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# Experimental study of passive cooling of building facade using phase change materials to increase thermal comfort in buildings in hot humid areas

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**Abstract**
Storage of cooler night temperatures using Phase Change Material (PCM) energy storage technique, for cooling of ambient air during hot day times can be an alternate of current cooling techniques in building sector. This work presents the results of an experimental set-up to test energy saving potential of phase change materials with typical construction materials in building facade in Hot-Humid Climatic Regions in real conditions. The main objective of this research is to demonstrate experimentally that it is possible to improve the thermal comfort and reduce the energy consumption of a building without substantial increase in the weight of the construction materials with the inclusion of PCM. This research was conducted to study and evaluate the performance of the existing materials integrated with Organic PCM Polyethylene glycol (PEG) E600. This research suggested that the heat gain is significantly reduced when the PCM is incorporated into the brick (conventional building material).


**Keywords:** Hot and humid climates; Latent heat storage; Phase change material; Sustainable design; Technology thermal comfort.

## 1. Introduction
The worldwide economical and technological development requires higher energy demands and higher comfort expectations (heating and cooling systems). However, energy sources are limited and related to harmful gases, which are responsible for climate changes, global warming and environmental problems. Scientists all over the world are in search of new and renewable energy sources to reduce the $CO_2$ emissions from the combustion of fossil fuels, particularly in areas where low temperature applications are involved. In an attempt to reduce $CO_2$ emissions (as well as to reduce the cost associated with the cooling and heating of buildings), various studies based on the use of energy storage materials, which can absorb thermal energy at one time(day time) and release it at later time(night time), are engaged all over the World.
The concept of storing heat within the building walls has been around since 1881. The building's mass plays an important part in determining the temperature. A heavy building is able to smooth out temperature peaks by virtue of its mass. The use of thermal mass in shelter dates back to the dawn of humans, and until recently has been the prevailing strategy for building climate control in hot regions. Today there is a shift away from traditional construction materials and block building techniques towards light weight building materials and prefabricated building elements. However, a move to lightweight

construction raises concerns over internal comfort conditions due to lack of thermal storage properties, resulting in rapid swings of internal temperature.

Optimized selection of building materials for making the external envelop also plays an important role in achieving thermal comfort in buildings, where thermal comfort is achieved through passive –cooling, strategies. Many materials and systems currently on the market are designed to keep interiors warm by virtue of their insulating properties. PCMs are proved to be very effective in light weight buildings, since they increase their thermal mass.

Phase Change Materials (PCMs) are proposed as a solution to reduce energy demands from buildings by the addition of PCMs to construction materials as concrete, gypsum or plasterboard panels [1, 2]. Recent research has looked at the incorporation of organic PCMs into porous building materials, creating functional and effective building elements which can affect significant energy savings.

The thermal energy storage property of PCMs is based on its capability of latent heat storage, because large amounts of energy can be stored in a small volume of PCM. Therefore, the material containing PCMs can absorb and release heat more effectively than conventional building materials [3]. Similarly, the energy needed to produce the PCMs would only be a fraction of the energy needed to produce blocks, bricks or concrete with the same heat storage capacity [4]. Its high thermal inertia does not require the use of thick layers, resulting as a very low invasive technology. *Thermal inertia is* the degree of slowness with which the temperature of a body approaches that of its surroundings and which is dependent upon its absorptivity, its specific heat, its thermal conductivity, its dimensions, and other factors

The utilization of PCM in active and passive solar buildings has been subject to considerable interest since the first reported application in the 1940s [5]. PCMs store latent heat as the ambient temperature rises up to the melting point (PCM changes from solid to liquid state) [6]. As the temperature cools down, the PCM return to solid phase and the latent heat is released. This absorption and release of heat takes place at a constant temperature, which is ideal to smooth temperature fluctuations. The thermal improvements in a building due to the inclusion of PCMs depend on the climate, design and orientation of the construction, but also to the amount and type of PCM [7].

PCM materials can contribute to the energy efficiency of buildings by reducing the peaks in the daily temperature cycles. It may be possible that mechanical air conditioning is not needed at all; as a minimum, the energy consumption for air conditioning can be reduced. And this is how it works: as part of normal overnight ventilation, the warm air in the building is replaced by cold night-time air, which also reduces the temperature of the building's solid structures over the course of the night. PCM can increase the heat capacity of the building, meaning that additional 'coldness' can be stored in the building's structures. PCM can be integrated into walls, ceilings or facade elements, for example.

## 2. Comfort temperatures and climatic data for Madurai region

A hot-humid climate is defined as a "region that receives more than 20 inches of annual precipitation" and either has 3,000 or more hours of 67˚F temperature or 1,500 or more hours of 73 ˚F temperature during the warmest six months of the year. In this type of climate, the main function of the buildings is to simply moderate the daytime heating effects of the external air [8].

The air temperature and relative humidity are the important factors in determining the comfort level in the hot and humid region. The typical climate of the hot and humid region is the high air temperature at an average of 28˚ Celsius with an average of 80% of relative humidity. These factors have become the biggest challenge for the architects in designing a passive cooling building. The hot air and high relative humidity have become very problematic in designing naturally ventilated buildings.

The experimental study area Madurai comes under hot humid climate with maximum average temperature 35.38˚c and minimum average temperature 24.82˚c (for year 2009-2010) and average relative humidity 60 %( for year 2009-2010). Since it is like summer all year around, cooling is the main issue regarding buildings in Madurai. Most of the buildings are built with Reinforced Concrete Slabs (RCC) as roofing system and Clay tile roofs for a smaller percentage. Moreover, most of these buildings have no insulation material installed As a result, these buildings act like a sauna, where most of the building facades are exposed to excessive solar radiations that absorb heat throughout the day. The heat is then conducted to the inner spaces, thereby creating thermal discomfort for the building occupants.

PCM has never been tested in a hot humid climate like Madurai in India, and thus the potential benefits remain uncertain, especially for the residential sector. This study investigates the potential of using PCM for thermal heat storage in building facades in hot humid climates**.** This integration will likely cause an

increase in heat transfer that will increase heat storage capacity and reduce internal temperature fluctuations compared with other materials that have been used until today.
Average monthly daily hourly temperature data for a year of June 2009 to May 2010 of Madurai is obtained from Meteorological department and is shown in Table 1 which will be used for further analysis and basis for finding the comfort temperatures. The average monthly maximum and minimum temperatures are obtained is used to calculate the mean temperatures. Mean temperatures are then used to calculate the comfort temperatures for each month. Adaptive comfort temperature standards allow occupants to restore comfort when they feel discomfort [9].

Table 1. Temperature data: -Madurai, Tamilnadu, India 2009-10 (in Celsius)

| **Year** | **Month** | **Maximum** | | **Minimum** | | **Humidity in %** | |
|---|---|---|---|---|---|---|---|
| | | **Highest** | **Mean** | **Lowest** | **Mean** | **8.30 Hours** | **17.30 Hours** |
| 2009 | June | 39.6 | 37.9 | 24.6 | 26.2 | 58 | 44 |
| | July | 39.8 | 37.7 | 25.2 | 26.7 | 53 | 42 |
| | August | 39.6 | 37.0 | 23.4 | 25.8 | 62 | 51 |
| | September | 39.6 | 36.6 | 23.8 | 25.8 | 66 | 52 |
| | October | 37.8 | 35.9 | 22.8 | 25.0 | 65 | 46 |
| | November | 33.6 | 30.8 | 20.6 | 23.6 | 81 | 75 |
| | December | 31.8 | 29.8 | 20.9 | 22.7 | 78 | 67 |
| 2010 | January | 33.0 | 31.3 | 19.8 | 21.9 | 75 | 51 |
| | February | 37.0 | 33.5 | 19.7 | 22.1 | 76 | 39 |
| | March | 38.8 | 37.2 | 19.4 | 24.1 | 70 | 32 |
| | April | 40.2 | 38.7 | 24.4 | 26.8 | 66 | 42 |
| | May | 41.4 | 38.2 | 23.2 | 27.2 | 77 | 64 |

*Source: India Meteorological Department, Chennai-6*

Many of the International Standards produced are found to be inadequate for describing the comfort condition in the tropical climate. The majority of the field studies conducted discovered that the international set up is either overestimating or underestimating the comfort condition in this climate [10]. This is partly due to the derivation of the standards that are mainly based on the studies conducted in the moderate environmental condition.
One of the international standards frequently used for indoor climate condition is ISO7730 based on Fanger's predicted mean vote (PMV/PPD) equation. The equation of the formula is applied to derive a numerical value depicting the comfort conditions based on the ASHRAE scale. The air temperature of 30° Celsius is considered normal for this climate and the air movement of more than 1 m/s is desirable to relieve the heat. The outside climate plays a very influential role in thermal comfort perception for a free-running building. The study by Humphreys and Nicol [11] discovered that the comfort temperatures are linearly related to the mean outdoor temperature.
Comfort temperatures are defined using equation (1)

$$Tc = 0.534To + 12.9 \tag{1}$$

where $Tc$ is comfort temperature and $To$ is average monthly mean outdoor temperature.
In equation (1) '$To$', mean temperature of any month and is defined by

$$To = (T\max + T\min)/2 \tag{2}$$

In equation (2) Tmax and Tmin are the monthly average maximum and minimum temperatures which are obtained from Table 1.
Standard that is frequently referred in evaluating comfort condition in Hot Humid Regions is ASHRAE Std 55. A revised version of ASHRAE Std 55, known as Adaptive Comfort Standard (ACS), has been produced to be applied for naturally ventilated buildings since the original version is found to be irrelevant for naturally ventilated buildings. In the revised version, allowance for the warmer indoor

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temperature is given and to be applied during summer time for the naturally ventilated (NV) buildings. A wider range of indoor temperature was given based on the findings from the occupants in the NV buildings. The wider range is mostly influenced by the outdoor climate patterns which led to the derivation of the optimum comfort temperature, *Tcomf*, that is based on the mean outdoor dry bulb temperature, *Ta,out*:

$$Tcomf = 0.31Ta,out + 17.8 \tag{3}$$

*Tcomf*, aiming to discover the temperature or combination of thermal variables (temperature, humidity and air velocity) which most of the people consider 'neutral' or 'comfortable'.
Ta,out is calculated according to equation (2).
Humphreys and Nicol [11] had also suggested that in evaluating thermal comfort using adaptive principle, there are three main contextual variables that need to be considered which are the climate, building and time.
Comfort temperatures according to equation (3) are tabulated in Table 2 for all the summer months in Madurai –India.

Table 2. Comfort temperature for Madurai –India

| **Temp. (˚C)** | **June** | **July** | **Aug** | **Sept** | **Oct** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** | **Apr** | **May** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Maximum (ambient) | 37.9 | 37.7 | 37.0 | 36.6 | 35.9 | 30.8 | 29.8 | 31.3 | 33.5 | 37.2 | 38.7 | 38.2 |
| Minimum (ambient) | 26.2 | 26.7 | 25.8 | 25.8 | 25.0 | 23.6 | 22.7 | 21.9 | 22.1 | 24.1 | 26.8 | 27.2 |
| Mean | 32.05 | 32.2 | 31.4 | 31.2 | 30.45 | 27.2 | 26.25 | 26.6 | 27.8 | 30.65 | 32.75 | 32.7 |
| Comfort | 27.74 | 27.78 | 27.53 | 27.47 | 27.24 | 26.23 | 25.94 | 26.05 | 26.42 | 27.30 | 27.95 | 27.94 |

## 3. Materials and experimental techniques

### *3.1 Materials*

The sensible heat storage capacity of building materials has been recognized since ancient times. Heating a liquid or a solid, without changing phase is called sensible heat storage. However, in order for sensible heat storage to be effective in modern buildings, a number of problems arise such as high cost, excessive mass and undesirable temperature fluctuations. Hence, there is a rationale for the development of latent heat storage in building materials. Heating a material which undergoes a phase change (usually melting) is called latent heat storage.
The characteristics of PCMs make them inherently suitable for use in buildings for energy conservation purposes without the complications brought about by other thermal storage devices requiring separate plant and space [12]. The improved thermal distribution, cost and space-saving implications are some of the advantages of this type of thermal storage.
PCMS has high thermal conductivity so that the temperature gradient required for charging the storage material is small. PCMS has high density, so that a smaller container volume holds the material. PCMS has no chemical decomposition, so that the latent heat storage system life is assured. PCMS doesn't cause corrosiveness to construction material.
Within the human comfort temperature range (approximately 20–28ºC), latent heat storage materials have been found to be very effective. Indeed, research has shown that PCM-impregnated building materials can store 5-14 times more heat per unit volume than their conventional sensible storage counterparts. Some Commercial PCMs have been also developed for building application. With respect to thermal comfort criteria, the isothermal storage of heat energy is one of the most attractive features of a PCM as a component building material [13].
Organic and inorganic compounds are the two most common groups of PCMs. Most organic PCMs are non-corrosive and chemically stable, exhibit little or no sub cooling, are compatible with most building materials and have a high latent heat per unit weight and low vapor pressure [14]. Their disadvantages are low thermal conductivity, high changes in volume on phase change and flammability. Inorganic compounds have a high latent heat per unit volume and high thermal conductivity and are Non-

Flammable and low in cost in comparison to organic compounds. However, they are corrosive to most metals and suffer from decomposition and sub cooling, which can affect their phase change properties. So Organic PCMs are better for building applications [15].

Many potential PCMs were tested for building applications, including inorganic salt hydrates, organic fatty acids and eutectic mixtures, fatty alcohols, neopentyl glycol, and paraffinic hydrocarbons. There were several moderately successful attempts in the 1970s and 1980s to use different types of organic and inorganic PCMs to reduce peak loads and heating and cooling energy consumption [16].

Recent research has shown that PCM-impregnated building materials show great promise as functional and effective building elements which can affect significant energy savings. Hawes and Feldman [17] have considered the means of PCM incorporation into the building by direct incorporation, immersion and encapsulation.

Castellon et al. [18] studied how integrating PCM in construction materials (concrete in their case) would affect the effective thermal energy storage (TES) of a building. Using the granules of microencapsulated PCM as part of the aggregate for the concrete, the PCM is embedded simply and effectively within the construction material. Their experiment included a building a small concrete cubicle with embedded PCM and another cubicle made from regular concrete. The results indicate that the peak temperature of the cubicle with PCM occurred about 2 hours later; this means that the cubicle was kept cooler longer.

The performance of PCM construction materials in terms of thermal comfort, an experimental and numerical simulation study was fielded by Athientis *et al*. [19]. It was shown that the utilization of PCM gypsum board in a passive solar building may reduce the maximum room resultant temperature by 4˚C during the daytime and can reduce the heating load at night significantly. Peippo *et al*. [20] developed a very useful procedure which may be used to select a PCM with predictable melting points adjustable to the optimum temperature of the application.

Organic PCM -PEG E600 with Melting Point 25 & 31°c, specific heat 1800 J/kgk, Density 1.126 g/cm$^3$ was selected as experimental material for study & analysis based on the weather data & the material which is readily available in the market. Organic PCMs are Recyclable & reusable. Polyethylene Glycol (PEG) E600 is chemically stable with high heat of fusion, safe and non reactive and recyclable.

*3.2 Experimental techniques*

Experimental building models each of one cubic feet were constructed using special type of hollow bricks integrated with PCM Polyethylene glycol (PEG E600). Strength tests were performed for ordinary bricks and the special type of hollow bricks in compression testing machine. Strength of ordinary brick was 94 KN and the Strength of hollow brick was 84 KN. Difference in the compressive strength of ordinary brick and the selected hollow brick for experimental model was negligible.

Building models each of 1 cubic feet using RCC slab, hollow bricks & cement mortar and tile roof, hollow bricks & cement mortar were constructed to test the performance of PCM integrated walls with different roofing systems. Glass test tube filled with phase change material PEG E600 was inserted inside the hollow brick façade in two sides. Temperature sensor was used to measure the inside room temperature & outside temperature on a Peak summer days June 15$^{th}$ 2011 to June 18$^{th}$ 2011. Building model was painted with white emulsion since white reflects more radiation. For white Body, Reflectivity (r) is equal to 1, Absorbtivity (α) is equal to 0 and Transmissivity (τ) is equal to 0.

*3.2.1 Thermal performance analysis using PEG E600 integrated hollow brick walls covered by RCC Slab placed in East West direction*

Building model was constructed for 1 cubic feet using hollow bricks, plastered and painted white and was covered with RCC Slab as in Figure 1. Glass test tube is filled with Polyethylene glycol E600 was inserted inside the hollow bricks. Temperature was measured in on June 15$^{th}$ 2011 between 9.00 am to 3.30 pm. Building is kept toward East to West direction. From the temperature reading plotted it was proved that until 12.30 pm the temperature at the inside of the building model was below the outdoor ambient temperature. (Figure 2). It was efficient for 4.30 hr and there was an increase in indoor temperature after 12.30 pm.

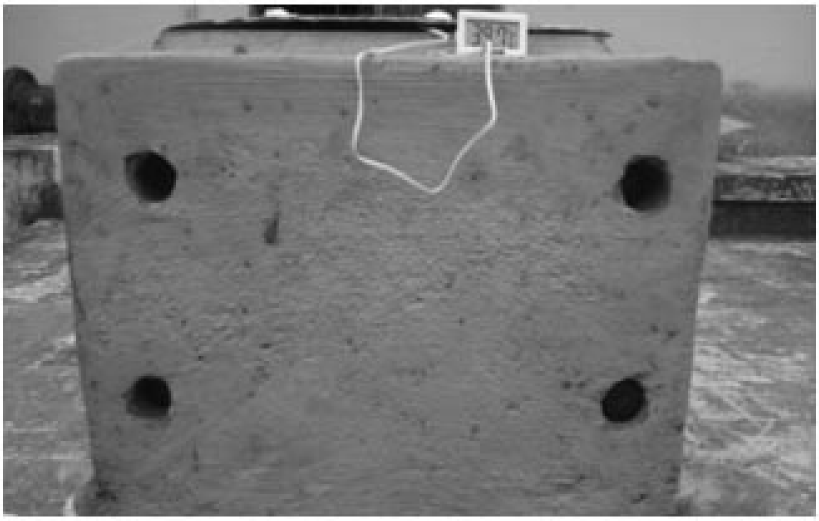
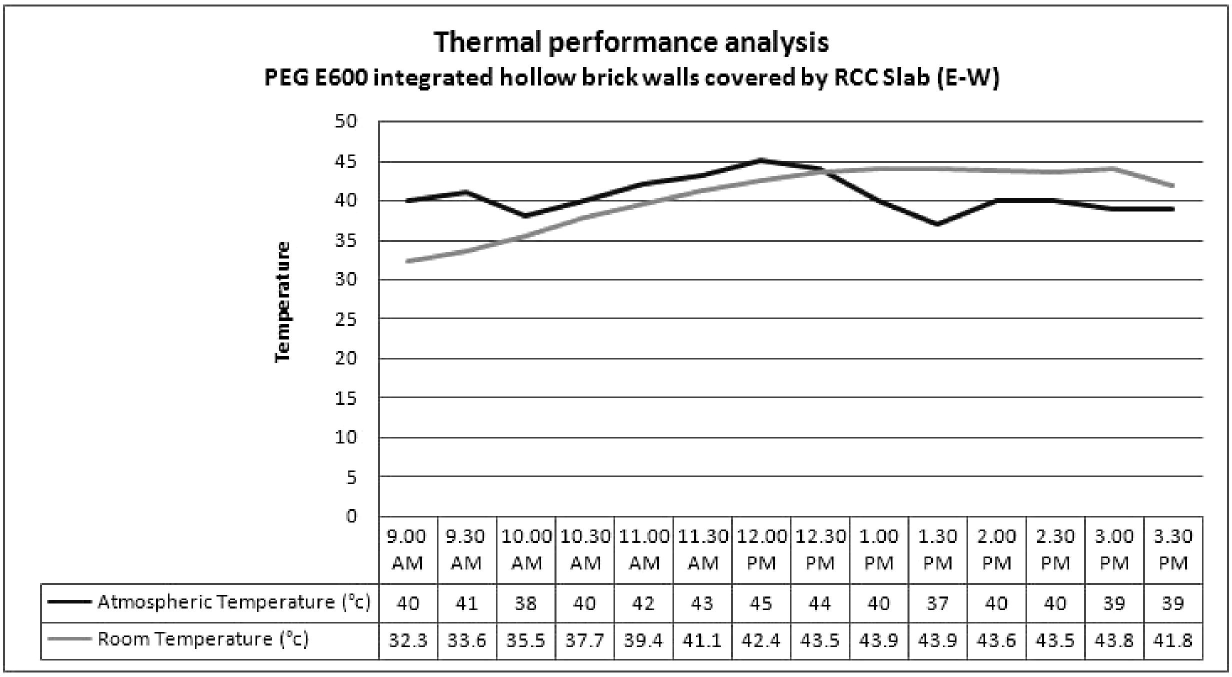


Figure 1. Building model setup PEG E600 integrated hollow brick walls covered by RCC Slab




| | 9.00 AM | 9.30 AM | 10.00 AM | 10.30 AM | 11.00 AM | 11.30 AM | 12.00 PM | 12.30 PM | 1.00 PM | 1.30 PM | 2.00 PM | 2.30 PM | 3.00 PM | 3.30 PM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Atmospheric Temperature (°c) | 40 | 41 | 38 | 40 | 42 | 43 | 45 | 44 | 40 | 37 | 40 | 40 | 39 | 39 |
| Room Temperature (°c) | 32.3 | 33.6 | 35.5 | 37.7 | 39.4 | 41.1 | 42.4 | 43.5 | 43.9 | 43.9 | 43.6 | 43.5 | 43.8 | 41.8 |

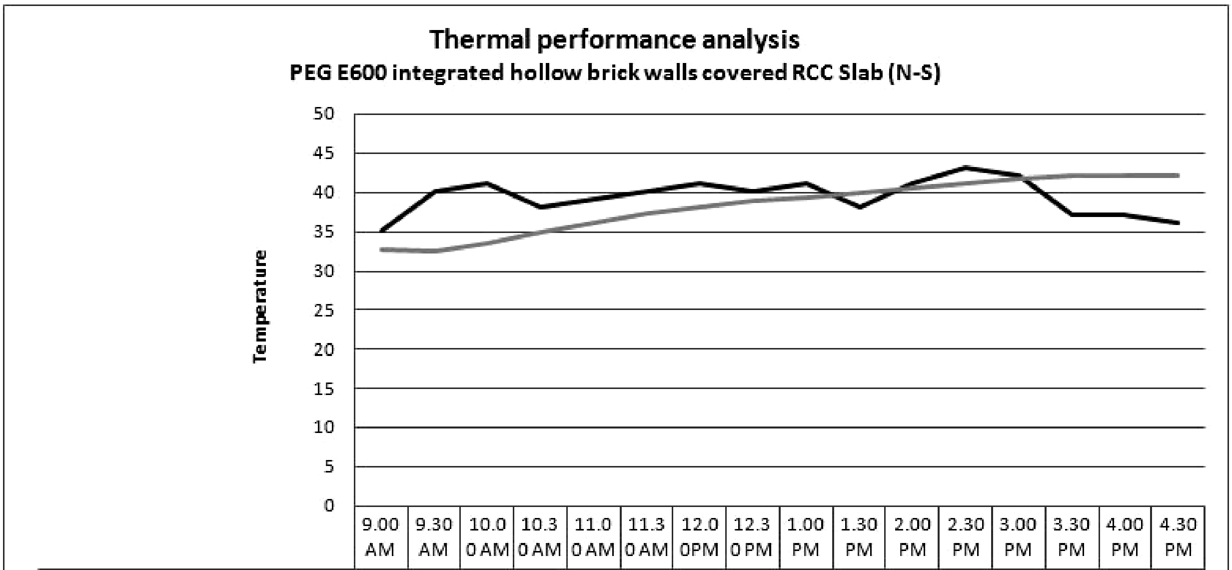
Figure 2. Thermal performance analysis graph using PEG E600 integrated hollow brick walls covered by RCC slab placed in East West direction

*3.2.2 Thermal performance analysis using PEG E600 integrated hollow brick walls covered by RCC Slab placed in North South direction*

Temperature was measured between 9.30 am to 4.30 pm on June 16$^{th}$ 2011(Figure3). Building when kept towards North South direction, it was proved that indoor temperature of building model was below outdoor ambient temperature until 2.00 pm. It was efficient for 6.00 hours.

*3.2.3 Comparative result*

Experimental model when placed in East to West was efficient for 4.30 hours. Oppositely when placed towards North to South it was efficient for 6.00 hours. Comfort Temperature calculated within the building model is 30.3˚C in E-W and 29.27˚C in N-S direction. Thermal analysis results shows that indoor temperature of building model with RCC slab when placed in N-S direction is near to the range of Thermal Comfort. Experimental research suggests that constructing building toward North to South integrating PCM with conventional building materials is an efficient way for saving electrical energy in Hot Humid Regions.




| | 9.00 AM | 9.30 AM | 10.00 AM | 10.30 AM | 11.00 AM | 11.30 AM | 12.00 PM | 12.30 PM | 1.00 PM | 1.30 PM | 2.00 PM | 2.30 PM | 3.00 PM | 3.30 PM | 4.00 PM | 4.30 PM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Atmospheric Temperature (°c) | 35 | 40 | 41 | 38 | 39 | 40 | 41 | 40 | 41 | 38 | 41 | 43 | 42 | 37 | 37 | 36 |
| Room Temperature (°c) | 32.5 | 32.4 | 33.5 | 34.8 | 36.1 | 37.1 | 37.9 | 38.7 | 39.2 | 39.8 | 40.3 | 41 | 41.6 | 41.9 | 42 | 41.9 |

Figure 3. Thermal performance analysis graph using PEG E600 integrated hollow brick walls covered by RCC slab placed in North South direction

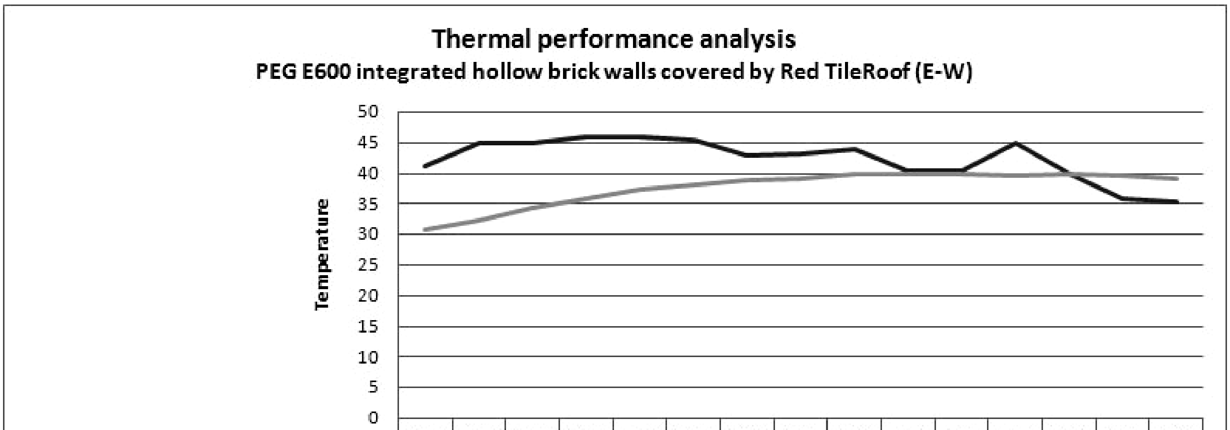
*3.2.4 Thermal performance analysis using PEG E600 integrated hollow brick walls covered by Red Tile Roof placed in East West direction and North South Direction*

Building model was constructed for 1 cubic feet using hollow bricks, plastered and painted white and was covered with Red Tile Roof as in Figure 4. Glass test tube is filled with Polyethylene glycol E600 was inserted inside the hollow bricks. Temperature was measured for 8 hours on June 17th 2011 and June 18th 2011 by place building model in East West and North South respectively.

Figure 4. Building model setup PEG E600 integrated hollow brick walls covered by red tile roof

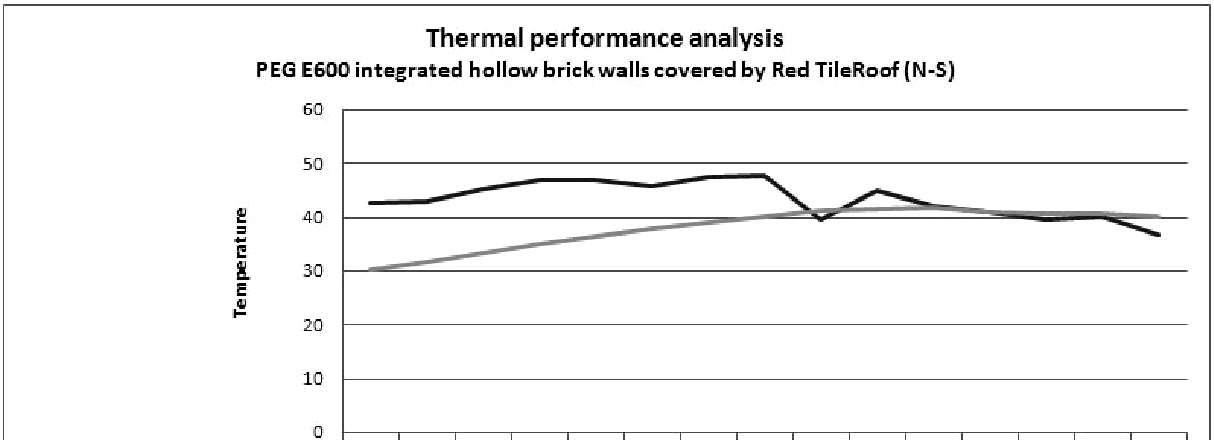
*3.2.5 Comparative result*

It is efficient for 7 hours out of 8 hours during day time. Comfort Temperature calculated within the building model is 29.4˚C in E-W and 29.6˚C in N-S direction. Thermal analysis results (Figures 5, 6) shows that indoor temperature of building model with Clay tile roof when placed in both in N-S direction as well as E-W direction is near to the range of Thermal Comfort.




| | 9.30 AM | 10.00 AM | 10.30 AM | 11.00 AM | 11.30 AM | 12.00 PM | 12.30 PM | 1.00 PM | 1.30 PM | 2.00 PM | 2.30 PM | 3.00 PM | 3.30 PM | 4.00 PM | 4.30 PM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Atmospheric Temperature (°c) | 41.2 | 44.8 | 45 | 45.8 | 45.9 | 45.3 | 42.8 | 43 | 43.9 | 40.4 | 40.4 | 45 | 39.8 | 35.8 | 35.3 |
| Room Temperature (°c) | 30.8 | 32.3 | 34.2 | 35.8 | 37.2 | 38.1 | 38.8 | 39 | 39.8 | 39.8 | 39.7 | 39.5 | 39.8 | 39.5 | 39 |

Figure 5. Thermal performance analysis graph using PEG E600 integrated hollow brick walls covered by red tile roof placed in East West direction




| | 9.30 AM | 10.00 AM | 10.30 AM | 11.00 AM | 11.30 AM | 12.00 PM | 12.30 PM | 1.00 PM | 1.30 PM | 2.00 PM | 2.30 PM | 3.00 PM | 3.30 PM | 4.00 PM | 4.30 PM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Atmospheric Temperature (°c) | 42.5 | 42.8 | 45.3 | 46.8 | 46.8 | 45.9 | 47.5 | 47.8 | 39.5 | 45 | 42 | 40.8 | 39.5 | 40 | 36.6 |
| Room Temperature (°c) | 30.2 | 31.6 | 33.2 | 34.9 | 36.3 | 37.8 | 39 | 40.1 | 41 | 41.3 | 41.7 | 40.8 | 40.7 | 40.5 | 40.1 |

Figure 6. Thermal performance analysis graph using PEG E600 integrated hollow brick walls covered by red tile roof placed in North South direction

## 4. Results and discussion

Typical facades without the installation of PCM conduct solar radiation and dramatically heat up the internal space. In contrast, building facades installed with PCM will gradually change its phase and store heat throughout the day instead of conducting all heat into the internal space. As a result, PCM can guarantee more stable internal temperatures, with no dramatic fluctuations, thus providing thermal comfort to the dwellers. By installing PCM in the building facade, heat will be stored and only a small amount of heat will be conducted to the internal space if the transition process is complete; when PCM cannot store heat anymore [21].

From the building thermal performance analysis conducted in peak summer days of June2011in Madurai Region it is observed that usage of PEG E600 is effective in reducing room temperature at comfortable level during noon time. From the Building thermal performance analysis it is proved that constructing building toward North –South Direction using PCM is best in this location. Maximum thermal discomfort in building in hot humid Regions will be until 2.00 pm where as PEG E600 is effective until 3.00 pm in maintaining the room temperature to a comfortable level. Temperature analysis suggests that constructing building toward North to South using PCM is efficient way for saving electrical energy in hot humid climates.

In building applications, only PCMs that have a phase transition close to human comfort temperature (25–30ºC) can be used. Some Commercial PCMs have been also developed for building application. The only way to maintain a pleasant temperature in summer without installing an air conditioning system is to increase the thermal capacity of the structure. Apart from enhancing the comfort, a large reduction in costs (Electrical Energy) can also be achieved by dissipating the accumulated energy during the night. The development of an energy storage system may be one of the solutions to the problem when electricity supply and demand is out of phase.

There two methods for incorporating phase change materials inside the building material currently in use are impregnation of PCMs into porous materials and direct incorporation of PCMs into hollow brick cavities.

PEG E600 for building application can be directly incorporated into Hollow Brick cavities and can be used in building facade.

As a consequence of the PCM treatment, reduction on the peak temperatures between day-night was observed and there is delay in the time to go to minimum or maximum temperatures. As a result of the experimental observations, a reduction in energy consumption can be anticipated and an increase in human comfort, due to a reduction of temperature variations during day and night.

## 5. Conclusion

The results show that the wall with incorporated with PCM can delay the temperature rise when the environmental temperature increases. This study examines the new concept of incorporating PCM inside the building material for enhancing the room air quality and reducing the energy consumption consumed by the air conditionings in the buildings. It is the new way to design the smart buildings with light weight by incorporating the PCMs inside the hollow cavity of brick.

Environment Friendly Cooling of building using phase change material inside the conventional building material (brick) was studied. It is quite evident from the preceding reviews that the thermal improvements in a building due to the inclusion of PCMs depend on the melting temperature of the PCM, the type of PCM, the percentage of PCM used inside the conventional material, the climate, design and orientation of construction of the building. When PCM -PEG E600 is applied inside the building material (brick) the heat entering the room reduces considerably. The Efficiency of PEG E600 is 33.33%. PCM offers the resistance for the heat flow and heat transfer was reduced. This research attempts to select a suitable material for regions with hot humid Climatic condition.

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