

## Building Roof Covering Materials for Residential and Commercial: Comparison and Best Choices

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### ABSTRACT

*Choosing the right roofing material is an important aspect of building design and construction. Both residential and commercial buildings have roof-related needs. But basically, the selection of roofing materials is not only for protection from but also based on energy efficiency, aesthetics, and longevity of the building. In addition, the design of roof shape selection must be done carefully because the wrong selection can cause rainwater seepage or leakage on the roof and high repair costs. This research aims to explore by comparing the characteristics of roof covering materials and provide the best choice based on needs. The research method used is a qualitative research method with the stages carried out, namely data collection techniques, sample determination, data analysis and research conclusions. Based on the analysis, it is concluded that for residential houses, tile roofs and concrete deck roofs are the best choice because they offer an optimal combination of aesthetics, durability, energy efficiency, and cost that is suitable for the Indonesian climate. While for commercial buildings, metal tile roof is an excellent choice due to its durability, energy efficiency, and modern aesthetics that suit the needs of commercial buildings.*

**Keywords:** Roof Covering Materials; Comparison; Residential; Commercial.

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### INTRODUCTION

The roof has an important role because it serves as the crown of the building and is the most visible part of the house because it is at the front. Nowadays, there are many houses with various attractive roof models due to the creativity of architects, such as modern gable roof designs used for urban buildings. However, with the tropical climate and high rainfall in Indonesia, this design must consider and be adapted to the environmental conditions when built [1]. One of the building components most affected by weather and seasons is the roof. The shape and type of material used to cover the roof greatly affects the roof's ability to withstand rain, heat generated by sunlight, long wave radiation that dissipates heat at night, and other climatic factors [2]. The roofs of architectural buildings in Indonesia generally have a slope of 30° or more, this is because the shape of the roof that has a slope of 30° or more can make buildings located in the Indonesian climate, which is tropical, have high rainfall, rainwater that falls on the building can flow smoothly and flow directly to the ground without worrying about the top of the building being flooded [3].

The growth of residential and commercial development as a means of supporting housing is uncontrollable due to the fulfilment of people's needs for housing and other supporting needs, which is one of the triggers for the reduction of green open space in an area. With the development of technology and increasing awareness of environmental sustainability, the choice of roofing materials is now increasingly diverse and innovative. The selection of the right roofing material is a crucial aspect in the design and construction of buildings, both residential and commercial. Roofing materials not only serve as protection from natural elements such as rain, wind, and sunlight, but also play an important role in the energy efficiency, aesthetics, and longevity of the building [4]. In addition, the design of the roof shape selection must be done carefully because the wrong selection can cause rainwater seepage or leakage on the roof and make people inside the building disturbed and uncomfortable. Damage to the roof can be repaired, but it requires a lot of money in addition to compensating for roof repair losses [2].

Residential and commercial buildings have different needs regarding roofing materials. Residential buildings generally emphasise aesthetics, thermal comfort, and affordability. This is due to the economic level of the majority of people in Indonesia, which is still middle to lower class, so that people can be cheaper and more affordable in building houses. On the other hand, commercial buildings focus more on durability, energy efficiency, and the business image displayed by the building [5][6]. Therefore, an in-depth analysis of the advantages and disadvantages of different types of roofing materials is needed to provide the right recommendations for both types of buildings.

Sola's research (2022) shows that the selection of the right roofing material can significantly reduce building energy consumption and improve indoor thermal comfort. Where the roof cover with zinc material, has a temperature that tends to be higher than the roof cover using tile material. So that Indonesia with a tropical climate in the use of the roof is very influential on the temperature and comfort in space, especially in terms of the use of building roof covering materials [4]. Further studies are needed to comprehensively understand how each type of roofing material can contribute to the specific needs of residential and commercial buildings in the Indonesian climate. Thus, this research aims to explore by comparing the characteristics of roof covering materials and provide the best choice based on the needs.

## **METHOD**

This research uses qualitative research methods. The stages of the data collection method carried out are data collection techniques, sample determination, data analysis and research conclusions. The details of the stages of this research are:

1. Data collection techniques: using a literature study which is a search for references that are relevant to the topic discussed. These references can be in the form of journals, articles and internet sites. The output of this literature study is the connection of references to the topic of the problem discussed.
2. Research stages:
  - a. Initial stage: determining suitable objects for residential and commercial buildings by comparing roofing materials.
  - b. Data collection stage: data obtained from previous research references related to building roof covering materials and residential and commercial buildings.

- c. Data analysis stage: this stage analyses the literature obtained from journals, articles and internet sites.
  - d. The conclusion stage: concluding the results of the analysis related to the comparison of roof covering materials for residential buildings and commercial buildings and providing the best recommendations in the selection of building roof covering materials.
3. Sampling: this study sampled the types of roof coverings commonly used in Indonesia.

**RESULTS AND DISCUSSION**

1. Types of roof covering materials

The outermost part of the roof structure is the roof covering. The roof covering must have waterproof properties in order to prevent water seepage when it rains. The structure of the roof covering is directly related to workloads or weather so that in planning it must be chosen from materials that are waterproof and resistant to weather changes. Roof covering materials that are often used include wood (shingles), zinc, tile, concrete deck and metal tile [7]. Each type of roof covering has its own advantages and disadvantages. The selection can be done by considering the appearance, practicality, shape and age of each plan.

a. Wooden Shingle Roof

Many of the materials used in traditional Indonesian houses are wood-based. Shingles are formed from thin pieces of wood arranged in 3 (three) or 4 (four). These pieces of wood are then nailed to the multiplex that lines the roof frame. This roof covering made from thin pieces of ironwood (*eusideroxylon zwageri*), its working life depends on the environment, the quality of the ironwood used, and the angle of the roof. This type of roof covering can last between 25 years and forever. Its unique shape is suitable for country-style homes and those that blend with nature [8][9].

Table 1. Advantages and disadvantages of shingle roofs [10][11]

Advantages	Disadvantages
High aesthetics, gives a natural and classic impression to the building	More expensive than other roofs
Lightweight, does not burden the building structure	Maintenance is more difficult, prone to leaks and requires precision for repairs
Weather and pest resistant if using quality wood (ironwood, teak, etc.)	Requires an expert for installation
Durable for decades with regular maintenance	Not easily found in all building stores

b. Tile Roof

According to the material, there are concrete roof tiles, traditional clay roof tiles and ceramic clay roof tiles. Meanwhile, according to its shape, roof tiles consist of ordinary roof tiles (S tiles), frog roof tiles, cross-pressed roof tiles [8].

Table 2. Advantages and disadvantages of tiled roofs [10][12]

	<b>Advantages</b>	<b>Disadvantages</b>
Concrete Tile Roof	<ul style="list-style-type: none"> <li>• Has excellent strength</li> <li>• Has good resistance to various external attacks</li> <li>• Available in various forms</li> <li>• Has many colour choices</li> <li>• Has a shape that is not easily changed</li> <li>• Can ward off heat</li> <li>• Tile can be repainted when it is felt that the aesthetics have diminished</li> </ul>	<ul style="list-style-type: none"> <li>• Has a relatively heavy weight</li> <li>• Requires more difficult maintenance</li> </ul>
Ceramic Tile Roof	<ul style="list-style-type: none"> <li>• Has excellent strength</li> <li>• Does not require difficult maintenance</li> <li>• Environmentally friendly</li> <li>• Long-lasting colour</li> <li>• Good resistance to weather changes</li> <li>• Good resistance to fire</li> <li>• Can counteract heat</li> </ul>	<ul style="list-style-type: none"> <li>• Has a heavy weight</li> <li>• The installation process is quite complicated</li> <li>• The cost is much more expensive</li> </ul>
Clay Tile Roof	<ul style="list-style-type: none"> <li>• Low price</li> <li>• Strong enough to withstand various attacks and loads</li> <li>• Easy to obtain because many produce</li> <li>• Can withstand hot and cold air</li> <li>• Has a light weight</li> <li>• Resistant to noise</li> </ul>	<ul style="list-style-type: none"> <li>• Prone to leaking</li> <li>• The installation process is a little complicated</li> <li>• Easy to grow moss and mould</li> <li>• Tile colour fades quickly</li> </ul>

c. Zinc Roof

This roof is actually made from thin steel sheets that are given a zinc coating by electrolysis. The purpose is to make it rust-resistant. So, the word zinc comes from the coating material. This type will last as long as the zinc coating hasn't worn off, which happens around the 30s. After that, the roof will start leaking if any part of it is attacked by rust [7][13].

Table 3. Advantages and disadvantages of zinc roof [13]

<b>Advantages</b>	<b>Disadvantages</b>
<b>Affordable price:</b> More cost-effective than other metal roofs such as copper or aluminium	<b>Noise when it rains:</b> The sound of heavy rain will be clearly audible
<b>Lightweight:</b> Does not burden the building structure	<b>Less aesthetically pleasing:</b> Plain appearance and lack of colour variation
<b>Easy installation:</b> The installation process is relatively quick and simple	<b>Lack of thermal insulation:</b> The room can feel hotter, especially during the dry season
<b>Weather resistant:</b> Durable and resistant to sunlight and heavy rains	<b>Prone to rust:</b> Requires regular maintenance to prevent rust
<b>Various types available:</b> Wave and flat zinc types offer a choice as per the requirement	<b>Less environmentally friendly:</b> Zinc production process may produce waste

d. Concrete Deck Roof

This roof is usually a flat roof made of a combination of iron and concrete. Widely used in modern minimalist and contemporary houses. Its strong construction makes it

possible to use this roof as a place for activities. For example, drying clothes and growing plants with pots. Leaks in concrete deck roofs often occur. So it is necessary to monitor the casting and use waterproofing on the top layer [7][13].

Table 4. Advantages and disadvantages of concrete deck roofs [7][14]

Advantages	Disadvantages
<b>Multifunctional:</b> Can be utilised as additional space (rooftop) or rainwater harvesting.	<b>Prone to waterlogging:</b> Requires a good drainage system to prevent waterlogging on the surface
<b>Minimalist aesthetics:</b> Displays a modern and clean impression on the building	<b>Relatively expensive:</b> Higher material and labour costs
<b>Strong and durable:</b> Resistant to extreme weather and heavy loads	<b>Requires accurate calculations:</b> Concrete deck structure must be carefully calculated to withstand the load
<b>Easy maintenance:</b> Requires regular cleaning and checking for potential leaks	<b>Prone to cracking:</b> Concrete deck roofs are prone to cracking, especially if the concrete is not of good quality or the roof is not properly maintained.
<b>Can be fitted with skylights or solar panels:</b> Allows for natural lighting and solar energy utilisation	<b>Not suitable for all regions:</b> Not ideal for areas with high rainfall and poor drainage.

e. Metal Tile Roof

The shape is sheet, similar to zinc. This tile is planted on the roof truss beam using screws. The installation is not much different from clay tiles, only the size is larger. This tile is an alternative to ceramic or clay tiles that are generally used by the community. The available sizes vary, 60-120 cm (width), with a thickness of 0.3 mm and a length between 1.2-12 m [7][15].

Table 5. Advantages and disadvantages of metal tile roof [15][16]

Advantages	Disadvantages
<b>Lightweight and strong:</b> Suitable for earthquake-prone areas and does not burden the building structure.	<b>Relatively expensive:</b> Compared to concrete or clay tiles.
<b>Durable:</b> Average lifespan of 20-30 years with minimal maintenance.	<b>Less aesthetic:</b> Plain appearance and less colour variation compared to other roof tiles.
<b>Fire and termite resistant:</b> Safe from fire and pest infestation.	<b>Noisy when it rains:</b> The sound of heavy rain is more clearly audible.
<b>Easy and fast installation:</b> Saves installation time and cost.	<b>Prone to dents:</b> Need to be careful during installation and storage.
<b>Large selection of colours and shapes:</b> Offers a variety of designs for building aesthetics.	<b>Requires regular maintenance:</b> Repainting to maintain colour and prevent rust.

2. Comparison of Residential and Commercial Building Roof Covering Materials

Residential and commercial buildings have different needs regarding roofing materials. Residential buildings generally emphasise on aesthetics, thermal comfort, and affordable cost. Commercial buildings, on the other hand, focus more on durability, energy efficiency, and the business image that the building portrays [5][6].

Table 6. Comparison of residential and commercial building roof covering materials [2][4][14]

Roof Materials	Aesthetics and Design	Durability and Maintenance	Energy Efficiency	Initial and Long-term Costs	Suitability to Indonesian Climate
Wooden Shingle Roof	Natural aesthetics, traditional look	Durable (30-50 years), regular maintenance	Good thermal insulation, natural temperature regulation	High initial cost, moderate long-term cost	Suitable, but needs care against damp
Tile Roof	Classic aesthetics, wide choice of colours	Durable (>50 years), minimal maintenance	Good thermal insulation, reduced energy costs	Medium initial cost, low long-term cost	Very suitable, heat and rain resistant
Zinc Roof	Simple look, less aesthetic	Durable (20-30 years), easily damaged	Low insulation, high heat transfer	Low initial cost, high long-term cost	Less suitable, susceptible to corrosion
Concrete Deck Roof	Modern and versatile, customisable	Very durable (>50 years), low maintenance	Excellent insulation, reduces energy costs	High initial cost, low long-term cost	Very suitable, resistant to extreme weather
Metal Tile Roof	Modern and elegant, wide range of colours	Durable (40-70 years), minimal maintenance	Reflective, reduces heat, energy efficient	High initial cost, low long-term cost	Suitable, resistant to heat and rain

Table 7. Summary of the comparison of residential roofs and commercial roofs

Category	Residential Roofing	Commercial Roofing
<b>Aesthetics and Design</b>	Focus on harmonisation with the architectural style of the house and neighbourhood.	Customising with business identity and branding, can be more diverse.
<b>Durability and Maintenance</b>	Owners perform regular maintenance, preference for durable materials with minimal maintenance.	Must be efficient in maintenance, preference to durable materials with minimal maintenance.
<b>Energy Efficiency</b>	Important for occupant comfort, reduction in need for artificial cooling/heating is favoured.	Important for operational efficiency, materials that reduce energy consumption in large buildings are favoured.
<b>Initial and Long-term Costs</b>	Owner may be willing to incur high initial costs to reduce maintenance costs and have longevity.	Must be balanced between initial and long-term costs, a large investment if it results in significant savings.
<b>Suitability to Indonesian Climate</b>	Must withstand heat, rain, and high humidity for occupant comfort and protection.	Must withstand extreme weather that may affect business operations, focus on harsh environment durability.

Comparison of Roof Types: Advantages and Disadvantages

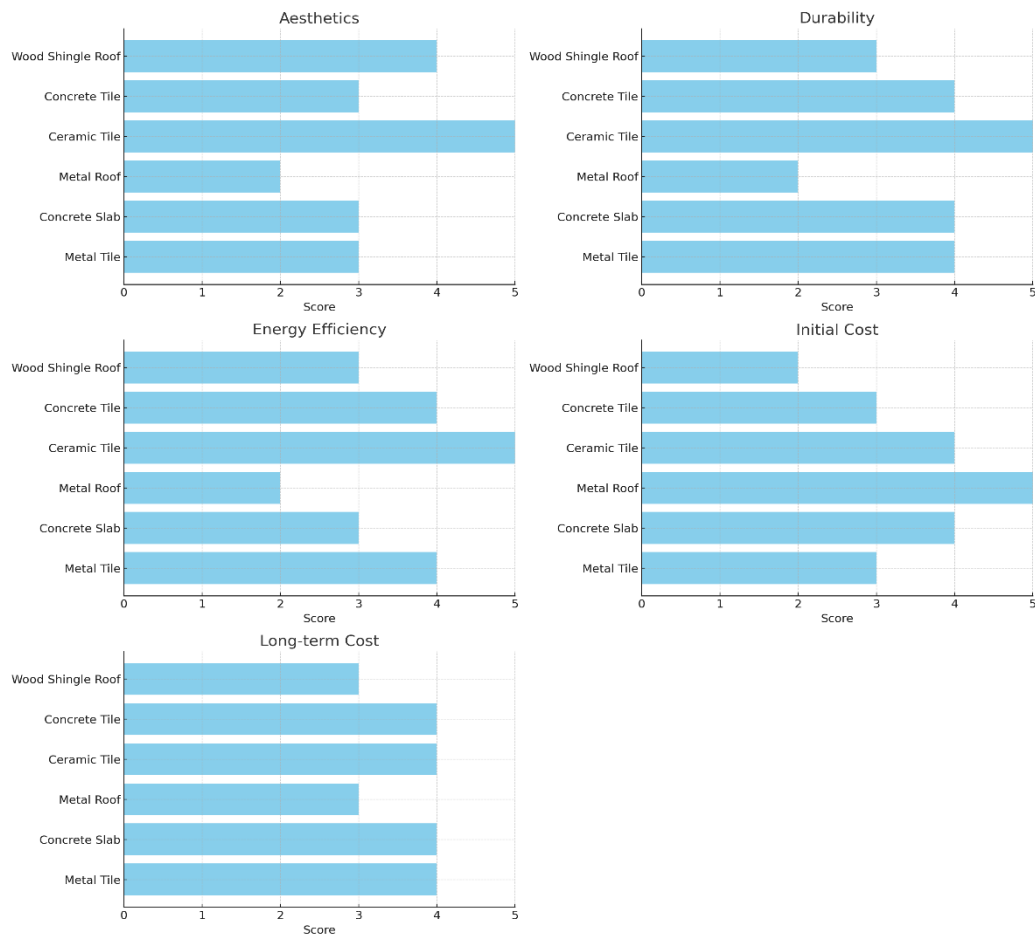


Figure 1. Comparison of roof covering materials

Based on the analysis of the various types of roofing materials, the best recommendation for residential houses and commercial buildings is that for residential houses, tile roofs and concrete deck roofs are the best choice because they offer an optimal combination of aesthetics, durability, energy efficiency, and cost that is suitable for the Indonesian climate. As for commercial buildings, metal tile roofing is an excellent choice due to its durability, energy efficiency, and modern aesthetics that suit the needs of commercial buildings.

## CONCLUSION

Based on the analysis results related to the comparison of roof covering material types and comparison for residential and commercial houses, it can be concluded that wood shingle roofs have natural aesthetics and are lightweight, but are susceptible to fire, termites, and mould. Concrete and ceramic tile roofs offer longevity, fire resistance, and ease of cleaning, but are heavy and less aesthetically pleasing. Tin roofs are an economical option, but are prone to rust, lack aesthetics, and are noisy when it rains. Concrete deck roofing is highly durable, fire-resistant, and multifunctional, but is expensive and requires a strong structure. Metal tile roofs are lightweight, easy to install, durable, and fire-resistant, but expensive, less aesthetic, and noisy when it rains. So based on these types of roof covering materials, the best choice is for residential houses, tile roofs and concrete deck roofs are the best choice because they offer an optimal combination of aesthetics, durability, energy efficiency, and cost that is suitable for the

Indonesian climate. As for commercial buildings, metal tile roofing is an excellent choice due to its durability, energy efficiency, and modern aesthetics that suit the needs of commercial buildings.

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