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Assessment of Energy Efficiency of a Building through the Choice of Building Materials for Walls

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Abstract
Energy efficiency has become a growing issue all over the world .The buildings sector is the largest energy-consuming sector, accounting for over one-third of final energy consumption globally and an equally important source of carbon dioxide (CO2) emissions. In the energy efficient building design, the use of energy efficient building materials plays the crucial role for lowering the energy intensity and CO2 footprint. Choosing the right building materials and installing them properly is key to the construction of an energy efficient house. This paper presents the results of Life cycle assessment study by comparing the different building materials. Embodied energy for Expanded Polystyrene Blocks(EPS) has been found as lowest which is almost 50% lower than Bricks. For analysing the operational efficiency, a hotel in Kathmandu is identified and various walling material are used to observe the energy efficiency. It was observed that bricks consumes 15% higher annual energy compared to EPS block and Autoclaved Aerated Concrete (AAC) Blocks.

Keywords
Energy Efficiency, Autoclaved Aerated Concrete (AAC) , Expanded Polystyrene Blocks(EPS), Life Cycle Analysis

1. Introduction

Energy efficiency has become a growing issue all over the world .The buildings sector is the largest energy-consuming sector, accounting for over one-third of final energy consumption globally and an equally important source of carbon dioxide (CO2) emissions. In terms of primary energy consumption, buildings represent around 40 % in most of the countries and 65 % of the total electric consumption.In the case of Nepal, energy demand from the residential sector constituted almost 89 % of the total energy consumption in the country in 2008/09 [1].

The energy efficiency considers sparing use of energy and ratio of energy use per production. Whereas the material efficiency is about sparing use of natural material resources, effective management of side-streams, reduction of waste, and recycling [2]. Using energy efficient techniques in one's own home will greatly reduced utility bills because less energy, electricity, etc. The Department of Energy finds, "Energy efficiency is one of the easiest and most cost effective ways to combat climate change, clean the air we breathe, improve the competitiveness of our businesses and reduce energy costs for consumers" [1]. In addition to switching to low-carbon energy sources and employing energy conservation strategies, energy efficiency is a key way to reduce CO2 emissions. The long term energy costs for construction largely depend upon the materials used in the building of the construction. When a selection for the material is made considering the energy efficiency, it is needed to take the energy consumption at all the stages including the obtainment of the materials from their source, its convert to the building material, its transportation, its usage, its destruction and obliteration/recycling as a whole [3].

There are few researches that have been focused on materials and energy efficiency of building in case of Kathmandu but enough research has not done in the field of energy and building materials. Choosing the right building materials and installing them properly is key to the construction of an energy efficient house. In the energy efficient building design, the use of energy efficient building materials is very important since the construction materials can positively support the constructions in which they are used by reflecting their environmental features with their all other features into the construction. For this reason, for energy saving, it is important to select energy efficient building material in the beginning of design [3]. Alternative Building materials available in market are as follows.

- Cellular Lightweight Concrete (CLC): Foam concrete, is a version of light weight concrete that is produced like normal concrete under ambient conditions. It has thermal insulation 0.09 – 0.12 Thermal insulation (depending on density)
- Insulating Concrete Forms: It is produced through the process of pouring concrete between multiple layers of insulation material, insulating concrete forms become locked into the home's structure permanently, resulting in a high level of strength and durability, as well as energy efficiency levels able to meet high code requirements.
- Ecopanel : Eco Panel is a light weight interlocking prefabricated sandwich panel with the composition of non asbestos calcium silicate board, Cement, water, Sand and Expandable Polystyrene (EPS)
- Autoclaved Aerated Concrete (AAC Blocks): The autoclaved aerated concrete is obtained from a mixture of sand, cement, lime, gypsum, water and a gas generator, which gives the porous structure.
- Hollow Concrete Bricks: Cement, Aggregate, sand, fine gravel 1:3:6 as generally used mix ratio .Thermal insulation 0.6 to1.0 W/ m.K
- CSEB(Compressed Stabilized Earth block) :- it has material composition of 25 Cement(6%), Gravel, sand(65%), silt(12%) clay(17%), Water . it has thermal insulation 0.9 W/ m.K

1.1 Problem statement

In the context of Nepal, the maximum buildings are being 25 designed with concretes and bricks. Which have high cost and high embodied energy and thermal performance is weak. Alternative building material are available in the market and claimed to have higher energy efficiency .But there hasn't been proper investigation done on energy efficiency of these materials in terms of embodied energy consequence to environment, cost, thermal performance and Life cycle assessment in Kathmandu There is no readiness among people for using these alternative building materials for overall building envelop, might be of no awareness, or have costly image for overall building envelop.

1.2 Objective of the research

The main objective of this research is to evaluate energy performance of low U-value alternative materials in a building envelope. The specific research objectives are as following:

- To study and analyze the life cycle energy of different alternative building materials.
- To evaluate energy performance of selected walling materials for a hotel building.

2. Literature Review

Construction of building is energy intensive process which consumes energy in each stage right from site clearance up to operation and maintenance throughout its life cycle. Improvement in energy efficiency of building results in reducing energy demand, saving of scarce natural resource and reduction in carbon emission. This improves overall environmental performance of the building. Construction of buildings includes various activities, viz. planning, design, execution, operation and maintenance. Each stage of building construction uses energy in one or the other form. Sources of energy used in the development of building include coal in manufacturing of construction materials, oil and fuel in transportation and running equipment and electricity for operating appliances. Improving environmental performance of the building through its improved energy efficiency can be divided into five stages; policy formulation on global and national levels, planning and designing energy efficient building, making construction process energy efficient and using energy efficient appliances [4].

There are several researchers working on analysis of energy for construction of building using different types of materials. One of such research is done for Alker Building, four apartments on 2 stories at Urfa, Turkey [3]. This research has found that the selection of building material and energy efficient features of building materials are important parameters for the provision of energy efficiency. The Assessments of building materials including Wood, Gypsums mud brick,Pumice,Perlite,Cellular concrete, Cellulosic insulation material,Aerogels, Waste ceramic insulation material in terms of energy efficiency was done. Natural wood material has found positive in terms of all criteria. Furthermore, it is highlighted that the use of renewable energy in the production of the construction materials is not very widespread, and that amount of energy consumed in the manufacture of some materials is high. As a result, instead of using such materials, alternative materials satisfying the same conditions should be preferred.

In another case study to evaluate energy performance of building materials in a building for Romanian,it was observed that the thermal insulation influences the cost of heating the building and 30 cm thick AAC does not require thermal insulation [5]. It is found that there is extensive use of the alternative materials in post-disaster temporary housings. In an attempt to study life cycle energy and cost analysis of two common types of post-disaster temporary housings construction in Turkey,the results expressed that prefabricated housings have 25.1% and 29.7% lower life cycle energy and cost requirements respectively [6].

Very few researches have been done for the energy analysis on the use alternative buidling materials in the context of Nepal. Bodach et. al. explored the energy conservation potential in hotel design for all bioclimatic zones of Nepal by using building energy simulation with parametric analysis. This research concludes that wall insulation in Kathmandu is only cost-effective up to 0.59 W/m2K which means an insulation layer of 50 mm [7]. Among the alternative materials, EPS lightweight concrete bricks consisting of cement,sand, coarse aggregate and EPS (as a reuse).It has been presented that EPS sandwich panel can be prepared in reasonable cost (as compared to common bricks) [8].

3. Research Methodology

The research involves the study of the literature on the field of attaining energy efficiency through the use of building material. The research methodology also adopts quantitative approach. The research primarily would focus on building materials for Energy efficient building design. The factors that are covered majorly in this research are identifying the walling materials for the building design during different climatic condition. The choice of case study area and interview questions will be prepared based on the data needed for possible design strategies for energy efficiency in building through the choice of building materials. Based on the review of data and literature on design strategies for energy efficiency, the appropriate parameters to be used during the modeling will be identified. The case study area being Kathmandu Valley, the climatic features of the study area is reviewed. Base case scenario for energy efficiency existing construction of the hotel building located inside Kathmandu Valley. Later, the base case scenario is modified in terms of walling material of the existing building.

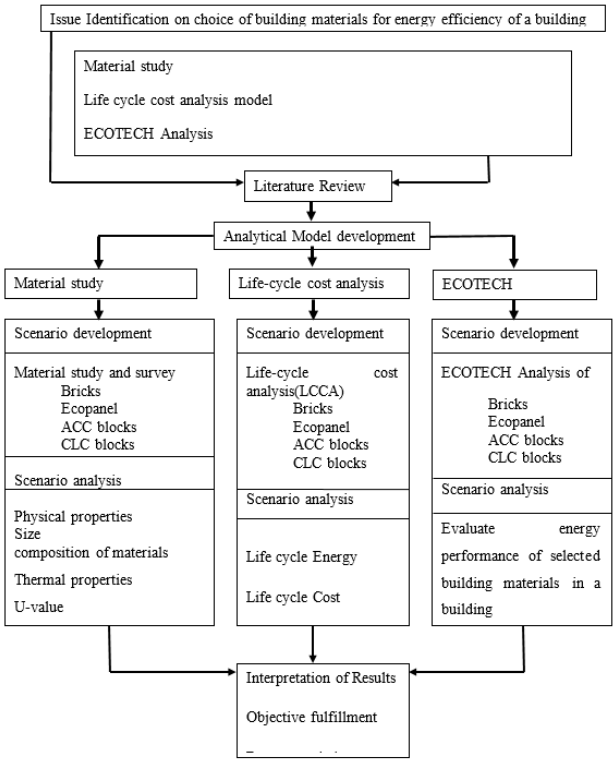

Figure 1: Research Frame work of the Study

The energy analysis considering of the base case scenario and modified wall material considering climatic condition of Kathmandu valley would be performed in Ecotect Software. The findings and simulation results will be interpreted based upon the qualitative and interpretive paradigm The detail Research Frame work of this Study is depicted in Figure 1.

3.1 Life Cycle Assessment

Life Cycle Analysis is a method of determining the real cost (or energy used) over the lifetime of a product, from cradle to grave. It is particularly helpful for comparing a number of options that is, identifying the most effective option available. It is also useful for bench-marking products [9] The tools of Life Cycle Assessment are integrated, which includes due consideration of all life cycle stages fixed in the ISO 14040 –14043 standards: Goal and Scope Definition, Life Cycle Inventory Analysis, Life Cycle Impact Assessment and Life Cycle Interpretation. The detail methodology use for Life Cycle Assessment is shown in Figure 2.

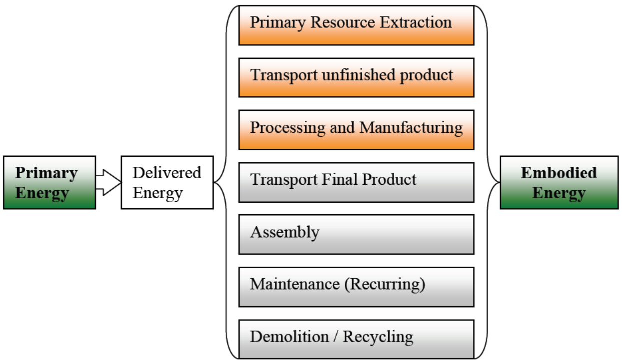

Figure 2: Breakdown of embodied energy calculations [10]

4. Study Area

4.1 Research Region:Kathmandu

Kathmandu is the nation's capital and largest city. Kathmandu Valley the most developed and populated place in Nepal. It is popular with for its unique architecture and rich culture and considered as the economic hub of Nepal. Kathmandu Valley lies between the latitudes 27º 32' 13" and 27º 49' 10" north and longitudes 85º11'31" and 85º 31' 38" east and is located at a mean elevation of about 1,300 meters (4,265 feet) above sea level [11].

4.1.1 Building Types

The Kathmandu valley is undergoing an urban expansion rather than managed urban growth as urban areas are expanding at the rate of 6.67% annually. Kathmandu Valley is losing at least 217,000 cubic meter of top fertile soil due to uncontrolled excavation to produce 117 million bricks per year [12].

Table 1: List of Manufacturing Industry of Different Walling Materials

S.N	Type of Material	Manufacturers count	Opening Date (A.D)	Location
1	Burnt Brick	103	All established before 2015	All within Valley
2	CSEB	2	2015	All within Valley
3	AAC	6	2015	1 in Valley,5 outside Valley
4	Ecopanel	1	2014	HO in Valley & branches outside

Table 1 shows the list of manufacturing industry of three walling materials in Nepal. There are 103 manufacturers of burnt brick, 6 manufacturers of AAC and only 2 manufacturers of CSEB all within Kathmandu Valley. The table also indicates that new construction walling material has emerged in the market after 2015 earthquake. Besides these materials, other walling materials are also in market like sandwich panel, CLC, cement boards. These materials are fast in installation but are expensive and also require skilled manpower for its installation. Many new materials arouse in the market, but with various advantages of AAC and CSEB they are now available in the market. In addition to this, a light weight interlocking prefabricated sandwich panel with the composition of Non asbestos calcium silicate board, Cement, water, Sand and Expandable Polystyrene (EPS), with significant features/advantages compared to other building materials also, become popular building construction material. This has given emphasis on the role of insulation, environmental protection, energy conservation and economically feasible for construction

4.1.2 Climate of Kathmandu

According to Köppen-Geiger classifications, Kathmandu hhas been classified into Cwa group: Dry-winter humid subtropical climate i.e. monsoonal influenced, having the classic dry winter – wet summer pattern associated with tropical monsoonal climates [13]. According to the Holdridge, life zones system of bioclimatic classification Kathmandu is situated in or near the subtropical wet forest biome. The annual mean temperature is 18.3 °C. In the winter time, the day temperatures reaches 19.7 °C on average falling to 2 °C overnight. In spring time, the temperatures reaches 27.3 °C generally in the afternoon with overnight lows of 11 °C. During summer average, high temperatures are 28.3 °C and average low temperatures are 19.3 °C.During autumn/fall, the temperatures decrease achieving average highs of 26 °C (78.8 °F) during the day and lows of 12.3 °C shortly after sunrise. The total annual precipitation averages 1343 mm which is equivalent to 1343 Liters/m^2 (32.94 Gallons/ft^2). On average there are 2556 hours of sunshine per year [14].

4.1.3 Hotels in the Valley

The hospitality industry is one of the most important sectors for economic development in Nepal because of tourism and the sector is estimated to grow by 5 % every year in the next decade. New hotel designs often do not consider climate responsive design strategies or apply any energy efficiency technologies. Engineers and architects not familiar with the application of insulation materials for walls, roofs and flooring [7]. Hotel owner not familiar with the passive strategies that can reduce the energy usage and cost. Many newly constructed hotel buildings are equipped with modern HVAC systems that provide comfortable lodging for their guests. The hotels sector stands on rank 6 among the most energy-intensive industrial sectors in Nepal. Hotels spend almost 8 % of their turnover for energy cost [15]. As shown in Figure 3 Energy cost varies with industrial sectors in Nepal. Most hotels have switched from conventional lighting to more efficient CFL and about 10% are already using most-efficient LED technology. However, 90% of surveyed hotels have neither checked the performance of major energy consuming equipment nor carried out energy audits in their hotels.

GIZ/NEEP baseline survey (2012) estimated the electricity saving potential of Nepalese hotels to be about 30,000 MWh which is equivalent to the annual consumption of about 84,000 households in Nepal. On the thermal side Diesel consumption could be reduced by 200,000 Litre and LPG by 91,000 kg per year. In total Nepal's hotel sector could save about 360 Million NPR every year by implementing most common energy efficiency measures.

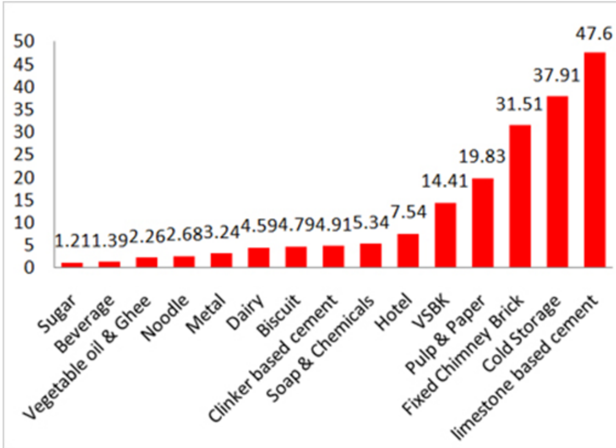

Figure 3: Energy cost on product value in % for different industrial sectors in Nepal [15].

Figure 4: Existing Hotel Structure

4.2 Site: Boudha Boutique Hotel

Boudha Boutique Hotel is located in Mahankal, Boudha , is chosen as case study area. The main reason to choose it as case study is because it is small size hotel and is mainly focused to the middle income group. In order to see how hotel can be made energy efficiency is the main reason to select this site. Currently, it is made up of modern materials like Brick, cement, wood, steel, aluminium etc. The buildings are RCC framed structure with column size of 230mm X 300mm. The external and inner wall of building is made up of 230mm and 110mm brick work with cement mortar (plaster) finish on both inner and outer side. Single-glazed wooden frame window of different size and wooden frame door of 100mm x 180mm are used. Its cost ranges from 85 lakhs to 2.5

crores depending upon the design and land. Hotel building is four & half storey with 20 numbers of rooms as shown in Figure 4 .It consists of different Space types like Restaurant, Café & Bar, Kitchen, Restroom, Corridor, Staircase, Lift, and Guest Room and attached bathroom.

5. Result and Analysis

5.1 Life Cycle Inventory Analysis Of Walling Materials

Life cycle inventory analysis of burnt brick, AAC block and EPS block: Data are collected through the manufacturing site visit, interviews with the manufacturers. The standard values for calculating embodied energy and carbon emissions are taken from the research articles [10, 16]. The embodied energy is calculated by quantifying the amount of raw materials used per one cubic meter volume of material during production process.

Table 2: Embodied Energy Calculations for Burnt Brick [10]

Particulars	Quantity	Embodied Energy	Total Energy
Fired Brick	636 units/m^3	7.9 MJ/unit	5024.4 MJ
Total RM EE			
Raw material Transport	1102 km	11.93 MJ/Km	13146.86 MJ
Electricity (kWh)	1 Kwh	9.28 MJ/KW	9.28 MJ
Coal	0.635 ton	18 MJ/ton	11.43 MJ
Total			172.22 MJ
All total			18343.48 MJ
0.098kg of CO2/MJ of embodied energy			1797.66 CO2/m^3

Table 2 shows embodied energy calculations for burnt brick [10]. Various sizes of bricks are available in the Nepal market but according to the national building code of Nepal (NBC 109-1994), the standard size of brick used in Nepal is 240mm x 115mm x 57mm which is about 1.57E-03 cum. The number of bricks produced per cubic meter is about 636.

The soil of Kathmandu valley is considered to be of a very good quality for making bricks. A majority of the brick kilns are situated on leased lands and utilize clay from nearby agricultural land/ fields but the coal as raw material has to be transported from Assam which is about 1102 km from manufacturing site.The standard value for embodied energy is taken as 7.9 MJ per unit for brick, 11.93 MJ per kilometers for transportation of raw material, 9.28 MJ per kilowatt for electricity and 18 MJ per ton for coal. The source of energy used during manufacturing phase is electricity 1 Kwh and coal is 0.635 tons for burning of 636 bricks. The total amount of embodied energy is 18343.481 MJ of energy and the carbon emission is 1797.67 kg per cubic meter during production of the material.

Table 3: Embodied Energy Calculations for AAC block [10]

Particulars	Quantity	Embodied Energy	Total Energy
Lime	50 kg/ m^3	5.63 MJ/Kg	281.5 MJ
Gypsum powder	19.64 kg/ m^3	1 MJ/Kg	19.64 MJ
Aluminum powder	0.45 kg/ m^3	260 MJ/Kg	117 MJ
Cement	148.81 kg/ m^3	4.2 MJ/Kg	625 MJ
Sand	428.57 kg/m^3	0 MJ/Kg	0 MJ
Total Raw material EE			1043.14 MJ
Gypsum powder	1002 km	11.93 KJ/Km	11953.86 MJ
Aluminum powder	1002 km	11.93 KJ/Km	11953.86 MJ
Cement	64.7 km	11.93 KJ/Km	771.871 MJ
Lime	1002 km	11.93 KJ/Km	11953.86 MJ
Total transportation			36633.45 MJ
Electricity (KWH)	10.71 kwh/m^3	9.28 MJ/Kwh	99.388 MJ
Coal (Kg)	0.009 ton/ m^3	18 MJ/ton	0.162 MJ
Total			99.55 MJ
All total			37776.14 MJ
0.098kg CO2/MJ of embodied energy			3702.06 CO2/m^3

Table 3 shows embodied energy calculations for AAC block [10]. Likewise, for manufacturing AAC block with one cubic meter of raw material 50 kg of lime, 19.64 kg of gypsum powder, 0.45 kg of aluminum powder, 148.81 kg of cement and 428.57 kg of sand is used. The embodied energy of these raw materials is 5 MJ per kg for gypsum powder, 260 MJ pe kg for aluminum powder and 4.2 MJ per kg for cement. The energy consumed during transportation of these raw material to the manufacturing site is 1043 MJ. Fuel used are 10.71 Kwh and 0.009 ton per cubic meter. The calculated value for embodied energy is 37776 MJ and carbon emission is 3702 Kg per cubic meter.

Table 4: Embodied Energy Calculations for EPS board [16]

Particulars	Quantity	Embodied Energy	Total Energy
Cement	750 kg/ m^3	4.9 MJ/Kg	3675 MJ
Fly ash	220 kg/ m^3	0.1 MJ/Kg	22 MJ
Sand	304 kg/ m^3	0.08 MJ/Kg	24.32 MJ
EPS (virgin)	25 kg/ m^3	88.6 MJ/Kg	2215 MJ
Cement Fibre Sheet	348 kg/m^3	10.4 MJ/Kg	3619.2 MJ
Total Raw material EE			9555.52 MJ
Cement	64.7 km	0.76 MJ/ton/km	36.879 MJ
Fly ash	64.7 km	0.76 MJ/ton/km	10.81784 MJ
EPS (virgin)	1002 km	0.054 MJ/ton/km	1.3527 MJ
Cement Fibre Sheet	1002 km	0.054 MJ/ton/km	18.82958 MJ
Total transportation			67.8791 MJ
Electricity (KWH)	5 kwh/m^3	9.28 MJ/Kwh	46.4 MJ
Total			99.55 MJ
All total			9722.95 MJ
0.098kg CO2/MJ of embodied energy			952.849 CO2/m^3

Table 4 shows embodied energy calculations for EPS board [16] for EE of Materials for producing 18 number of 100 mm thick EPS panels. For manufacturing this 100 mm thick panel block with one cubic meter of raw material 750 kg of Cement,220 kg of Fly ash,304 kg of Sand, 25 kg of EPS (virgin) and 348 kg of Cement Fibre Sheet is used. As seen in the table, the calculated value for embodied energy is 9722.95 MJ and carbon emission is 9722.95 Kg per cubic meter.

5.2 Simulation

Simulation is carried out using the Ecotect Analysis 2011. Autodesk Ecotect Analysis is an environmental analysis tool that allows designers to simulate building performance from the earliest stages of conceptual design. It combines analysis functions with an interactive display that presents analytical results directly within the context of the building model. This software was developed for architects and engineers to carry out sustainable analysis on the variable physical environment during the conceptual design, including thermal environment (heating/cooling load, energy consumption simulation, hourly temperature analysis and so on); wind environment (nature ventilation, solar heating and so on); lighting environment (sky illumination, mechanical lighting, nature lighting); sound environment (noise analysis, acoustical design); sunlight environment (sunlight reflector design, shading devices design); economic analysis (cost estimating, resources consumption analysis); environmental impact and visibility analysis.

The base simulation model is created according to current construction details, materials, and systems. The purpose of creating a base model is to estimate the annual energy consumption of conventional construction practice for the existing building. This way, it can be possible to compare the role and sensitivity of each component and system after proposed energy-efficient techniques in terms of total energy consumption.

5.2.1 Simulation Environment

The simulation in Ecotect software is performed based on the weather data of the Kathmandu valley and the building performance parameters (such as indoor thermal environment, indoor lighting environment, and solar radiation level) influenced by the variable design conditions. The Ecotect modeling parameter is listed in Table 5.

5.2.2 Simulation Results

A 3D model of an existing building was developed in Revit and gbXML file was exported and loaded in Ecotech Analysis 2011. The parameters mentioned in Table 5 were set in the software. The weather data for Kathmandu valley was also loaded in the software. The holidays for Nepal were also set in the software based on year 2019. The analysis area was manually assigned as zones. Twenty-four 4 rooms, kitchen,

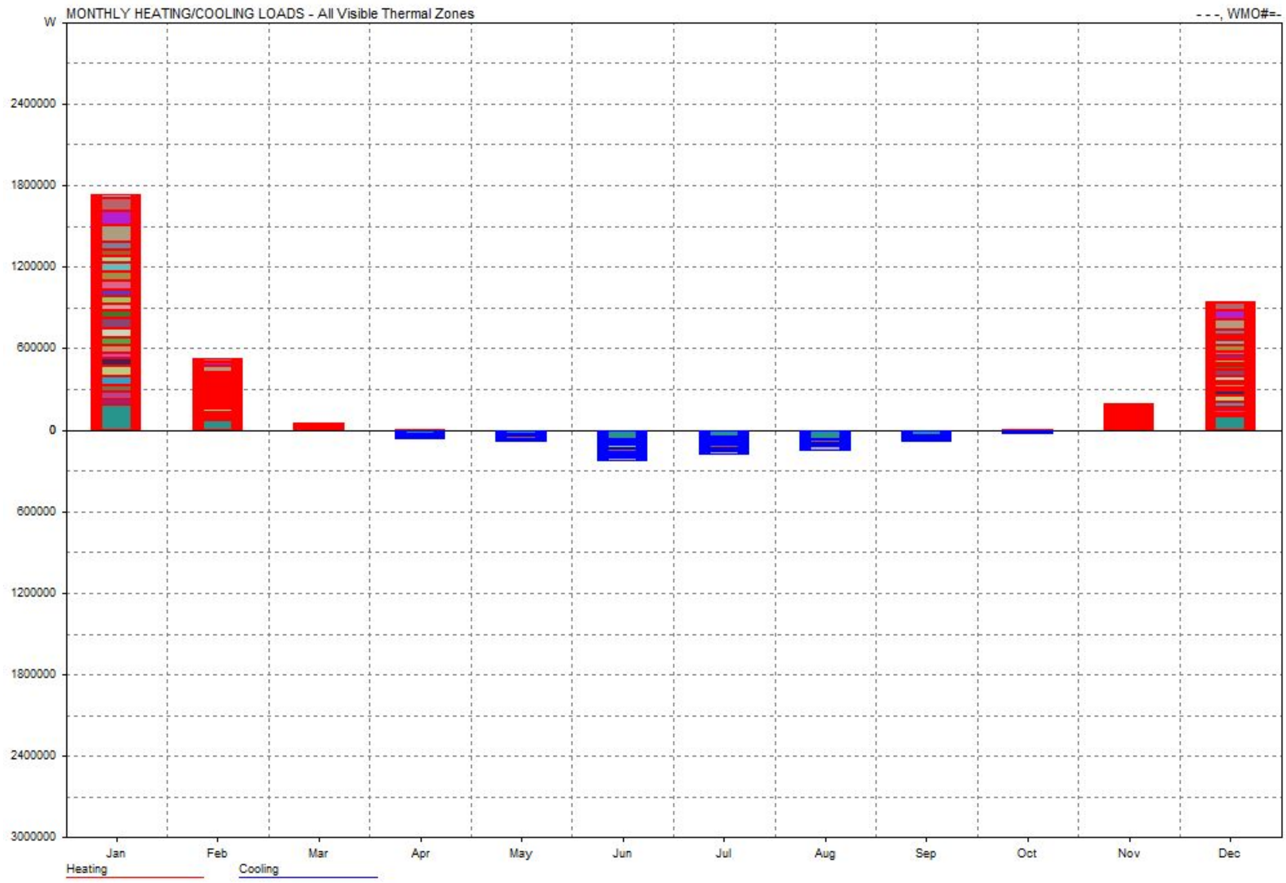

Figure 5: Monthly Heating Cooling for all zones for base model with brick as wall material

dining and corridors were assigned as zones. All the analysis performed hereafter can be viewed zone-wise too.

Table 5: Ecotect modeling parameters values

Clothing	1
Humidity	0.6
Air Speed	0.50 m/s
Lighting Level	300 -400lux
No. of people	2
Activity	Sedentary- 70W
Sensible gain	5 W/m2
Latent gain	2 W/m2
Air change rate	0.5 ACH
Wind sensitivity	0.25 ACH
Active system	Mixed mode system
Lower Comfort	18
Upper Comfort	26

At first the analysis was performed using base model with wall material as brick. Electricity usage for heating and cooling for all visible rooms throughout the year is as shown in Figure 5. It was observed that the Max Heating was required on 3rd January with 18906 W and the Max Cooling: was required on 26th July with 15886 W.

In the next experiment, the wall material was changed to AAC block.Electricity usage for heating and cooling for all visible rooms throughout the year is as shown in Figure 6. It was observed that the Max Heating was required on 2nd January with 8099 W and the Max Cooling: was required on 1st August with 10401W.

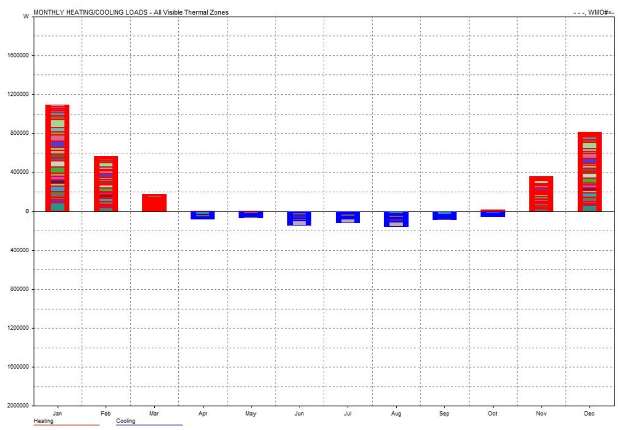

Figure 6: Monthly Heating Cooling for all zones with AAC as wall material

In the final experiment, the wall material was changed to EPS block.Electricity usage for heating and cooling for all visible rooms throughout the year is as shown in Figure 7. It was observed that the Max Heating was required on 2nd January with 8612 W and the Max Cooling: was required on 1st August with 11858 W.

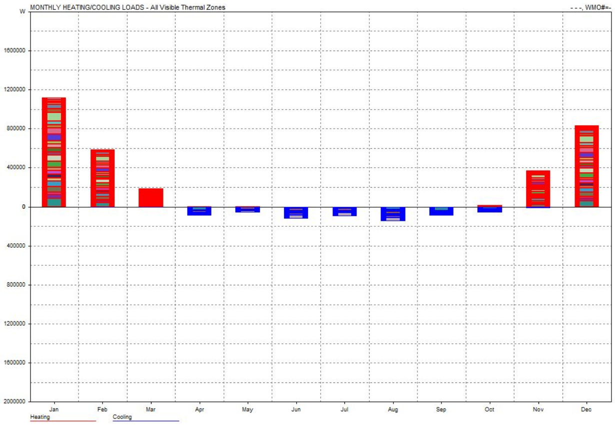

Figure 7: Monthly Heating Cooling for all zones with EPSas wall material

For all the materials, it has been observed that during winter month (November – March), the heating of building is necessary with maximum heating necessary in the month of January. This trend is independent of hour of operation. The higher the operation duration, the higher is the value of electricity power consumption. This factor contributes to cost of operation. Similarly, it has been observed that during summer month (Apr – Oct), the cooling of building is necessary with maximum value necessary in the month of June & August.

5.2.3 Comparison

Figure 8 shows the Embodied energy of different walling Materials.It was observed that the embodied energy of AAC block is maximum of 37776 MJ whereas EPS panels has least Embodied energy of 9722 MJ.The embodied energy of AAC is maximum because the distance of transferring the materials is higher.

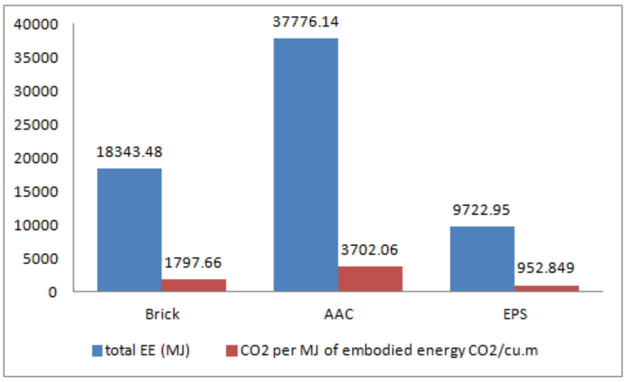

Figure 8: Embodied energy and Carbon footprint for Different Walling Materials

For all the materials, monthly max Heating Cooling for all zones was compared as shown in Table 6. It can be seen that max heating cooling point lies almost at the same time of the year.But, both max heating & max cooling wattage was found relatively lower for AAC and EPS compared to brick.Similarly, for all Walling Materials, the total Annual Heating & Cooling KWh for all zones was compared as shown in Figure 9.

Table 6: Monthly Max Heating Cooling for all zones for Different Walling Materials

Walling material	Max Heating	Max Cooling
Brick	18906 W at 13:00 on 3rd January	15886 W at 16:00 on 26th July
AAC	8099 W at 23:00 on 2nd January	10401 W at 1300 on 1st August
EPS	8612 W at 20:00 on 2nd January	11858 W at 13:00 on 1st August

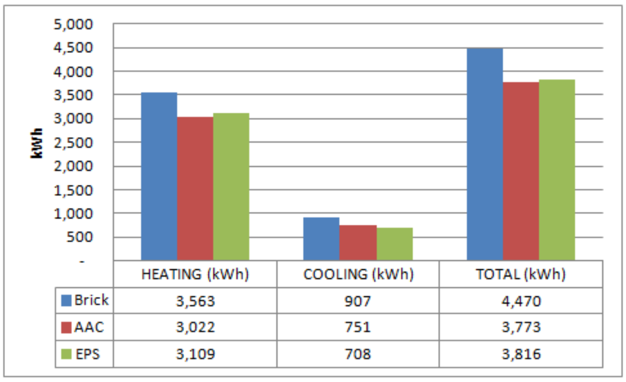

Figure 9: Total Annual Heating Cooling for all zones for Different Walling Materials

6. Conclusion

The building industry has consumed a vast amount of natural resources and also been responsible for a significant energy usage. Therefore, any building material that minimizes the usage of natural resources or use waste materials to a certain extent could have a promising future. In this paper a comparative study of Embodied energy of different walling Materials carried out. It was observed that the embodied energy of AAC block is maximum of 37776 MJ whereas EPS panels has least Embodied energy of 9722 MJ. EPS blocks required almost 50% lower embodied energy compared to Bricks and low carbon emission in its manufacturing. Also, in this paper, the base model was analyzed with ecotech software as per model parameters mentioned in Section Simulation Environment.The energy consumption during the operation of building with different wall materials was analyzed. The general trend for all the material is the maximum heating necessary in the month of January and the maximum cooling of building is necessary in the month of late July & August. For all Walling Materials, the total Annual Heating & Cooling for all zones was analyzed. It was observed that EPS block and AAC block has comparable total Annual Heating & Cooling energy consumption. Their energy consumption is almost 15% lower compared to Brick walls.

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