JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

ECO-FRIENDLY AND ENERGY EFFICIENT BUILDING

[1]Mr. Sahil Salunkhe, [2]Mr. Ajinkya Darure, [3]Mr. Abhishek Mali, [4]Sudhanshu Pise, [5]Mr. Mayur Jadhav, [6]Mr. A. A. Hosurkar.

[1,2,3,4,5]B. Tech Students, Department of Civil Engineering, Sharad Institute of Technology College of Engineering, Ichalkaranji, Maharashtra, India.

[6]Assistant Professor, Department of Civil Engineering, Sharad Institute of Technology College of Engineering, Yadrav Maharashtra, India.

Corresponding author:
Mr. Sahil Anil Salunkhe,
B. Tech Students, Department of Civil Engineering,
Sharad Institute of Technology College of Engineering,
Ichalkaranji, Maharashtra, India

ABSTRACT

Eco-friendly items and materials are defined as being not environmentally harmful. These products promote green living or green manufacturing methods that lessen the amount or types of resources used. In short, eco-friendly products help the earth, not cause it harm. Saving energy is one of the most actual topics for today. Modern buildings and facilities have huge reserves to increase their thermal efficiency. Energy consumption of buildings, which was not significant for the past, has become the dominant measure of the quality of the project. Over time, modify and extend the object of study: energy efficiency in buildings and structures. One way of reducing energy costs is to become more energy efficient so as to optimize existing resources and plan the right investments in new technologies. This will help manage operating costs and provide better delivery of services to customers while reducing environmental impacts and mitigating risk. Additionally, a documented commitment to sustainable development is a powerful and effective way to demonstrate social responsibility and meet changing customer preferences. Broken rocks, wood, pre-stressed sheets, re-used materials, cocoon panels and bamboo are the major materials that can be adopted to construct eco-friendly and energy efficient building. It is also good to have an airflow that is uninterrupted, as anything blocking the air flow inside the building can cause damage to both the building residents' health. One of the reasons for proper air circulation is moisture lingering in the home. Proper ventilation is essential for any home. This helps improve airflow, which keeps dampness in check and stops fungus from spreading. It keeps the house odor free, and members of the house in good health. Here is how you can set up proper ventilation infrastructure for the building.

Keywords: *Eco-friendly, Broken rocks, Bamboo, Pre-stressed sheets, Fly ash bricks.*

1. INTRODUCTION

Maharashtra with a total area of 307,713 km2 (118,809 sq mi), is the third-largest state by area in terms of land area and constitutes 9.36 per cent of India's total geographical area. The State lies between 15°35' N to 22°02' N latitude and 72°36' E to 80°54' E longitude. It occupies the western and central part of the country and has a coastline stretching 840 kilometres along the Arabian Sea. The dominant physical feature of the state is its plateau character, which is separated from the Konkan coastline by the mountain range of the Western Ghats, which runs parallel to the coast from north to south. Maharashtra experiences a tropical monsoon climate with hot, rainy, and cold weather seasons and dry summers. The month of March marks the beginning of the summer and the temperature rises steadily until June. In the central plains, summer temperatures rise to between 40 °C or 104.0 °F and 45 °C or 113.0 °F. May is usually the warmest and January the coldest month of the year. The winter season lasts until February with lower temperatures occurring in December and January. On the Deccan plateau that lies on eastern side of the Sahyadri mountains, the climate is drier, however, dew and hail often occur, depending on seasonal weather.

The rainfall patterns in the state vary by the topography of different regions. The state can be divided into four meteorological regions, namely coastal Konkan, Western Maharashtra, Marathwada, and Vidarbha. The southwest monsoon usually arrives in the last week of

June and lasts till mid-September. Pre-monsoon showers begin towards the middle of June and post-monsoon rains occasionally occur in October. The highest average monthly rainfall is during July and August. In the winter season, there may be a little rainfall associated with western winds over the region. The need for energy efficient construction is taking momentum by the rising power consumption in real-estate sector. The buildings being designed and used today are consuming excessive energy for heating/cooling and lightning. There is about 30-40% energy saving potential in the building industry which shall not only reduce the load on the power sector to meet its demand but also help the inhabitants in reducing their energy bills. The leadership in energy and environmental design (LEED-INDIA) Green Building rating system is a nationally and internationally accepted benchmark for the design, construction and operation of high performance green buildings. LEED-INDIA promotes a whole building approach to sustainability by recognizing performance in the following five key areas: - Sustainable site development, Water Savings, Energy efficiency, Materials selection and Indoor environment quality.

A Green building costs 3-8% more than the conventional buildings. However, the cost is recovered within two to three years through savings in maintenance costs. Due to substantial reduction in operational costs, the total cost of ownership of green building is invariably lesser than the conventional building. Maximum cost increment is due toEfficient envelopes, systems and lightning which are ECBC recommendations. Once ECBC becomes mandatory, there will be no extra cost. Also an analysis shows that the Life Cycle Cost of Energy efficient buildings is lower than that of the conventional buildings. Traditional building design was largely reliant upon two-dimensional drawings (plans, elevations, sections, etc.). Building information modelling extends this beyond 3D, augmenting the three primary spatial dimensions (width, height and depth) with time as the fourth dimension and cost as the fifth. BIM therefore covers more than just geometry. It also covers spatial relationships, light analysis, geographic information, and quantities and properties of building components. Autodesk Revit® software is specifically built for Building Information Modeling (BIM), empowering design and construction professionals to bring ideas from concept to construction with a coordinated and consistent model-based approach. Revit is a single application that includes features for architectural design, MEP and structural engineering, and construction. It allows to design a building and structure and its components in 3D, annotate the model with 2D drafting elements and access building information from the building models database. The Revit work environment allows users to manipulate whole buildings or assemblies (in the project environment) or individual 3D shapes (in the family editor environment). Energy Analysis for Autodesk® Revit® software is a cloud-based energy simulation service powered by Autodesk® Green Building Studio® that supports sustainable design. The energy analytical model feature in Revit building design software provides tools for fast, flexible creation of models for energy simulation. It can create energy analytical models to suit different design stage needs, workflows, and precision preferences either directly from architectural building elements and room/space elements, or create it manually using conceptual massing. Conceptual energy analysis tools help to make every design more sustainable. It can help in presenting analysis results in a highly visual format for easy comparison and interpretation. Also the tools can be used to quickly compare the energy consumption and lifecycle costs of design alternatives right from within Autodesk Revit Architecture software. Autodesk® Green Building Studio is a flexible cloud-based service that allows to run building performance simulations to optimize energy efficiency and to work toward carbon neutrality earlier in the design process. The Autodesk Green Building Studio web service provides: Annual energy cost • Lifecycle energy costs (30 year) • Annual energy consumption (electric and gas) • Peak electric energy demand (kW) • Lifecycle energy consumption (electric and gas) • Onsite energy generation from photovoltaic and wind systems • Water use analysis • Assistance with day lighting using glaze factor calculations • Natural ventilation potential calculations • Carbon emission calculations. Analysis results are presented in a highly-visual, graphical format for easy interpretation. It can also facilitate collaborative design, allowing to transfer essential information on your building design to the applications used for engineering design or code analysis. The Autodesk Green Building Studio service can help to change the way building energy analysis is used in the building design process.

2. MATERIALS AND METHODS

Fig.1 presents the methodology followed during the study. Site investigation The project site is located near Kolhapur, Maharshtra state. The building located in the South-West corner of the site and it consists of ground floor, first floor and second floor. The building is spread over an area of 98.477 square meters. Site investigation is organized to obtain the possible information about the electricity consumption of the building, window orientation and also placement. The most important orientation aspect to consider is the direction of the house, windows face and their solar access.

Details of each floor: - Ground floor has 3 Shops and parking (West• face) is provided and there is no window. 28.8 units of electricity is consumed in the ground floor per month. First floor consists of living room, kitchen, 2• bedrooms, 2 bath and wc, puja room. The electricity consumption is 90 units per month.

Fig.1: Method followed during the research study

Kitchen - window dimensions of 3'0"x 2'6" at south Dinning - window dimensions of 3'0"x 4'0" at east Master bed room - window dimensions of 5'0" x 4'0" at south Master bed room, Bath & WC - window dimensions of 2'6" x 2'6" at west Living room - window dimensions of 1'6" x 4'0"- 2 windows at west Living room – window dimensions of 4' 0" x 6'0" at east Bath and WC - window dimensions of 2'6" x 2'6" at west Bed room – window dimensions of 5'0" x 4'0" at north Courtyard provided above the puja room at east side • Second floor has 2 individual house each consisting of 1 bedroom, living, kitchen and dining, bath and wc, puja room. This consumes 87 units of electricity per month.

Materials Used: Following materials as presented in Table 1, were the eco-friendly construction materials adopted in the present work and also can be adopted in general.

.

Table 1: Eco-Friendly Construction Material

Materials	**Features**
Glass	The biggest advantage that makes glass a major component in green buildings is the fact that it is recyclable and also does not have a huge impact on the environment itself.
Broken Rocks	A further notable feature of natural stonework as a construction material is its ability to resist heat and fire.
Wood	One of the greatest attributes of wood is that it is a renewable resource, it has low carbon impact and low embodied energy. The amount of energy needed for producing wood products is much less than comparable products made from other materials.
Prestressed sheets	Precast concrete is truly a sustainable green product, is also highly durable and uses an extremely low water-cement ratio. All of these sustainable benefits result in precast concrete products being chosen as priority materials in LEED-certified buildings.
Reused materials	Green building materials, also called eco-friendly materials, are building construction materials that have a low impact on the environment. They are composed of renewable resources rather than non-renewable resources. These have to be natural and will not spoil by the heat, humidity, or cold.
Cocoon Panels	Eco-Cocoon's modular construction system makes it easy for architects to design projects that attain Passive House standard – a blessing in today's fast-evolving energy crisis. The energy-efficiency standard results in ultra-low energy buildings that require next to no energy for heating or cooling.
Bamboo	Bamboo is considered a highly sustainable resource due to its rapid growth rate and ability to regenerate after being harvested. It's also resistant to pests and diseases (remember this point), making it an ideal material for eco-friendly buildings.

Details of Materials used under eco-friendly building: Polyiso, or polyisocyanurate, is a rigid foam insulation used in more than 70% of commercial roof construction and offers a continuous insulation solution for commercial flat (low slope) roof insulation and wall assemblies. The low thermal conductivity of these high molecular weight blowing agents used to create the inner layer between the two protective facer barriers is the main contributor to the low thermal conductivity and high thermal resistance of polyISO insulation. It's a common misconception that polyiso-based insulations cannot be used in damp applications. Since the core material (polyisocyanurate) is made of a thermoset plastic, its molecular structure is actually inherently water-resistant. Details of polyisocyanurate are as below under Table 2 (a) and (b).

Standard Dimensions:

Table 2(a): Physical Dimensions for polyisocyanurate

Table 2(b): Technical Details for polyisocyanurate

Chemical Composition	Rigid polymer foam based on special grade Methylene Di Phenyl and Polychemical system
Fire Properties	Fire propagation: Class 0, according to BS 476 part 6 and part 7 Surface spread of flame: Class 1
Temperature Range	$-40°C$ *to* $150°C$
Overall Foam Density	$45(\pm 10\%)$ kg$/m^3$
Initial Thermal Conductivity	0.023 W/m K (at 10 deg. Mean Temp.) (Max.)
Compressive Strength	115 KN$/m^2$ (Min)
Water Absorption (By Volume)	0.5% (Max)
Water Vapor Transmission (Permeability)	8.5 ng/Pasm (Max)
Closed Cell Content	90% (Min)
Horizontal Burning	25 mm (Max)
Dimensional Stability	2% (at 100°C) (Max)

(a) **(b)**

Fig.2: (a) Picture of panel Polyisocyanurate Board. (b) Foam insulation board

Applications: Following are the applications of Polyisocyanurate Board for converting the building as eco-friendly and energy saving. These are

3. RESULTS AND DISCUSSION

It is also good to have an airflow that is uninterrupted, as anything blocking the air flow inside the building can cause damage to both the building residents' health. One of the reasons for proper air circulation is moisture lingering in the home.

Proper ventilation is essential for any home. This helps improve air flow, which keeps dampness in check and stops fungus from

spreading. It keeps the house odor free, and members of the house in good health. Here is how you can set up proper ventilation infra structure for your home.

Orientation

The orientation of the building is the term used to define the setting or fixing the direction of the layout plan of building respect to the direction of north. The orientation of building refers to the direction of normal to the normal to the long axis. For example, if the length of building East-West orientation North-South. Proper orientation means setting or fixing the direction of the directions of the plan of thebuildingwhichallowstheinmatesofthehouseorbuildingtoenjoythealmostwhatever is good and to avoid whatever is bad in respect of comfort in the elements of nature.

Sun path, sometimes also called day arc, refers to the daily and seasonal arc-like path that the Sun appears to follow across the sky as the Earth rotates and orbits the Sun. The Sun's path affects the length of daytime experienced and amount of daylight received along a certain latitude during a given season**.**

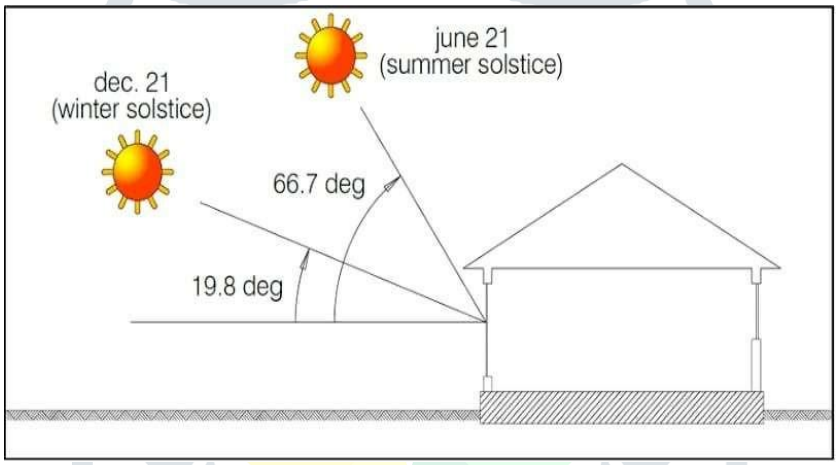

Fig.3: Sun path for fixing orientation

Acknowledgement: Authors deeply acknowledge the cooperation, motivation and help by Sri. Anil Bagane, Executive Director, Sharad Institute of Technology in carrying out this research work.

References

1) Bharath B, Maheshwari, Juber Ahmed Pathan, Rahul R Patel: 2014, Studies on Stabilized Adobe Blocks, International Journal of Research in Engineering and Technology, 03 06, pp.259-264.
2) Deepak Bansal, Ramkishore Singh and Sawhney R.L, 2014, Effect of construction materials on embodied energy and cost of buildings—A case study of residential houses in India up to 60 m^2 of plinth area, Energy and Buildings, Vol.69, pp 260-266.
3) Elisa, Adorni., Eva, Caisson., and Daniele, Ferretti.,2013, "In situ characterization of archaeological adobe bricks", Construction and Building Materials, Vol.40, pp 1-9
4) Kumutha.R.&Dr.K. Vijay: 2013, Feasibility Study on Utilisation of Stabilized Earth Blocks, Research Desk, 2(3). ISSN 2319-7315 pp. 229-236.
5) PrinceG. Arulraj, Mr.A. Adin and Mr.T. SureshKannan: 2013, Granite Powder Concrete, IRACST – Engineering Science and Technology: An International Journal (ESTIJ), ISSN: 2250-3498, Vol.3, No.1.