focuses on the design of bamboo roof covering according to selected designs from suitable types of bamboo used in construction. It is significance to identify the best methods in curing process to produce sustainable and agronomic products. Other than that, bamboo also suitable in construction due tensile capacity of the bamboo is better than steel.

The material use is significance in define, the weather resistance of the building, so choosing the right material based on the environment will help the roof to hold on for a long time. The price range also need to be considered before the construction process. The price of roofing products could differ greatly depends on the materials and the installation process [2].

In addition, the construction of bamboo roofing based on the roof design is one of the new innovations in Malaysian industries [3]. This is due to the use of bamboo as a roof material is very little in Malaysia. Therefore, this can give awareness to Malaysians to take advantage of the use of bamboo in construction [4]. So, the rate of application of bamboo as a roof covering in Malaysia will be increased. It also can preserve the use of natural materials around our house.

2. Materials and Methods

The materials and methods are based on the production of the bamboo roof. There are based on the research of the best method to use in producing the roof. The materials to produce the bamboo roof is usually same, but there are some materials has been change in the model which mostly on the binder.

2.1 Materials

The main material that has been used in this project is bamboo. The types of bamboos that has been used are *kuku kerbau* and *betung*. This types of bamboo have prefect size to fit as a roof materials. The bamboo have big diameter of bamboo and large hollow in it. The *betung* bamboo is used at the bottom part of the roof meanwhile the *kuku kerbau* used at the top part. *Kuku kerbau* bamboo have large size compared to *betung* bamboo. It is suitable for roof design because it covers the space between the bamboo. For the binding materials, cable ties is used to hold the bamboo on their place while nails and screws has been used to connect bamboo and woods. Next, the binding technique is used in order to produce a good roof model based on bamboo.

For the chemical materials, borax and boric acid are the best materials as a solution of treatment bamboo [5]. It is because borax and boric acid is easy to get and less harmful to the environment rather than other wood preservatives. The ratio used in this study for boric acid and borax is 1:1.5 respectively [6] which is the standard ratio for boric acid and borax.

2.2 Methods

This sections describes the methodology and procedure that is applied in designing and build a roof covering based on bamboo as illustrated in **Figure 1**.

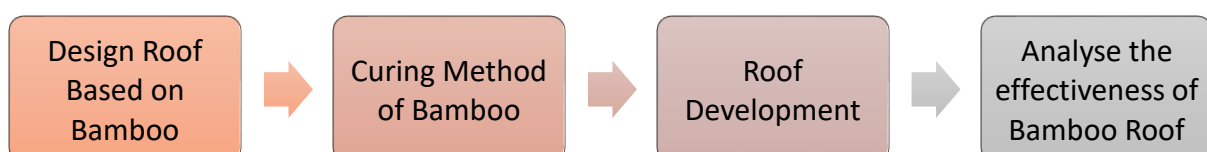


Figure 1: The flowchart of the study

2.2.1 Design Bamboo

The design use for the roof bamboo is based on some recommendation and also based on the suitability of the design with the project as the model of the roof covering that been built [7]. The design for the roof is limas roof which is the common design used for the roof in Malaysia. This type of roof is easy to build and works very well to ensure the occupants get the cover from any weather.

2.2.2 Curing Method of Bamboo

The method used for the project is chemical method which is easy to get in Malaysia. This method used borax and boric acid as the agents for the curing.

2.2.3 Roof Construction Process

The development process is important to be consider for the production process. Binding method used in the development process determine the strength of the roof. If the bamboo been connect properly, the roof will last in long term.

2.2.4 Analyse the Effectiveness of Bamboo Roof

The analysis for the effectiveness of the bamboo as a roof structure are based on people opinion in using bamboo as the roof materials. The data collected form a questionnaire made to gather people opinion regarding this project. The effectiveness of the bamboo also taken form the model made in this project. The method used in producing the model will be consider as the effectiveness of this project.

3. Results and Discussion

The result for this project is based on the successfulness of the method we used to build the model of roof covering. The design, method of curing and the development of the model will represent the findings for the project. There are also analysis data based on questionnaire that we make regarding the knowledge of Malaysian about the use of bamboo. The data collected helps to show the level of acknowledge regarding the use of bamboo in construction. The result for this project are based on the method chosen to produce the roof bamboo. Each aspects important to ensure the bamboo roof comply the characteristic of a good roof structure.

3.1 Design

The design used for the model is limas roof which is based on some recommendation and based on the suitability of the design with the project. This design is commonly used in Malaysia, and it is easy to build and works very well as a shelter for the occupants to take cover from the weather. This design of roof possesses 30 degrees of slope that helps the water to drain from the roof whenever it is raining. This shows the efficiency of the roof in providing protection to the user.

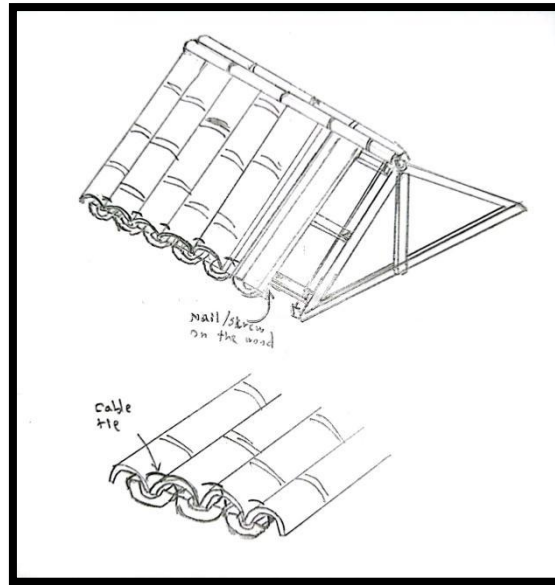


Figure 2: Roof covering design

3.2 Curing

Next, the curing method that we choose is by using boric acid and borax as the chemical agents for the curing. This method is widely used available and can be used in large quantities. The ratio to cure the bamboo is 1:1.5. As the results for the curing, the treatment will prevent insects from the bamboo. This helps the bamboo to last longer by preventing termites from harming it.

3.3 Roof Construction

For the development of bamboo roof covering, it is based on the limas and need to be do step by step to construct a good model. The bamboo that had been cure arranged based on the design and be measure with the woods that will be use as the holder for the roof covering. The bamboo and the woods been shellac to provide some protection and also as an aesthetics aspect. Then, nail been used to connect the bamboo with the woods. The bamboo the place overlaps each bamboo before been tie by using cable tie. Finally, the roof covering place on the holder and screw been use to make sure the roof covering not moving.



Figure 3: Completed roof covering

3.4 Questionnaire

From the questionnaire that has been given to the respondents, the opinion of each respondents can be used as references to identify the effectiveness of the bamboo as a roof structure. The respondents were from the citizens around Pagoh area which are UTHM students and Pagoh residents. We used them as the respondents because it is easy to gain the respondents. There some question given to the respondents that related to the use of bamboo as roof structure. For examples, the opinion of the respondents regarding the long lasting of the bamboo and the benefits of using bamboo as a roof structure.

Based on the questionnaire, there are around 91% of the respondents is agree that bamboo can be use in construction sector. This analysis is shown in **Figure 4**.

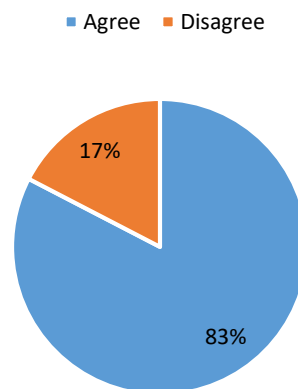


Figure 4: The use of bamboo in construction

There are 57% of the respondents agree that bamboo can be use in a long term. By using a correct method for the curing and also the proper development steps helps in making the roof bamboo sustain in a long time. The analysis for this factor is shown on **Figure 5**.

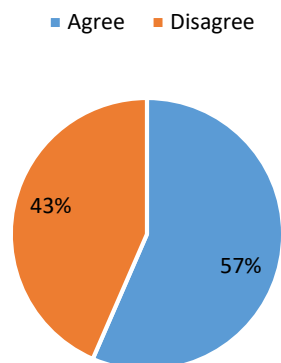


Figure 5: The strength of bamboo

Next, from the questionnaire, there are some advantages of using bamboo in roof construction listed in the question. There are 31% of the respondents agree that bamboo have their our uniqueness as a roof structure, 24% of the respondents agree that bamboo is lightweight and also easy to find and 21% agree that bamboo provide high strength. This data are based on **Figure 6**.

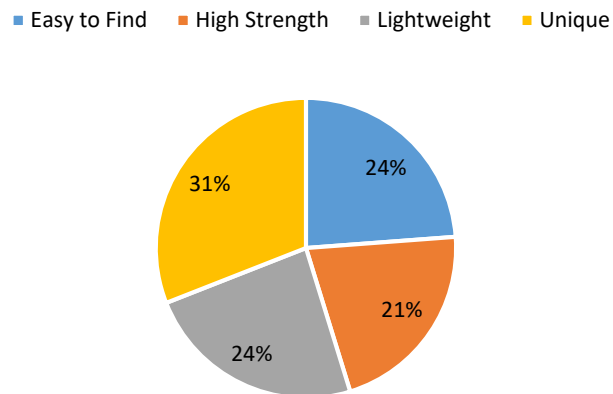


Figure 6: The advantage of bamboo as a roof

Finally, more than 80% of the respondent agree that bamboo can be utilised in the roof construction. This data is based on **Figure 7**.

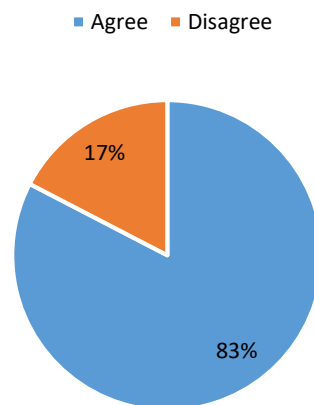


Figure 7: The opinion of a respondent to apply bamboo as a roof

4. Conclusion

In conclusion, this project met its goal and objectives in identify the method of curing bamboo roofs for last in a long time for outdoor use. Besides, the bamboo can be used as an alternative to build a roof on building and their effectiveness is agreed by respondent among UTHM students and Pagoh resident. This is because of all the bamboo has run a treatment for 14 days. The findings found that more than 80% of the respondent agree that bamboo can be utilized in the roof construction. The innovation of

this study can be utilized as a reference for future research in order to increase the basic knowledge on the concept and method in designing a rooftop by using bamboo.

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