

## **APPRECIATION**

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**TITLE: COOLING ROOF**

**SESSION : JUNE 2019**

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## **ABSTRAK**

Dalam struktur rumah, bumbung memainkan peranan penting dalam memastikan rumah berada dalam keadaan perlindungan dari kesan panas matahari dan hujan. Masalahnya pada waktu tengah hari dan petang suhu bumbung naik dengan ketara menyebabkan haba di dalam rumah mengalami kenaikan suhu dan mewujudkan ketidakselesaan kepada penghuni rumah. Ketidakselesaan ini juga wujud kerana faktor pemilihan bumbung yang tidak sesuai, terutama jika mereka menggunakan bahan bumbung dengan rintangan haba yang tinggi, masalah ini mungkin boleh diminimumkan. Oleh itu tujuan utama kajian ini adalah untuk menyediakan bumbung yang boleh mengurangkan suhu rumah, menentukan campuran bahan yang terbaik untuk menghasilkan bumbung dan membandingkan produk yang dihasilkan dengan produk yang sedia ada dari segi suhu dan berat. Hasil kajian ini mendapati bahawa bumbung yang diperbuat daripada bumbung konkrit dan aluminium foil dapat mengurangkan suhu sebanyak 3.19% di dalam rumah. Hal ini dapat memberikan pengguna kepuasan dan keselesaan yang lebih tinggi. Oleh itu, penggunaan penghawa dingin juga boleh dikurangkan dan seterusnya menjimatkan kos elektrik.

**Kata kunci:** bumbung, ujian suhu

## **ABSTRACT**

In the structure of a house, the roof plays an important role in ensuring the home is in state of protection from the effects of hot sun and rain. The problem in the afternoon as the roof temperature rises sharply causing the heat in house to causes discomfort to occupants home .this discomfort also exists due to the material selection factor roofs are not suitable, especially if they use roofing material with high solar resistance this problem may be minimized. Therefore the main objective of this study was to prepare a roof that can reduce the temperature of the house, determine the optimum mixture of materials to produce the roof and determine the effectiveness of the roof when installed on the roof. The results of this study found that roofs made from concrete roofing and aluminium foil can reduce 3.19% the temperature inside the home. This can give users greater satisfaction and comfort .Thus, the use of air conditioning can be reduced and save on electricity costs.

Keyword: cooling roof, temperature test

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# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 INTRODUCTION**

Global weather changes as well as global warming problems will be inviting to the weather extreme predicted to hit the country and will continue for a long time. This means that Malaysia will be hit by hot weather as well as receiving a rainy season high levels can lead to disaster events such as droughts and floods. The matter was also supported by data obtained by the Department of Meteorology since several last year which showed a noticeable increase consistently every year in all observation area throughout the country.

This problem has caused residence residents to be uncomfortable to stay home them, due to the overheated internal temperature. This problem also became contributors to environmental pollution, where consumers will continue to rely with mechanical air conditioning system. In addition, the selection of the roof structure of the appropriate materials are important to reduce the heating rate in the home. In addition, most modern houses in Malaysia are now designed without attics to save construction costs.

Therefore, it is very important for each involved parties including contractors to apply this cool roof in construction activity. In other words, if the issues related to heat temperature problems in a residential area is persistent then it can cause discomfort to the occupants and the next will increase the use of electricity due to the use of air-conditioning. Electricity bills per home will also increase due to the use of air-conditioning that utilizes strong electric power.

## 1.2 STATEMENT OF PROBLEM

The selection of construction materials plays an important role for sustainable development because it is able to protect the environment. That is, the roof is cool or recognizable as a 'cooling roof' is seen as one of the elements that can give a positive impact on construction projects as well as providing comfort and satisfaction to consumers.

Furthermore, the roof is a part that directly exposed to the sunlight other than wall part. However, the study of the cool roof still less widely explored. This can be seen after the existence of components Industrialized Building Systems (IBS) such as lightweight concrete, key bricks and components IBS like pole, wall, roof truss and others. However, the components for the cool roof is rare and if the component is practiced will make the user feel comfortable and can reduce the temperature in the home.

If it is touched on issues related to social principles, it should be more closely related to human life, where the majority of consumers in Southeast Asia are relying heavily on air conditioning systems to reduce the heat in their homes. According to Winter (2013), the demand for air conditioning systems has increased by 75% by 2030 in Southeast Asia. For example, economic progress in Singapore has increased the energy demand in the country by 60% for the sector building and 34% of the total has been used for air conditioning systems the building. Additionally, the estimated heat trapped on the structure of the building that is 30% (19% through the wall and 11% through the roof). For that reason, to overcome this problem, the use of cool roof construction material is seen as one of the building materials that can reduce the level of heat inside the home.

Malaysia is also facing the problem up to 75% users in Malaysia rely on air conditioning systems. This problem has led to increased electricity consumption and operating costs (Yacouby et al., 2011). In addition, residential development in Malaysia is also experienced high heating in the roof space due to roofing and roofing factors are not suitable. Abdul Rahman et al., (2013) also classifies occupants Malaysian hospitality is not comfortable due to high global warming and unsuitable roofing selection factors. This, it affects the social well-being of the people in Malaysia when feeling uncomfortable with the atmosphere in their home. Furthermore, Malaysia is a country with experiencing hot and humid tropical climate throughout the year, therefore the use of cool roofs are strongly encouraged..

In addition, problems with cracked roofs often occur. According to Rajeev et al ., (2016) cracking on concrete roof tiles can cause water as well as dangerous objects infiltrate into the roof. In addition to roof types concrete, asbestos is also a type of roof that is easy to crack and can carry death. Exposure to asbestos can lead to a variety of diseases such as asbestosis, malignant mesothelioma, and lung cancer. This disease is dangerous and until now, there is still no definite treatment for asbestos-related illness (ARD) (Lim, et al., 2011). However, the use of asbestos is still widespread in the industry construction and between countries that still use asbestos roofs are China, India, Indonesia, Malaysia, Mongolia, Philippines, Thailand, and Vietnam (Takahashi & Kang, 2010). If not controlled, the problem will continue to disrupt the stage universal human life.

In conclusion, even though Malaysia has various outputs the type of roof on the market with various colours, sizes, and types of materials, however problems with issues of discomfort still exist, even the demand for the system air conditioning in every house is increasing. In addition, according to Allen et al., (2008) houses in Malaysia use more concrete roofs compared to the roof of the clay, whereas Terreal (2008), considers the use of the roof of this clay is better because it has good fire resistance and will not be affected when dealing with hot sun temperatures. As such, this study is conducted to identify factors to meet the roof criteria based on social aspects of the universal human life.

### **1.3 RESEARCH OBJECTIVE**

The objectives of the study are as follows:

- 1) Produce a roof that can reduce the temperature.
- 2) Determine the best mix of items for cooling roof.
- 3) Compare with the existing product in terms of temperature and mass.

### **1.4 SCOPE OF STUDY**

This study is aimed at targeting projects around low cost resident. This matter because Shah Alam is one of the most population. Furthermore, Shah Alam is growing rapidly as there are developments in the industry and education sectors.

## **1.5 THE IMPORTANCE OF THE STUDY**

Malaysia is a tropical and humid tropical country throughout the year but when the world is facing the issue of high global warming, it has caused the demand for air conditioning systems to grow over time. The roof is a multifunctional part that protects the structure from heat and rain. Roofs are also an important element of the home side that is expected to provide a comfortable environment for the occupants. Additionally, this study is important when the construction of the roof is still lacking in its research on the production of materials that can reflect more sunlight such as light concrete, brick keys and IBS companions such as pillars, walls, roof trunks and so on. This study is necessary to identify the potential of cool roofs in minimizing the temperature in the home and to provide comfort to the occupants.

## **CHAPTER 2**

### **LITERATURE RESEARCH**

#### **2.1 INTRODUCTION**

The roof is the part of the building that receives heat directly from the sun and in summer the temperature on the roof surface rises up to 65o C. So there are some deficiencies in the roof which has caused human unpleasantness. Among the shortcomings are the roof used is not durable, easy to crack, easy roof colour shabby and unable to provide better ventilation to so users are forced to use the help of air conditioning systems to make their homes more comfortable. This chapter will deepen the study of the roof literature in the context of roof factors that can reduce heat from entry to homes principles so that human welfare will be more secure in line with the progress of the country.

## **2.2 THEORY**

The cool roof is designed to reflect more sunlight and absorbs less heat than the ordinary roof. Cool roof can be made of highly reflective paint, cloth cover, or highly reflective tile. Almost every kind of building can benefit from a cool roof, but it is considered by climate and other factors before deciding to install it.

Just like wearing brightly coloured clothes, it helps to keep cool on a sunny day, cool roofing material designed to reflect more sunlight and absorb less heat than the ordinary roof. Standard rooftop or dark can reach temperatures of 150 ° F / 65 ° C or more during the summer. Roof which is cool under the same condition can remain more than 50 ° F / 10 ° C cooler and more saving energy and money by using less air conditioning (U.S Department of energy, 2010)

## **2.3 PREVIOUS STUDIES**

### **2.3.1 SUNLIGHT**

Sunlight called sunshine , solar radiation that is visible at Earth's surface . the amount of sunlight is dependent on the extent of daytime cloud cover. Sunlight is broken down into three major components is visible light , ultraviolet radiation and infrared radiation. The infrared radiation has its chief merit in its heat- producing quality . close to half total surface solar radiation received at the surface of earth is infrared.(Encyclopaedia Britannica).

### **2.3.2 HEAT**

The sun heats the earth through radiation. Since there is no medium (like gas in our atmosphere ) in space , radiation is primary way that heat travels in space .When the heat reaches the earth it warms the molecules of the atmosphere , and warm other molecules and so on. This heat transfer is called conduction.(Merriam Webster,1828)

### **2.3.3 VEHICLES**

Our personal vehicles are major cause of global warming. Collectively cars, truck account for nearly one-fifty of all US emission, emitting around 24 pound of carbon dioxide and other global warming gases for every gallon of gas . global warming is already having significant and costly effects on our climate environment.(Newfoundland Labrador,2018-2019)

### **2.3.4 CLIMATE CHANGE**

Climate change is the catch-all term for the shift in worldwide weather phenomena with an increase in global average temperature. While this temperature increase is more specifically referred to as global warming, climate change. Human activity is currently generating an excess of long-lived greenhouse gases that don't dissipate in response to temperature increase, resulting in a continuing buildup of heat.(Center for Climate and Energy Solution,2000-2019)

### **2.3.5 ROOF TILES**

The roof tile is the cover, the protective, insulation and is a waterproof construction material. The main purpose of the roof tile designed to protect homes from rainwater. The tile roof is one of the longest construction materials available in the market and requires very little maintenance and has a level fire resistance is quite good. A roof is part of a building envelope. It is the covering on the uppermost part of a building or shelter which provided protection from animals and weather, notably rain, but also heat, wind and sunlight. The word also denotes the framing or structure which supports that covering. The characteristics of roof are dependent upon the purpose of the building that it covers and protects primarily against rain, sun, and heat.(hantekor, 2015)

### **2.3.6 COOLING ROOF**

A cool roof is one that reflects the sun's heat and emit absorbed radiation back in to the atmosphere at higher rate than standard material. Cool roof performance may be achieved with additives to the base material or by applying CRP. These type of roof literally stay cool , thus reducing the amount of heat held and transferred to the building below , keeping the building a cooler and more constant temperature.

### **2.3.7 TYPES OF ROOF TILES**

Hantekor (2015), believes roof tile is a building material that get attention where it combines decoration with functionality. Among the types of tiles that the available in the market today is:

**(i) Concrete tile**

According to Terreal's roof tile manufacturers (2018), concrete roof tiles formed from a mixture of cement, sand, and water. Next, it will be saved in the mould so as to achieve the desired strength. Various colours and comprehensive texture is added to the concrete tile during the process manufacturing. The moulds for concrete tiles are usually made according to the desired shape. This concrete roof tile is compatible with roof components which is comprehensive and it allows installation to be easy and perfect. Between the advantages of concrete tile is, it is cheaper than tile saw land with 30% savings. In addition, concrete tiles in figure 2.1 have good features in terms of strength, durability, fire resistance, heat resistance and sound insulation.



Figure 2.1 Concrete tile

## **(ii) Clay roof tiles**

Through the "Building Material" book written from (Gambhir, 2011) clay roof tiles is formed through the burning process of "vitrification", where silica and alumina exist in dry clay. This formation has formed a solid material such as a non-hollow glass. In addition the clay tiles are expensive tiles and require labor which is compact but it has an infinite level of endurance. For example, it has a good, shiny and better quality binder. Besides, clay roof tile also has good fire resistance properties and not will be affected when dealing with hot sun temperatures.



Figure 2.2 Clay roof tile

### **(iii) Metal tiles**

This tile is used in a variety of climates because of its materials that resist to temperature changes. Roof tiles are also known as "metal deck "and it is made of aluminium alloy. In addition, this roof tile available in various shapes, colours and sizes. Method of tile installation this roof is depend on type, home design and has a screw which is specific to the installation.



Figure 2.3 Metal tiles

#### **(iv) ARTICLE RELATED**

The cool roof is a roof system that produces higher reflectivity of the solar system (the ability to reflect infrared wave length, ultraviolet visible light from the sun, reducing heat transfer to the building) and higher heat loading (the ability to emit absorbed, or not reflected solar energy) from standard-designed roof products. Historically, the cool roof has either white or some other lighter colour. Its standard roof or dark coloured absorption temperature can reach 150 ° F or more in the summer. When compared to the cold roof under the same condition it can stay cooler 50 ° F and can save energy and reduce the use of air conditioning.

## 2.4 MATERIALS USED TO CREATE COOLING ROOF:

### 1) CLAY ROOF

Clay being a poor heat conductor makes GC! Clay Roof Tiles a natural insulator, effectively giving your home a cooler summer and a warmer winter. Such an active trait significantly reduces the dependency on air-conditioning and heater during these seasons and thus, increasing efficiency in energy utilisation. The clay roofing selection factors are Long lasting colour. A tiled roof as figure 2.4 is painted at very high temperatures, around 1050 ° c ensuring that the clay roof of the clay will not fade, corrosive. Unlike other roofing products, the clay roof of the clay also costs very low maintenance. Clay roof is a natural thermal insulator. This is because the clay roof of the clay has the characteristics of "energy savers". Provide natural sound insulation. Last, the environment friendly, clay roof of the clay is 100% natural, made of clay widely digested in the State. ( Golden Clay Industries Sdn Bhd)



Figure 2.4 Clay roof

## 2) FIBER GLASS

Fiberglass really is made of glass, similar to windows or the drinking glasses in the kitchen. The glass is heated until it is molten, then it is forced through superfine holes, creating glass filaments that are very thin, so thin they are better measured in microns. These threads can then be woven into larger swatches of material or left in the somewhat less structured although more familiar puffy substance used for insulation or soundproofing. This will depend on whether the extruded strands were made longer or shorter, and the quality of the fibre glass. The advantage of fibre glass is able to adapt to weather changes. Able to reduce noise when it rains. Able to hold from ultra-violet radiation. Last, fibre glass is not easily broken and not fragile. (N.M. Cameron, C.F. Rapp, in Encyclopedia of material Science and Technology, 2001)



Figure 2.5 Fibre glass

### 3) ALUMINUM FOIL

The heat-reflecting aluminium foil insulation. The aluminium foil insulation reflects up to 97% of heat in the direction of its source and its reflectivity is maintained even after years of usage. External heat cannot enter the house, which increases energy efficiency. Heat is not transmitted from the outside to the inside, therefore less energy is generated by the air-conditioning system to cool down the house. Aluminium foil insulation is also lightweight and malleable, hence its position under the roof will not exert pressure on the structure of the house.

Having aluminium foil insulation prevents external heat from entering the house, which in turn increases energy efficiency. Heat is not transmitted from the outside to the inside; therefore less energy is generated by the air-conditioning system to cool down the house. Aluminium foil insulation is also lightweight and malleable; hence its position under the roof will not exert pressure on the structure of the house. (Julia R. Thomson(2017)



Figure 2.6 Aluminium foil

## **2.5 SUMMARY**

Overall derived from this chapter is the experimental reference to be made to previous research sources to complete the work done. Additionally, some information from previous studies on cool roofs about materials to make the rooftop roof and criteria available on rooftops such as roof strength, water absorption and heat and rain resistance. The implementation of this cool roof can reduce the temperature in the home and beyond can reduce the use of air-conditioning that uses high electricity.

## **CHAPTER 3**

### **RESEARH METHODOLOGY**

#### **3.1 INTRODUCTION**

In this chapter we describe the approach of this study method. Diagram 3.2 shows the flowchart for how this research will work. Through this chart, careful planning, methodological methodology and the technique of analyse the data is correct, has helped to achieve the objective of the study.

In addition, the study methodology is the method or procedure used for conducting research that is a method and technique of designing, collect and analyse data to produce as much evidence as possible support a study. The purpose of the methodology is to help understand more about the application of the method by making the description about the research process.

### 3.2 RESEARCH DESIGN / STRUCTURE

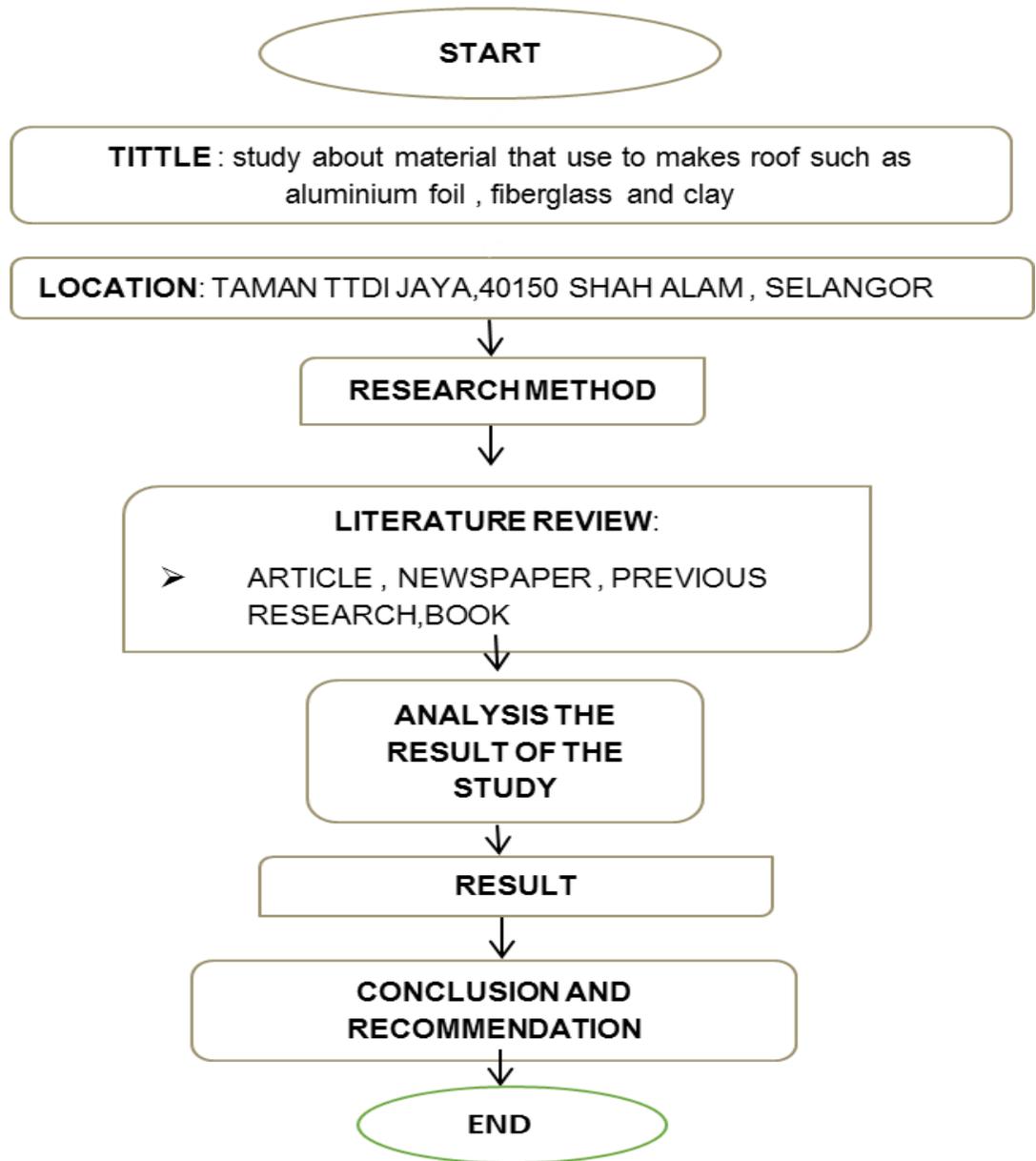


Figure 3.2 Flow chart of project implementation.

### 3.3 PROCEDURE

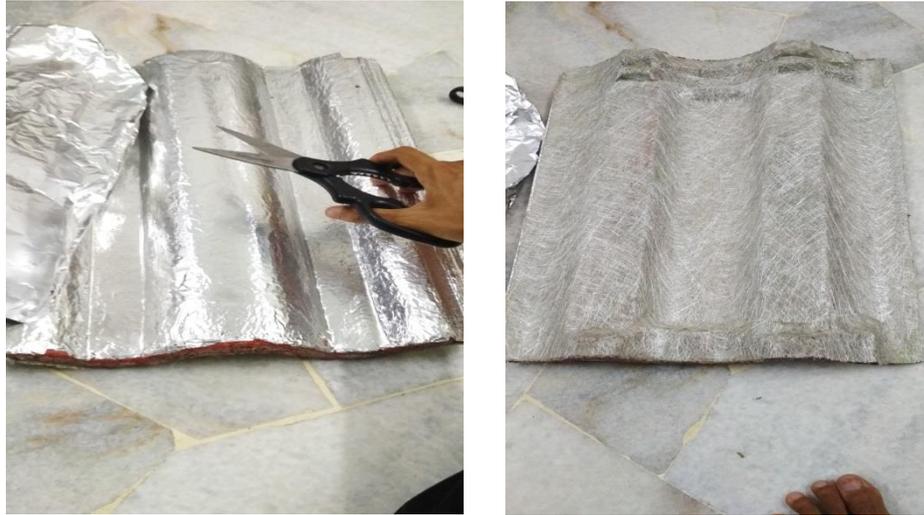


Figure 3.3: Aluminium and fibre glass is pasted to roof

- I. Aluminium is cut according to the size of the concrete tiles.
- II. Fibre glass is cut according to the size of the concrete tiles.
- III. Aluminium and fibre glass pasted on concrete tiles.
- IV. Step I to III is repeated on clay tile.

Cool roof is made as shown as figure 3.3.1. the cool roof is made using the different materials. The mix material to make a cool roof is mix is concrete tile, aluminium foil and fibre glass. Second mix is concrete tile and aluminium foil. Third mix is clay tile, aluminium foil and fibre glass. Forth mix is clay tile and aluminium foil.

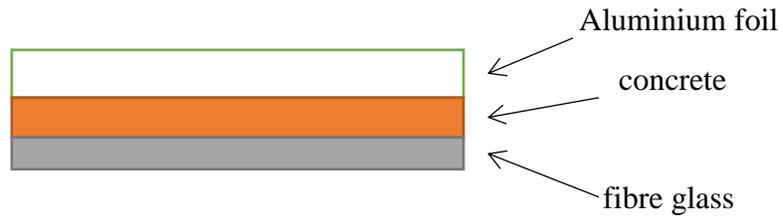


Figure 3.4: cool roof use the mix concrete tile, aluminium foil and fibre glass.

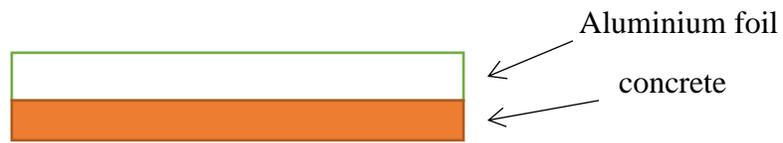


Figure 3.5: cool roof use the mix concrete tile and aluminium foil

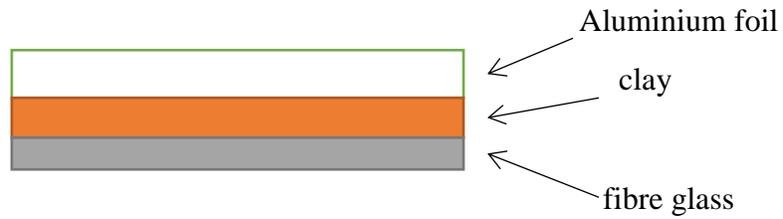


Figure 3.6: cool roof use the mix clay tile, aluminium foil and fibre glass



Figure 3.7: cool roof use the mix clay tile and aluminium foil



Figure 3.8: Make a house model

The house model was created using the boards as shown in figure 3.3.2. A total of 6 home models were created to the difference between reading of temperature with different materials used to make the roof.



Figure 3.9: house model

A total of 6 house models have been created as shown in figure 3.3.3. The house model is 2 x 2 x 1 feet. All models are in the same size.



Figure 3.10: apply the roof on the house model.

The total of six sample roof is placed on six models of houses as shown as figure 3.3.4.



Figure 3.11: All the roofs are soaked

All the roofs are soaked for two hours under the sun or get the temperature reading as shown as figure 3.3.5. All the roof are oaked in the same time to get the best result.



Figure 3.12: The reading of the temperature taken and recorded

After two hours, the reading of the temperature are taken and recorded at the same time as shown as figure 3.3.6. Temperature readings were taken three times to obtain the average temperature.

### 3.3 PARAMETERS

<b>UNITS</b>	<b>PARAMETER</b>
°C	Temperature
mm & g	Thickness & Mass
Mass, g	Size

Table 3.3 Parameter and unit for project scope

In general, the temperature is a physical quantity expressing hot and cold. It is measured with a thermometer calibrated in one or more temperature scales. The most commonly used scales are the Celsius scale. The temperature testing of the roof can be said the amount of heat present in a roof. Then, for the strength, it can be said as the capacity of the roof to withstand great force or pressure. Next, the thickness and mass can be said as the roof regardless of its volume or of any forces acting on it respectively.

### **3.4 METHOD OF DATA COLLECTION**

Literature Review This literature review focuses more on effectiveness of the use of materials makes roofing such as clay, aluminium foil and glass fiber in lowering the temperature. Facts and past studies are collected to find finding the relevance of this cool roof requirement to humans. Through this literature review, information can be collected and able to make comparisons or conclusions of the data already available.

#### **3.4.1 Documentation**

- a) Journals
- b) Article

#### **3.4.2 Direct observation**

Our group students go to door to door do the observation to find the condition of the roof and outcome of the result.

#### **3.4.3 Sampling techniques**

Sampling techniques are scientific method of selecting representative sample from the population. We have use quota sampling and snow ball sampling for this research.

### **3.5 RESEARCH INSTRUMENT**

In implementing this study, the method used to collect data is to find information on previous studies on cool roof. The information collected will then be compared and concluded. The data obtained will be identified by the weakness and strengths in each of the studies. Additionally, data is also collected through searches from newspaper and related books on cool roofs. Data such as backups and reviews from users can also be collected.

## CHAPTER 4

### ANALYSIS AND DATA

#### 4.1 COLLECTION DATA.

There are various of test that need to be done to determine the cooling roof effectiveness. It is made to have a lower room temperature compared to a normal roof's room temperature. It is important to provide comfort to the house owner. Various of the tests performed. First of all is temperature test and followed by mass test. The table below show the result of the temperature readings of each roof's type.

## 1) TEMPERATURE TEST

Table 4.1: Temperature result for each roof type

ROOF MATERIAL USED	AFTER 2 HOURS (°C)			AVERAGE (°C)
	Take 1	Take 2	Take 3	
<b>Cement</b>	<b>34.2</b>	<b>34.8</b>	<b>34.4</b>	<b>34.5</b>
<b>Cement + Aluminium Foil</b>	<b>33.3</b>	<b>33.6</b>	<b>33.3</b>	<b>33.4</b>
<b>Cement + Aluminium + Fibre glass</b>	<b>33.7</b>	<b>33.6</b>	<b>33.3</b>	<b>33.5</b>
<b>Clay</b>	<b>34.8</b>	<b>34.4</b>	<b>34.2</b>	<b>34.5</b>
<b>Clay + Aluminium Foil</b>	<b>33.8</b>	<b>33.9</b>	<b>33.8</b>	<b>33.8</b>
<b>Clay + Aluminium foil + Fibre glass</b>	<b>34.2</b>	<b>34.4</b>	<b>34.3</b>	<b>34.3</b>

Based on the table, the objective to reduce temperature of the roof was achieved. The best mix for the lower temperature reading is mix of concrete tile and aluminium foil which is 33.4°C. The concrete temperature reading is 34.5°C.

**1) MASS TEST**

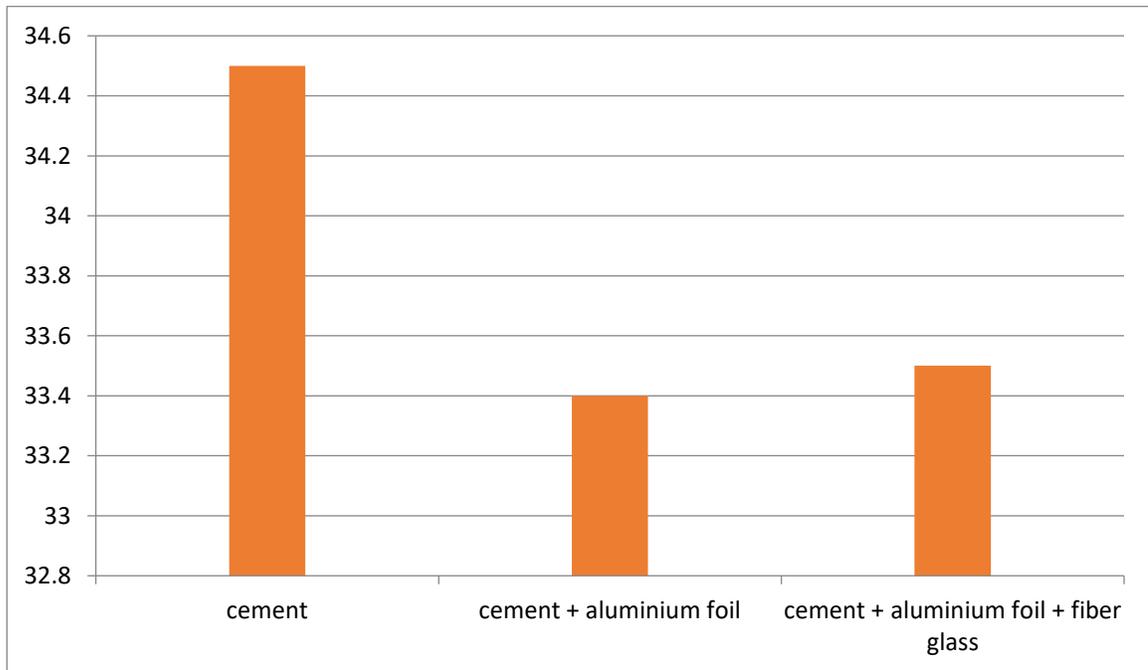
**table 4.2: result of the mass readings for each roof type.**

<b>ROOF MATERIAL USED</b>	<b>MASS (kg)</b>			<b>AVERAGE (kg)</b>
	<b>Take 1</b>	<b>Take 2</b>	<b>Take 3</b>	
<b>Cement</b>	<b>4.500</b>	<b>4.502</b>	<b>4.503</b>	<b>4.502</b>
<b>Cement + aluminium foil</b>	<b>4.776</b>	<b>4.777</b>	<b>4.775</b>	<b>4.776</b>
<b>Cement+ aluminium + fiber glass</b>	<b>4.800</b>	<b>4.810</b>	<b>4.808</b>	<b>4.806</b>
<b>Clay</b>	<b>3.860</b>	<b>3.859</b>	<b>3.856</b>	<b>3.858</b>
<b>Clay + aluminium foil</b>	<b>3.962</b>	<b>3.960</b>	<b>3.9642</b>	<b>3.962</b>

<b>Clay + Aluminium foil + fiber glass</b>	<b>4.009</b>	<b>4.010</b>	<b>4.008</b>	<b>4.009</b>
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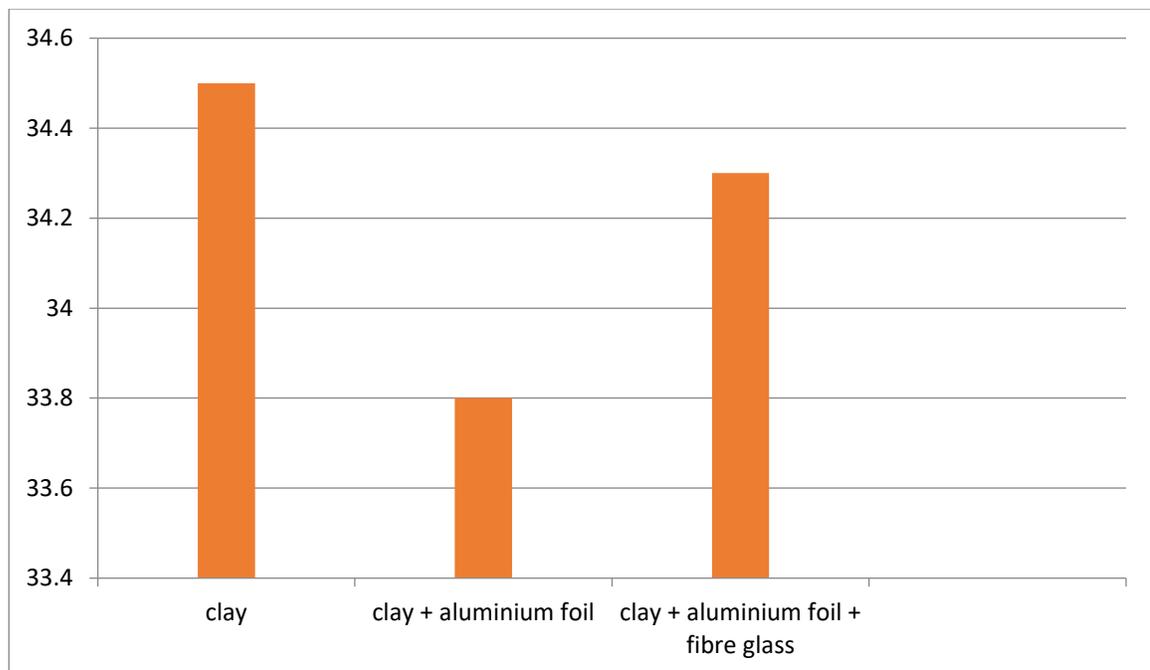
Based from the table, the objective to reduce the mass of the roof is failed. This is because the actual mass for cement tiles is 4.502kg.

Figure 4.1: The result of temperature test based on cement



The reading of temperature test for cement and aluminium foil can reduced about 3.19% and for cement, aluminium foil and fibre glass is 2.9%. From this data, the different between this three show the best is come from mix of cement and aluminium foil.

Figure 4.2 : the result of the temperature test based on clay



The reading of temperature test for clay and aluminium foil can reduced about 2.03% and for clay, aluminium foil and fibre glass is 0.57%. From this data, the different between this three show the best is come from mix of clay and aluminium foil.

## **CHAPTER 5**

### **DISCUSSION AND CONCLUSION**

#### **5.1 INTRODUCTION**

This chapter is the final step of the study, in which it involves a summary for the results of the research that have been carried out according to the research method. Therefore, this chapter will explain the discussion and conclusion of the study results from the analysis document and interviews conducted. Discussion and conclusion of this study will is shown according to the study which is to prepare a roof that can reduce the temperature of the house, determine the best mixture of materials to produce the roof and to compare with the existing product in terms of temperature and mass.

#### **5.2 DISCUSSION**

The following is a discussion of the overall objectives of this study. This discussion is to determine the main factor that should be highlighted in the cooling roof. Based on the results, it can be said that the use of roof cover from concrete is very efficient. This is in line with the study of Terreal's roof tile manufacturers (2018), concrete tiles have good features in terms of strength and heat resistance. In addition, the price of concrete tiles is

relatively low compared to clay tiles. Building Material book written from (Gambhir, 2011), the clay tiles are expensive tiles and require labour which is compact but it has an infinite level of endurance. The use of aluminum foil also helps in reducing the heat received by the roof. This proves that aluminum foil is an excellent heat reflector.

### **5.3 CONCLUSION**

In conclusion, this study found that roof coverings have good heat resistance. The widespread use of concrete helps to reduce the problem of high temperatures in the home. This does not mean that, clay is not good, as it also has good heat. In addition, the lower price of concrete than clay makes it easier to own and use in residential areas. The use of aluminium foil also helps to reduce the temperature in the home and acts as a heat reflector directly received by the roof cover. The more heat that is reflected the less the heat is trapped. The fiberglass glass used can be helpful, but it does absorb heat well. Malaysia is facing the problem up to 75% users in Malaysia rely on air conditioning systems. This problem has led to increased electricity consumption and operating costs. so as little as we can reduce the use of air conditioners and save costs. Malaysia is a country with experiencing hot and humid tropical climate throughout the year, therefore the use of cool roofs are strongly encouraged.

### **5.4 SUGGESTION**

Overall there are some improvements that can be made such as adding aluminium foil

thickening, getting the best layer coating for cold roofs, using strong adhesive material for each coating and adding irrigation systems intended to help cool the roof.

## GANTT CHART

Activities/ week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Group discussion	White Brown													
Design the product sample		White Brown												
Search for materials			White Brown											
Make product					White Brown									
Test the product								White Brown						
Compare product result											White Brown			
Present the product result														White Brown

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LINKS :

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Books:

## **Geothermal Energy: Sustainable Heating and Cooling Using the Ground 1st Edition**

About the Author

Dr. Rosen is a Professor of Mechanical Engineering at the University of Ontario Institute of Technology. He has served as President of the Engineering Institute of Canada and of the Canadian Society for Mechanical Engineering. His main areas of research are thermodynamics, energy technology, sustainable energy and the environmental impact of energy systems. He was also the founding Editor-in-Chief of the journal Sustainability (MDPI).

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Author

Fantazy Vintage

**Green Roof: A Case Study: Michael Van Valkenburgh Associates' Design For the Headquarters of the American Society of Landscape Architects 1st Edition**

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"Building Material" book written from (Gambhir, 2011)

Terreal's roof tile manufacturers (2018),