

Cool Roof Technology Using Earthen Pots

G. Jessie Swetha¹, P.Archana², P.Dhivya³, A.Vidhyalakshmi⁴, M.Kirubakaran⁵

U.G Student, Department of Civil Engineering, Loyola Institute of Technology, Chennai, India¹²³

Assistant Professor, Department of Civil Engineering, Loyola Institute of Technology, Chennai, India⁴

Associate Professor, Department of Civil Engineering, Loyola Institute of Technology, Chennai, India⁵

ABSTRACT: Current scenario of urbanization has resulted in a high temperature rise in the environment. This rise in temperature in home has lead to the implementation of coolers or setting up Air Conditioner(AC) which leads to the usage of large amount of electricity. Thus Cool Roof Technology(CRT) has been implemented as the most important cost effective way of reducing temperature. The roof reflects large amount of heat and absorbs less amount of heat. Thus making the temperature inside the home less than the usual temperature. This process is done by using earthen pots, which has a slow heating property makes the temperature inside the home to reduce to 70% even at the extreme hot condition. The temperature detection and analysis is done by the help of thermocouples. Cool Roof Technology helps reduce the electricity bill and can reduce the temperature to about 70 F. as the heat reflectivity rate is high, it can increase the service period of the roof. The new concept introduced in this cool roof technology is the implementation or the usage of plastic concrete, which is a new innovation applied in this technology. Plastic concrete is manufactured from old plastics, which is reinforced with concrete. Disposal of plastic waste in environment is considered to be a big problem due to its very low biodegradability and presence in large quantities. Therefore, high density polyethylene waste is mixed with Portland cement to investigate the possibility to produce plastic cement, by replacing Sand by fine polyethylene waste. The experiments were done by using the waste of polyethylene packages include bottle and food crates in the range of 10% to 80% by volume as a short reinforcement structure. The results show that there is a possibility to produce plastic cement from polyethylene waste and Portland cement by using 60% and 40%, respectively. Implementation of plastic concrete make this Cool Roof Technology, eco friendly, reducing the dumping of plastic wastes at the same time reducing the temperature of the residential home.Index.

KEYWORDS: *Urbanization, Earthen pots*

I. INTRODUCTION

Modern urban areas have typically darker surfaces and less vegetation than their surroundings. Collectively, dark surfaces and reduced vegetation warm the air over urban areas, leading to the creation of urban "heat islands." The additional air-conditioning use caused by this urban air temperature increase is responsible for 5–10% of US urban peak electric demand, at a direct cost of several billion dollars annually. Summer heat islands increase system-wide cooling loads and smog production because of higher urban air temperatures. Smog is created by photochemical reactions of pollutants in the air; and these reactions are more likely to intensify at higher temperatures. Cool Roofs is a green building technology that is especially suited to the climate of the India. It is a relatively cheap option with substantial benefits. The term itself provides a big clue to its meaning. Cool Roof is a roofing system that helps keep a building cool. It manages to do this via two methods reflect away a percentage of the visible, infrared and ultraviolet radiation from the sun. This reduces the heat gained by the building itself and is called high solar reflectance. emit away the heat retained by the building. This helps in the building down quicker as compared to traditional materials and is called high thermal emittance. A traditional, dark material roof can reach temperatures of 65oC. Installing an appropriate cool roof technology can bring this down to under 40oC. This is a big difference and results in energy and money savings by using lesser air conditioning. Another most important method is by using earthen pots by applying plastic concrete settlement.



1.1.OBJECTIVE

- To set up a cool roof at low cost
- To introduce the application of plastic concrete to reduce the plastic waste.
- To bring back the traditional approach in a modern way.

1.2. SCOPE

- To reduce the effect of urbanization heat
- To study the application of plastic concret
- To introduce the concept of cooling using earthen pots

II. TYPES OF COOL ROOF TECHNOLOGY

The types of cool roof technology depends on the area where we apply the technology. Based on the construction of roofs and buildings, cool roof technology are of mainly two types.

One is using reflective roofs. The reflective roofs includes painting it with white color. This is used to reflect lots of sun's heat which reduces the temperature gradually.

The another most important and the traditional method is using earthen pots and plastic concrete.

III. PLASTIC CONCRETE ADVANTAGES

- Plastic concrete has certain aggregate properties to face extreme weather conditions
- It can expand and contract at various conditions
- It will give additional cooling effect as it is a bad conductor of heat.

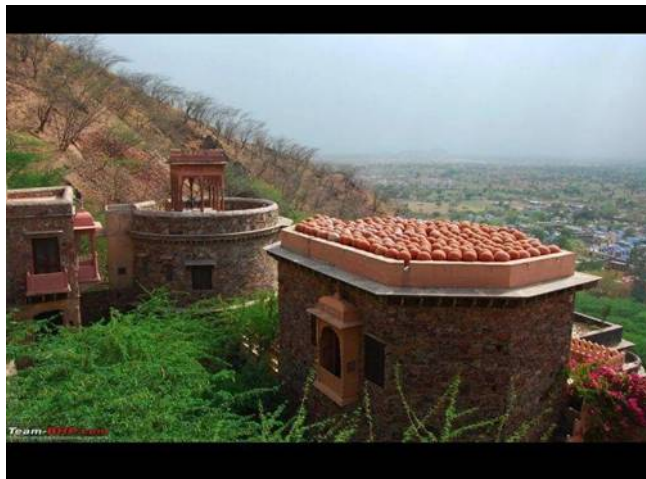
IV.METHODOLOGY

Steps involved in creation of CRT include

1. Step 1: Design & Development Materials required
Cost estimation Content organization
2. Step 2: Implementation and improvement
3. Step 3: Maintenance

VI.DESIGN AND DEVELOPMENT

- ▶ Design the implementation method
- ▶ Calculate the area for application (roof top)
- ▶ Estimate the initial cost for the implementation of technology
- ▶ Collect the materials needed



VII. PROCESS OF COOL ROOF TECHNOLOGY

The process followed is concised in the following steps:

1. Clean the roof surface
2. Apply 4 - 5 mm of waterproofing layer
3. Place inverted earthen pots (diameter - 175mm and depth 75mm) on wet cement mortar.
Cement:sand = 1:4
3. Fill the void space between the earthen pot with mortar bed, till about mid of the pot.

Leave it curing for a day.

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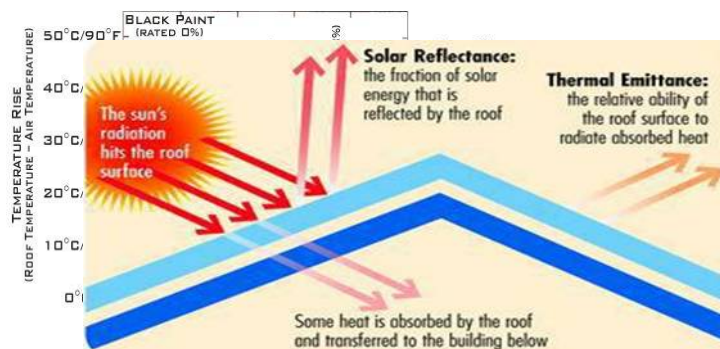
Department of Civil Engineering & MBA, Loyola Institute of Technology, Chennai, Tamilnadu, India

4. Finish the surface with 30 mm IPS (Indian patent stone) (cement: sand: aggregate = 1:2:4)
5. Make a 20 mm cement mortar bedding (cement:sand - 1:4)
6. Lay it with China mosaic tiling.

Fill the joints in tiles with white cement slurry. Wash the finished surface and clean with water

VII. MATERIAL USED

- Epoxy
- Plastic cement concrete
- Bedding Mortar Cement
- Earthen pots
- Ceramic tiles



VIII .ROOF REFLECTIVITY

A reflective roof is typically light in colour and absorbs less sunlight than a conventional dark-colour roof.

Less absorption of sunlight lowers the roof's surface temperature, reducing the heat transfer through the roof.

IX . TEMPERATURE DETECTION

A numbers of thermocouples were fixed on inside and outside surfaces of roof of both the structures for measurement of temperature.

Temperatures were recorded at a regular interval of 15 minutes using PC based data logger.

The provision was also made to measure the intensity of solar radiation using pyranometer with shading ring

IX. PROPERTIES OF COOL ROOF

Cool roofs have the ability to reflect and reject heat because the roofs are prepared with materials which have properties of both high solar reflectance and emittance.

A. Solar Reflectance

Solar reflectance, or albedo is the fraction of the incident solar energy that is reflected by the surface material. Solar energy consists of a spectrum of wavelengths, including ultraviolet, visible, and infrared light. The solar energy distribution as a function of wavelength is shown in Figure-2. Surface materials that reflect solar energy and all over wavelengths (i.e., that have a higher solar reflectance of surface material), will have better performance in reducing roof solar heat gain. Color is a good indicator of solar reflectance only in the visible light range, with reflectance typically increasing from a dark-colored to a light-colored surface. For example, traditional dark-colored roofing materials have a solar reflectance of about 0.04 to 0.18, whereas light-colored roof surfaces have a reflectivity of 0.70 or higher “Cool color” technologies can increase the solar reflectance of roofing materials in the infrared range through the application of a special coating. In this application, the roof has the same visual appearance, but is much cooler. In this example, the solar reflectance in the visible portion of the spectrum is the same for both products; however, the product employing “cool color” technology remains cooler by having much higher reflectance in the IR range.

B. Thermal Emittance

No roof is a perfect reflector, as all surfaces absorb some solar energy as heat. Part of the retained heat will be emitted back to the environment in the form of infrared radiation. Thermal emittance is a ratio between what a warm or hot surface emits and what a perfect blackbody emitter would emit at the same temperature. It has a value between 0 and 1, with a low emittance roof becoming relatively hotter than a high emittance roof since it is not as effective at getting rid of the retained heat.

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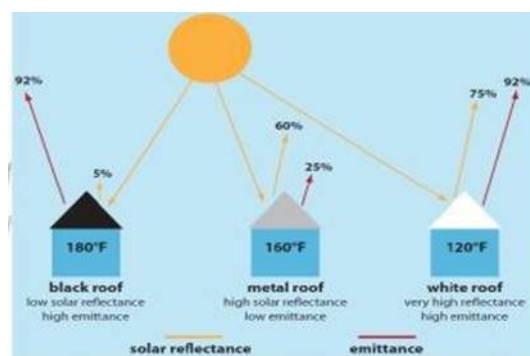


Fig: Example of Combined Effects of Solar Reflectance and Thermal Emittance on Roof Surface Temperature

XII. NORMAL V/S COOL ROOFS

- Green roofs are costlier than white roofs. Green roofs have high installation and maintenance cost, while white roofs need periodic refurbishing
- Green roofs have a longer life but due to its installation floor load is highly increases while white roof does not change the floor load.
- Green roofs improve storm water run-off management whereas white roofs optimize rain water harvesting

- White roofs are three times more effective than green roofs in cooling down the neighbourhood.

XIII. BENEFITS OF COOL ROOF

- Reduces interior temperature of building.
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- Reduces roof surface temperature by 20 to 60 degrees.
- Increases effective 'R' value.
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- Reduce a local air temperature, which improves air quality and slows smog formation.
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- Reduce peak electric power demand, which can help prevent power outages.
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- Reduce power plant emissions, including carbon dioxide, sulfur dioxide, nitrous oxides, and mercury, by reducing cooling energy use in buildings.
- Reduce heat trapped in the atmosphere by reflecting more sunlight back into space, which can slow climate change.
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- Applies toward LEED (Leadership in Energy and Environmental Design) credit.
- Extends life of air-conditioning systems.
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- Creates a more comfortable and healthier interior environment.
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- It helps to reduce urban heat islands
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- Can be applied over almost any type of roof surface

XVI. CONCLUSION

Using roof pond ,It was seen that the measured room air temperature under passive cooling to be lower than those of without passive cooling conditions during the one month measurement. In order to further evaluate the cooling potential of passive cooling with roof pond compared to the without passive cooling conditions; table 2.1 shows sample data for the variation of room temperature of room 1 (roof pond with water level 50 mm) and room 2 (with Bare RCC roof). It also indicates that the temperature below the RCC slab in room 2 was between 25.7 0C to 36.4 0C while it was 22.5 0C to 34.60C in room 1. This roof cooling system gives stable indoor temperature and reduce heat flux through the roof than bare RCC roof. Even in the afternoon, when the air temperature is relatively higher and solar radiation is intense, there is still a lower amount of heat flux flows through roofs into the room.

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