

Review Paper on Roofing Tiles

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Abstract

Managing waste is a global challenge that challenges the protection of our ecosystem due to its high rate of generation and its non-biodegradability. PWs must, however, be carefully handled to mitigate the emissions involved with their incineration and dumping into landfills. Waste can be recycled into new usable building materials. In this analysis, shredded waste aggregate from a recycling center was heated and used as a binding aggregate in complete replacement of cement with river sand to produce floor tiles. The properties of the aggregate materials and roof tiles (including their distribution of particle size, silt, clay and dust content, relative density, water absorption, porosity, flexural and compressive strength) were tested on different waste.

KEYWORDS: *Profile of tiles, Types of tiles, Waste used for manufacturing etc.*

1. INTRODUCTION

The Internet of Things (IOT) is the network of physical objects or devices, vehicles, buildings, and other items embedded with electronics, software, sensor and network connectivity that enables these objects to collect and exchange data. Mobile phone and other related technologies are becoming more and more famous. So that communication with every person has become easy and smart. Another technology used is Global System for Mobile Communication (GSM) for sending message anytime and anywhere. Notice board plays a vital role in today's world. It is commonly used in places like school, colleges, railway stations and other various institutes. But changing notices day to day is a difficult task. So to overcome such things this paper focuses on a digital notice board. The main objective of this paper is to develop a notice board using IOT that replaces the currently used electronic display. A digital notice board can be replaced in place of a conventional notice board which reduces manpower and resources. The digital notice board uses digital technology and electronic components. It is implemented to display notices or messages from anywhere or at anytime. A Smart Notice Board [1] designed and developed using Internet of Things. It uses a Mobile App that sends messages that are to be displayed on the notice board. This uses a Wi-Fi module which limits the distance from which the message is to be sent. A Digital Notice Board [2] is mainly consists of Raspberry Pi in which there is an android application that is connected to the LCD display. This project needs a continuous internet connection that too with registered network. A survey paper on The Android Controlled Smart Notice Board using IOT [3] has been implemented an Android Controlled Smart Notice Board using IOT which uses the Raspberry Pi and IOT. The drawback of this project is that it uses a specific App which is again to be developed for the same and it also requires continuous internet connection. Implementation of Digital Notice Board using Raspberry Pi and IOT [4] in which PC is used for sending information and Raspberry Pi is connected to internet at the receiving side. The need of continuous internet connection is one of the drawbacks of the system. A survey paper on Voice Over Wi-Fi based Smart Wireless Notice Board [5]. It is a system to wirelessly transmit short notice using Wi-Fi. This system uses Raspberry Pi for the Transfer of the information. Zigbee based Electronic Notice [6] Board. In this project the wireless notice board is developed with the help of ZigBee and GSM Technology. The software developed at the personal computer is to assist the user to send the notices to the students through emails through mobiles and to display the notices at the notice board. The drawback of this system is that it needs continuous internet connectivity to transfer information that is to be displayed through e-mails. In this paper a digital notice board is proposed which can be controlled/operated by authorized person from anywhere without any distance issue. The normal messaging app of an android mobile phone is used for transfer of notices/messages in this system to make it more user friendly. The resources, manpower, time consumption generally required for conventional notice board is reduced with the use of this system. It is also cost effective over the conventional notice board.

2. Roof tiles are usually produced from locally accessible materials such as terracotta or slate, and are meant to keep rain out. Modern materials like concrete and acrylic are also utilised, and some clay tiles are coated with a water-resistant finish. Roof tiles are nailed to the roof framework and then "hang" from it. The tiles are normally strung in parallel rows, with each row covering the row below it to keep rain water out and cover the nails holding the row in place. Roof tiles are also available for specific locations, such as where the planes of the various pitches intersect. Ridge, hip, and valley tiles are among them.

The roof is one of the most significant components of a structure. 60 percent utilise cement roof sheets, and 75 percent choose asbestos cement roof sheets because they are less expensive per square metre [1] and give good strength, flexibility, and thermal insulation characteristics, as well as adequate fire resistance. Toxic chemicals are found in asbestos roof sheets. Asbestosis, chronic lung illness, malignant pleural disease, malignancies, and other diseases are all caused by asbestos. Lung cancer, as well as cancers in other regions of the body. Considering the consequences of greenhouse gas emissions (GHGs) it is essential to discover solutions of mitigating these gases to secure the future [2]. About 40% of energy utilized globally and approximately 46% of this quantity being consumed by building industry [3]. A huge amount of waste is being generated in such activities of Construction [4,5]. Cement Industry alone emits 10% of CO₂ emissions as per International Energy Agency (IEA) [6]. Temperature greater than 1000 °C and 1.84 – 2.8 kJ/kg of energy are required for manufacturing of clay tiles [7]. This pollution can be checked by natural fibres which will be effective in production process suited to climatic regions as well. The global population generates 1.2 kg of solid urban waste every day on average (MSW). According to the United Nations, this quantity equates to 1.4 billion tonnes every year. In ten years, the world's population will increase by 2.2 billion tonnes, according to the United Nations. According to one source, The UN and the World Bank conducted an investigation in the previous 30 years, the global rubbish volume has increased. It was three times larger than population growth (Arajo et al., 2014).

In 2016, 78.3 million tonnes of rubbish were thrown in Brazil. On this basis, 91 percent of the money was collected, but nearly half of it (about 45 percent) went to controlled and uncontrolled spending. Landfills that are not under control. The Brazilian Public Sector Association ABRELPE (Association of Cleaning Companies and Special Waste) reported a total of 29.7 million tonnes of solid trash were produced. Incorrect disposal, which has a direct impact on the safety and health of people. From the standpoint of the next generation, suitably managed. The initiative to repurpose the material, on the other hand, was a success. As a solution to the vast volumes of discarded material. Garbage has been heavily promoted (ABRELPE, 2016).

In a global setting, reuse is common, especially when it comes to sustainable development. Natural resources are limited, particularly in the civil construction sector. They're used in a colossal amount. As a result, garbage is utilised. As well as a chance for product development innovation as well as contribute to environmental protection (MMA, 2012). Fortunately, some materials are already available. Bricks made from rubble, for example, are made from garbage. Concrete, ISOPET blocks (made from Styrofoam and PET bottles), with the addition of PET to tyre rubber or bricks and concrete PET fibres, for example. As a result, recycling and reuse are critical. Recycling of unwanted materials is widely encouraged, with the goal of long-term stability (Santos, 2018).

Roof tiles on the market are frequently made with new materials, some of which include hazardous compounds that are harmful to humans. The diversity has grown as a result of the constant hunt for cheaper pricing and a wider range of colours and shapes. Ceramic tiles and fibre cement tiles are the most common varieties seen in modern homes. Ceramics made from the drying and heating of clay ingredients are widely used in Brazil and provide good thermal comfort. They do, however, necessitate a strong structure to sustain the greater weight of the tile-covered roof (Cardoso, 2000). Fiber-cement tiles, on the other hand, which are popular due to their lightness, are being banned from being made and installed in the country due to the presence of asbestos in its composition. There is already an option without asbestos, but even so, tiles with low thermal insulation and aesthetically devalued (Beraldo, 2013).

To construct low-cost housing, it is vital to discover low-cost materials that will contribute to the enterprise's viability. According to the Brazilian Institute of Statistics, In 2017, according to the International Bureau of Geography and Statistics (IBGE), half of the world's population resided in cities on a lower-than-minimum-wage salary (Domingues, 2017). As a result, the market for popular house construction is booming. Because half of the Brazilian population lives in poverty socioeconomic status. As a result, the research reported in this paper was driven by the reuse of solid waste in the construction of affordable housing, with an emphasis on roof tiles. According to The major goal was to conduct a systematic literature review. Examine to see if any of the tiles were made from solid trash. Roofs on common houses can be used.

2. LITRATURE REVIEW

The concept of sustainability is constituted by three main pillars: economic, environmental and social sustainability. According to Ayres (1996), sustainability can be defined as a way of acting in relation to nature, since we are responsible not only with the present, but with future generations. The objective is to promote development without scarcity of resources to guarantee survival in a few years. The sustainability proposal within companies brings economic growth and financial success combined with benefits for society in general. It is seen as a way of relating environmental preservation to impacts within the company's business and profits (Savitz, 2016).

Companies work with products, which go through a series of processes before, during and after reaching the consumer. Based on this context, the Product Development Process (PDP) appears, being divided into three basic phases: predevelopment, development and post-development. The first phase of the project consists of market research, in search of the first ideas for creating a product. It is during this phase that economic and potential risk assessments are performed for the development of business plans. The second phase, known as development, consists of 4 different projects. The first is the Informational Project, combining the client's needs with the interpretation of what is presented. The second is the Conceptual Project, proposing a concept to the product and summarizing the functions to be performed by it. The last two, the Preliminary Project and the Detailed Project, respectively, determine the materials, design, components, and dimensions of the product, in order to allow the launch of the input on the market. Finally, the post-development is limited to monitoring the product launched on the market until its disposal in the environment. In this phase, measures are taken to repair possible defects and establish goals to remove the product from the market (Rosenfeld et al., 2016).

The initial stages of the process (pre-development) are extremely important since products with a good specification and consensus among all decision-makers are three times more likely to succeed in the market. Besides that, it is a stage when costs are low and products are being designed and could assist in reducing costs in the following phases (Bakster, 2013).

In civil construction, the development of new products must be carried out based on the same steps of the PDP. Alternatives that aim to reduce the consumption of materials, energy and waste generated must be found, to preserve and improve the built environment. As a consequence, the change in conventional projects must be applied in civil construction, to reduce the environmental impact based on the adoption of renewable, non-toxic materials, conducive to self-construction and potentially recyclable (Shelb, 2016).

According to Cardoso (2010), the roof is defined as: "Discontinuous covering made of materials capable of providing rainwater tightness, rested or fixed on a light structure." This consists of four main elements: roofing; weft; support structure and rainwater catchment system. The roofing is formed by the tiles, which in turn have the main function of sealing. The weft is the support system of the tiles, being constituted of the roof battens, rafters, and purlins. The system is supported on the structure with the function of distributing loads in the building. Finally, the catchment system has the function of draining rain.

3. PROFILES OF ROOF TILES

A large number of profiles of roof tiles have evolved. These include :

A. Flat Tiles: It is the simplest type, which are laid in regular overlapping rows. Flat roof tiles are usually made of clay but also be made of stone, wood , plastic, concrete or solar cells.

B. Imbrex and Tegula: It is an ancient Roman pattern of curved and flat tiles that makes rain channels on a roof.

C. Roman Tiles: It is flat in the middle, with a concave curve at one end and convex curve at the other, to allow interlocking.

D. Pantiles: It is with an S-shaped profile, allowing adjacent tile to interlock. These result in a ridged pattern resembling a ploughed field.

E. Mission or Barrel Tiles: It is semi-cylindrical tiles laid in alternating columns of convex and concave tiles. Originally they were made, by forming clay around a curved surface. Today barrel tiles are mass produced from clay, metal, concrete or plastic.

F. Interlocking Roof Tiles : It is similar to pantiles with side and top locking to improve protection from water and wind

4. TYPES OF ROOF TILES

Tiles come in many shapes and sizes. Below, we examine the different types available in the market.

1. Clay Tile Roof

Clay tiles have been around for centuries. They are long-lasting and can live for over 50 years. Sometimes they can even outlive the house if installed and maintained properly. They will also retain their original color all the while. Clay tiles are also exceptionally beautiful. The subtle variations in texture and color among different tiles give them a rich character that is hard to imitate. Moreover, they come in many designs and colors to suit varying preferences.



2. Concrete Tile Roof

Concrete tiles are a cheaper alternative to clay and slate tiles. They may lack the natural appeal of their counterparts, but they can mimic the look of clay, slate, or shingles, thanks to technology. Concrete tiles are also available in many color options. Concrete tiles perform better in colder environments than clay. However, their porous nature is a point of concern. They can certainly last as long as clay or slate. But we cannot say the same about their color. So, you might have to budget for a repaint job sometime in the future.



3. Slate Tile Roof

If you are looking for that classic gothic look, it does not get better than slate. Cut from naturally occurring rock, the tiles will differ in shape, size, texture, and color. The subtle variations are what give the tiles character. Slate makes the heaviest roofing tiles. They are also the most expensive to buy. Furthermore, they require specialized knowledge and skills to install. That translates to high labor costs. Basically, be ready to dig deep into your pockets. Slate roofing is most rewarding if you can bear the high initial costs. It is one of the most long-lasting and requires minimal repairs and maintenance. Moreover, installing a slate roof will increase the resale value of your home significantly



4. Metal Tile Roof

Metal tile roofing offers flexibility in design. It can suit both modern and traditional architectural styles. Some profiles can even mimic traditional tiles like clay, slate, and concrete. Metal also comes with more options in color. Metal tiles are lighter than traditional options. Installation is, therefore, a breeze-It is quicker and straightforward and thus less labor-intensive. Metal tile roofing is also cheaper compared to conventional materials. For one, you will not have to hire a professional to reinforce your roofing deck like in clay or concrete tile roofing.

Metal is not brittle like clay, slate, and concrete and will not crack or break under impact. It is also resistant to fire, pests, and mildew. However, it is susceptible to rusting and needs a thick coating to prevent oxidation. The color will also fade over time, making repainting a necessity.



5. Terracotta Tile Roof



Terracotta tiles also consist of clay. However, there are subtle differences between terracotta and clay tiles. The easily noticeable difference is the color. You can easily recognize Terracotta for its distinct red or orange hues. On the other hand, clay tiles feature a broad range of colors, including white, red, grey, etc. There are different types of clay, each having varying properties. Examples include porcelain, stoneware, and earthenware. Terracotta is a type of clay that is easily accessible with rich red and orange colors. However, some people use the word to refer to all clay tiles with a reddish-orange color.

6. Spanish Tile Roof (Synthetic Spanish Roof Tiles)



Spanish tiles feature a rounded “S” shape. When installed, they look like rows of waves interrupted by troughs that serve as water conduits. This design makes them appropriate for regions that experience heavy rain. Synthetic Spanish tiles come in rubber or plastic materials. They are, therefore, lightweight and easier to install than their clay or concrete counterparts. Moreover, they are appropriate for all climates and are more impact-resistant. But their main advantage is their lower price tag. Although synthetic tiles can last long, they are new in the market, and their longevity is still up in the air. Also, there are durability concerns since rubber and plastic can warp and curl. Of course, fire resistance is out of the question.

7. Rubber Tile Roof



Rubber tiles consist of rubber or other synthetic polymers. The materials come from recycled items such as old tires or sawdust, making the tiles environmentally friendly. Rubber tiles can mimic traditional materials like slate. Unlike conventional tiles, they are lightweight, cheap, and easy to install. They are also impact-resistant and non-porous. However, they are susceptible to fires. Rubber tiles can last for 30 to 50 years. Their longevity may not outperform conventional materials like clay or slate. However, they are more durable than asphalt shingles or wood shakes. They attract favorable warranties too.

8. Plastic Tile Roof



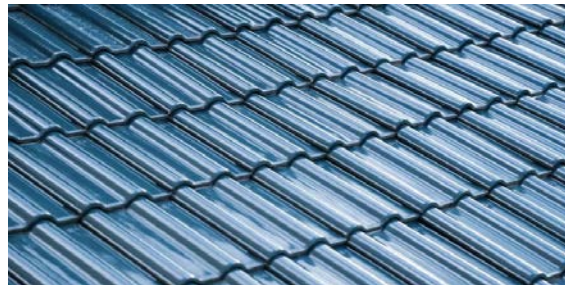
Plastic tiles roofs are manufactured from recycled plastic, making them eco-friendly. They are malleable and elastic and can last a decent while. However, they may not outlive traditional materials like slate or clay. Like rubber, plastic tiles can also mimic conventional roofing materials. They are a lighter and cheaper alternative for consumers who love the look of clay or slate but may not afford the expenses. The advantages of plastic roofing include high weather and impact resistance. However, they are highly flammable. Therefore, we don't recommend them for areas that often experience natural fires.

9. Composite Tile Roof



Composite roof tiles consist of recycled materials such as plastic, paper, fiberglass, and asphalt. They are eco-friendly and a cheaper and lighter alternative to traditional slate or clay options. Due to their lightweight nature, composite tiles are quicker and easier to install. Also, they are unlikely to put a strain on your roofing deck. Therefore, no reinforcements are necessary before installation. Composite tiles will last longer than asphalt shingles. Some manufacturers will even offer consumers a 50-year warranty. Longevity aside, the tiles are also more architectural and aesthetically pleasing. They can mimic the look of traditional tiles.

10. Ceramic Tile Roof



Ceramic tiles are a product of natural clay. However, they don't possess the drawbacks associated with traditional clay tiles. For instance, they perform better with varying temperatures. Also, they don't absorb water since their base material is natural white clay and not standard clay. White clay has superior reflectivity, making it more energy-efficient. The tiles also incorporate an outer shell that offers extra protection against the weather while serving as a waterproof coating. That makes ceramic tiles appropriate for low and high slope roofs. Ceramic tiles are lighter and more durable than traditional clay tiles. They last longer, and their color never fades. Some manufacturers will even offer a 30-year warranty on the color. Unlike red clay, white clay is not drawn to algae and fungus.

11. Stone Tile Roof



Traditionally, people relied on winter frost to naturally split rocks before dressing them to size and shape. Today, they use hand tools to do it manually due to time constraints. During installation, the smaller stones are placed further up, while the larger ones are lower. Stone tiles are lapped during installation. Since they don't lie flat on the batten-like slate, more coverage is needed to make them water-tight. As a result, only half the stone is usually visible. These tiles are porous and require steeper slopes than slates. The roof should have a minimum pitch of 45 degrees to ensure the rain falls off with ease. They are also susceptible to moss build-up. Therefore, ensure you scrape it off early to avoid hefty repair bills in the future.

12. Barrel Roof Tiles



Barrel roof tiles refer to a type of roofing tile that features a convex, barrel-like shape. They often fall into two categories: Spanish roof tile and Mission tile. The Spanish roof tile features a one-piece barrel design. When installed, they form a pattern of unique ripples across the roof. There are several types of barrel tiles, but the most common is the Terracotta barrel roof tile. You can recognize it by its rich reddish-orange color. Mission tiles are sometimes called “true barrel tiles.” They are installed as separate barrels that form a series of alternating concave and convex shapes.

13. Flat Tile Roof



Flat tiles are usually made from concrete, a mixture of sand, cement, and water. They often have interlocking ribs on the edges to keep the water at bay. Flat roofs and curved tiles have different benefits. For instance, curved tiles allow water to flow down with ease due to the presence of grooves. When it snows, the weight distributes evenly on flat tiles. On the other hand, curved tiles will not hold the weight evenly. Instead, the valleys will shoulder most of it. That could make the curved tiles more susceptible to ice damming. Moreover, it is more difficult to repair the flashing on curved tiles compared to flat tiles. Flat tiles can either be sand or smooth-faced. Smooth surfaces attract less dirt and are less susceptible to moss growth. You can use them on lower pitched roofs since they allow rainwater to flow more easily.

14. Interlocking Roof Tiles Types



As the name suggests, interlocking roof tiles interlock at their sides, making them waterproof. They are an alternative to double lapping, which requires more tiles to cover the same roofing area. Moreover, interlocking tiles are larger. Therefore, fewer of them are needed to cover the entire roof. Another advantage of this type of tile is a quick and straightforward installation process. That means they are more cost-effective to install than plain tiles.

15. Japanese Roof Tiles



The first thing that comes to mind when you think about Japanese roofing is Kawara. Kawara refers to a type of clay tile that has been part of Japanese architecture for 1400 years. Around half of all roof tiles in Japan are Kawara. Japanese tiles feature the traditional 'Smokey grey' glaze. However, they are also available in various glazed colors. The tiles feature designs that enable them to withstand strong winds and typhoon rains, such as those experienced in Japan.

16. Chinese Roofing Tiles



The use of clay tiles in China started as early as 10,000 B.C. Glazed tiles have been in use as roofing materials in the country since 1046 B.C. They are available in two forms: tubular and plate. As the name suggests, tubular glazed tiles feature a tubular design that looks like a semi-circle. Glazed plate tiles are lapped, with only 30% of the tile being visible. That makes the tiles waterproof even when cracks develop.

5.CONCLUSION

There are many benefits of tile roofing. They are long-lasting, energy-efficient, and aesthetically pleasing. However, not all tiles are created equal. There are varying designs and materials to choose from, and they have different strengths and weaknesses. Now days different waste are used to manufacture the roofing tiles it reduces waste as well as it consumed also. The green roof has so many benefits over conventional roof system that it should be adapted to all roofs where it is feasible. The higher initial cost could be easily absorbed as the savings will be more significant in the long run. Furthermore, agriculture roofing has even more merits compared to green roof, and if the green roof is feasible, the agriculture roofing could be adapted in most cases. The only constraints over selecting agriculture roofing would be the initial and maintenance costs or structural incapacity, but if those requirements can be met, planting edible plants rather than simple greenery can be extremely beneficial. In this regard, the key for success is the knowledge of farming. On top of the general knowledge of conventional farming, the farmers must know what crops are suited to grow, what fertilizers are environmentally safe to use, how to block the higher winds etc. Since agriculture roofing helps the society to become healthier and greener, more detailed and useful information on products, farming methods and techniques should be shared on a regional basis so as to let rooftop agriculture be widely acknowledged and practiced worldwide.

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