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Estimation Of Embodied Energy On The Replacement Of Convention Wall Material With Bison Sheet

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Nowadays building occupies major energy share for its construction and operation. Many studies have been carried out on the enhancement of efficiency of the devices which in turn reduces operating energy consumption. However, the construction materials play a major role. The embodied energy for the building material, like brick, cement has increased day by day. Several investigations have already been made on the point of strength of alternate building materials. This paper analyses the embodied energy consumption of conventional wall and a bison wall. Also, the paper studies the thermal profile of a conventional wall and the bison wall building which is recently constructed. The internal and external thermal profile has been continuously recorded using thermal imager and reported. The temperature rise alone will lead to increased operating energy consumption in the building.

KEYWORDS

Embodied energy, Bison wall, Thermal imaging

1. INTRODUCTION

Nowadays rural and urban areas have major problems that affect the natural resources and environmental factors due to the buildings. In the conventional building, the making of materials such as bricks, m-sand, cements and aggregates that are used for production and erection causes high embodied energy which leads to the making of the materials of artificial products that emit CO_2, CO, SO_4 and many acid forms into the atmosphere. And it can easily emit the UV and IR radiation very harmful to our environment and increases the thermal radiation temperature. Due to these reasons, in order to protect our environment the eco-friendly materials, such as bison wall can be used for buildings, an alternate way to reduce the operating energy used for the conventional wall buildings. Bison wall is a lowcost, sustainable material having low embodied energy which can maintain the temperature of buildings. This is the main motivation to developing a renewable energy buildings by the use of eco-friendly materials.

1.1 Need for bison wall

Bison wall contain about 68% of cement, 22% of wood and 10% of water. These bison walls are heat, water and weather resistant. The process of making bison walls is cost effective and eco-friendly. This ensures that erection of the walls is easier and less manpower needed as well as no need of highly skilled labours compared to conventional wall buildings (Figure 1). It is very sustainable and easy to make. It is very sustainable and easy to make. The advantage is the climate maintenance is more comfortless. This ensures that there will not be any additional heat or cool (Figure 2).

1.2 Green building

A green building is the building which has less use of conventional materials and more of bio materials. This ensures building's production and design in a low and very effective manner. In the bison wall building, the thermal energy on the inner and outer sides of the walls are much less when compared to the conventional wall buildings. Thermal comfort is defined as the condition which is satisfactory to our mind with respect to thermal environment. Equivalent temperature is the temperature either out-

Figure 1. *Bison wall merged in thermocoal*

Figure 2. *Building made of bison wall*

door or indoor at which the heat balance of the body is maintained with core and skin temperature under the conditions. This states that the operating energy on the bison walls is less while compared to the normal conventional wall building.

1.3 Embodied energy

Embodied energy is the energy which is utilized during the processes like making of a building from undermining and usage of natural resources for all needs. Embodied energy is measured in terms of non-renewable energy per unit of building material system. It is denoted by megajoules (MJ) or gigajoules (GJ) per unit weight (kg or tonne) or area (m^2). The consumption of energy at home : cooling and heating (47%), water heater (14%), washer and dryer (13%), lighting (12%), refrigerator (4%), electric oven (3-4%), TV, DVD, cable box (3%) and dishwasher (2%) of energy use.

Figure 3. *Thermal imager*

2. MATERIAL AND METHOD

2.1 Thermal imager

An infrared camera is a non-contact device that detects infrared energy (heat) and converts it into an electronic signal, which is then processed to produce a thermal image on a video monitor and perform temperature calculation (Figure 3). Estimation of conventional building :

Size of building : 24 m x 7.31 m x 5 m

Area of building : 175.44 m^2

Use M25 grade 1: 1:2 mix proportions

Quantity of brick

1 m^3 = 1/0.2x0.1x0.1 = 500 bricks

Cement mortar required for

1m^3 = (500x0.2x0.1x0.1)-(500x0.9x 0.09x0.09) = 0.23 m^3

Cement quantity required

1.63x(1/4) = 0.4075 m^3

0.4075x1440 = 586.8/50 = 11.73 bags

Fine aggregate quantity

1.63x(1/4) = 0.4075 m^3

0.4075 m^3 x 35.28 = 14.376 ft^3

Coarse aggregate quantity

1.63x(2/4) = 0.8 m^3

0.8 m^3 x35.28 = 28.224 ft^3

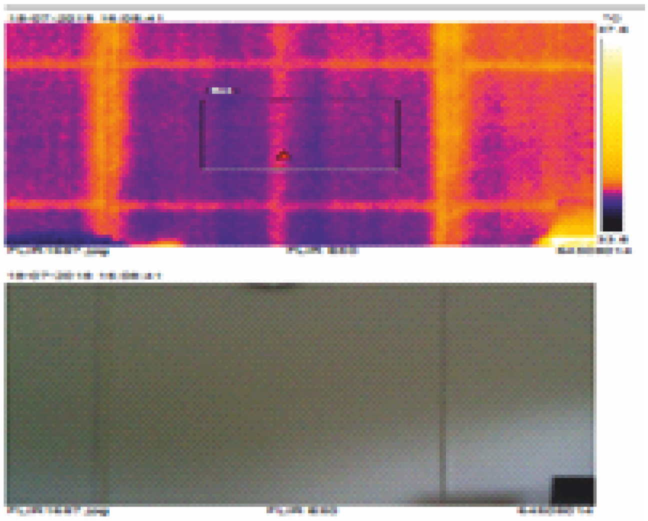

Figure 4. *Inner image of bison wall*

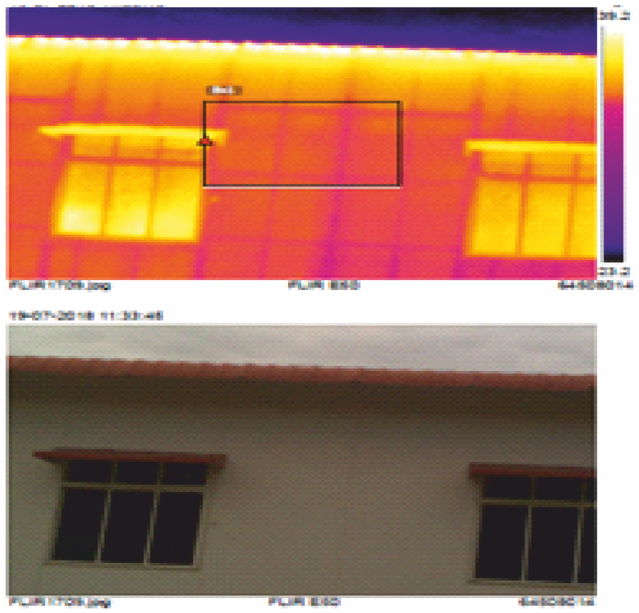

Figure 5. *Outer image of bison wall*

2.2 Methodology

In this paper, the experiment is carried out using the thermal imager. There are so many options to find out the temperature of certain areas. The imager has hot as well as cold regions. So that one can find out high temperature and the low temperature. It has the provision of a single spot and three spots where single spots show high spike and three spots show distributive temperature spike of the same area. Once we adjust the focus and capture the image, we can have the thermal image and the normal image of the required measuring quantity. By the use of the software called FLIR, select the required photos and import to the library. Once imported we can generate report and we have the detailed photos of the thermal imager and the normal imager for analysis. The calculation of embodied energy is given below.

a) Conventional wall

Total area ss = 314.35 m^3

Bricks = 500/m^3

For 314.35 m^3 = 314.35*500 = 157175

Embodied energy for bricks = 2235/m^3MJ

Total energy = 2235*157175 = 702.57*10^3 MJ/m^3

Sand

1 m^3 = 14.38 cft

314.35 m^3 = 14.38*314.35 = 452035 cft

Embodied energy for sand = 538/m^3MJ

Total energy = 538*314.35 = 169120.3 MJ/m^3

Coarse aggregate

1 m^3 = 27.2246

314.35 m^3 = 27.26*314.35 = 6986.114 cft

Embodied energy for aggregate = 538/m^3MJ

Total energy = 538*314.35 = 169120.3 MJ/m^3

Cement

1 m^3 = 11.73 bags

314.35 m^3 = 3687.32 bags

Embodied energy for aggregate = 9648/m^3MJ

Total energy = 9648*314.35 = 3032848.8 MJ/m^3

Total embodied energy of conventional wall = 702.57*103 MJ/m^3 + 169120.3 MJ/m^3 + 3032848.8 MJ/m^3 + 169120.3 MJ/m^3
= 4.07*10^6 MJ/m^3

b) Bison wall

Cement bonded board = 2*24*5*0/09
= 12.52 m^3

Embodied energy = 12.52*8109
= 101524.68 MJ/m^3

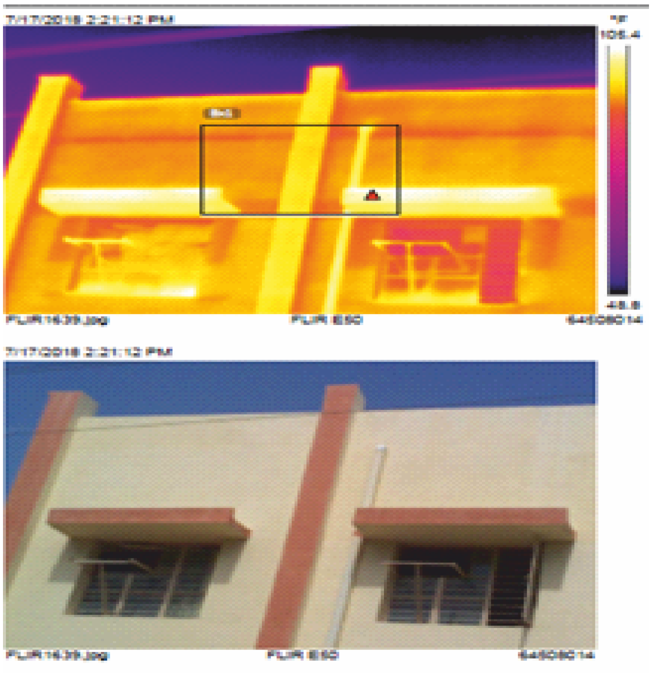

Figure 6. *Outer image of conventional wall*

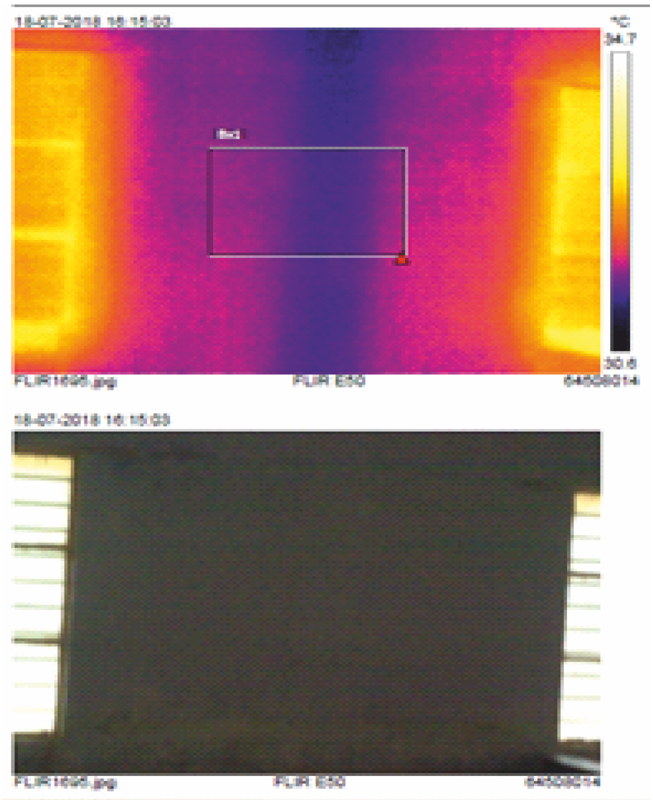

Figure 7. *Inner image of conventional wall*

Steel columns = 10

Weight = 130 kg/column

Total weight = 10*130 = 1300 kg

Table 1. *Time vs temperature*

Time	Temperature of inner wall, in ^{0}C	Temperature of outer wall, in ^{0}C
6.00 AM	29•	30•
1.00 PM	40•	46•
6.00 PM	36.7•	38•
9.00 PM	30•	36•

Table 2. *Time vs temperature on bison wall*

Time	Temperature of inner wall, in ^{0}C	Temperature of outer wall, in ^{0}C
6.00 AM	26•	28•
1.00 PM	32.4•	36.8•
6.00 PM	30•	34•
9.00 PM	29•	32.4•

1000 kg = 1 tonne

1300 kg = 1.3 tonne

1 tonne = 2.83 m^3

1.3 tonne = 2.83*1.3 = 3.68 m^3

Embodied energy = 42840*3.68 = 155080.8MJ/m^3

Total embodied energy of bison wall

101524.68 MJ/m^3 + 155080.8 MJ/m^3 = 256605.48 MJ/m^3

3. CONCLUSION

This paper briefly discusses the replacement of conventional wall by bison wall, it can reduce the embodied energy, efficiency and a low cost building. Due to the production of conventional building materials, it affects the whole environment which mainly contributes the air pollution and embodied energy. Some of the conventional building production, construction materials are more harmful and thermally radiated and it can easily affect our environment. For example concrete, brunt bricks reinforcement these are very high energy intensive. According to this results, the difference between normal conventional building and bison wall are 3.81x10^6. The bison wall has less embodied energy, more durable and sustainable material which provide long life period and it controls the environmental pollution. In this paper, our major research is how to consume the embodied energy in our building.

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