A
DISSERTATION
ON

"HIGH PERFORMANCE ENERGY EFFICIENT BUILDING"

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF

BACHELOR OF VOCATION

IN

BUILDING TECHNOLOGY

SUBMITTED BY

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UNDER THE GUIDANCE OF

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DEPARTMENT OF BACHELOR OF VOCATION

BHIWAPUR MAHAVIDYALAYA BHIWAPUR

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BHIWAPUR MAHAVIDYALAYA

BHIWAPUR, NAGPUR

DECLARATION

This Project wok entitled "High Performance Energy Efficient Building", is my own work carried out under the guidance of --Dr. Swapnil Satone Assistant Professor in Bachelor of Vocation, Bhiwapur Mahavidyalaya, Bhiwapur, Nagpur. This work in the same form or in any other form is not submitted by me or by anyone else for the award of any degree.

CERTIFICATE

This is to certify that the Project work entitled "High Performance Energy Efficient Building", is the bonafide work done by Student and is submitted to Bhiwapur Mahavidyalaya, Bhiwapur, Nagpur, for the partial fulfillment of the requirements for the degree of Bachelor of Vocation in subject name Building Technology

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I also express my sincere gratitude to Dr. Jobi George, Principal, Bhiwapur Mahavidyalaya, Bhiwapur, Nagpur, for his encouragement, and immense co-operation during my graduate studies at Bhiwapur Mahavidyalaya.

I wish to express my gratitude to my parents for sparing me to undertake this research project without any hindrances.

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BHIWAPUR, NAGPUR

CERIFICATE

This is certify that the project work entitled "High Performance Energy Efficient Building" is a bonafide work done by student's in the Building Technology section of the Bachelor of Vocation, Bhiwapur Mahavidyalaya, Bhiwapur Nagpur, in partial fulfillment of the requirement for the award of Bachelor of Vocation in "Building Technology"

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ABSTRACT

Building information modeling (BIM) is a supported process that supports various tools, technologies, and agreements. Rapid infrastructure growth and the energy crisis need to be reinforced. A high-performance building offers a relatively higher level of energy efficiency or greenhouse gas reduction than required by building codes.

Due to the boom of global wide population, it's a far almost approximately 40% of the once-a-year strength fed on within side the global in constructing today. The Indian homes are accountable for 1/3 of general strength intake today. This case examine focuses normally three types of bricks, Concrete Brick, AAC Block. We discover that AAC Block have best thermal resistance and Concrete Brick have less thermal resistance than AAC Block but more than that of Red Bricks.

With the help of Autodesk Revit and Green Building Studio the pathway to model an energy-efficient building is opened. The peak cooling load was generally reduced 6 times on comparison thus is a more preferred choice than conventional. Also, the efficient use of software like Auto Cad, BIM, etc. is used to analyze materials productivity, effect, use, and efficiency before actually using it on-site.

Keyword:

Energy Efficient, Autodesk Revit, AutoCAD, BIM, Peak Cooking Load.

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CHAPTER 01

INTRODUCTION

INTRODUCTION

1.1 Overview :

In present day times of a quick infrastructure growth and a looming energy crisis, there is a robust choice to cope with and comprise suitable practices for inexperienced energy and assets use on the identical time as making production plans, be it residential or commercial applications.

Building Information Modelling (BIM) is a way supported with the aid of using the resource of several tools, technologies, and contracts concerning the technology and manipulate of digital representations of physical and sensible tendencies of places. Building report models (BIMs) are computer files (regularity, however currently no exchanged, or networked to resource decision – making regarding a built asset, Individuals, organizations, and authorities, organizations that plan to assemble operate and keep houses and several physical infrastructures which encompasses water, refuse, energy, gasoline, communication utilities, roads, railways, bridges, ports and tunnels.

Cooling load is the price at which sensible and latent warm temperature should be removed from the distance to keep an everyday area's dry-bulb air temperature and humidity. Sensible warm temperature in the distance motives its air temperature to upward push on the identical time. As latent warm temperature is related to the upward push of the moisture content material, it influences the cooling lad in a constructing, requiring the usage of unique warm temperature transfer mechanism. The SI gadgets are watts. Homes with excessive standard overall performance are those that deliver an extensively higher diploma of energy overall performance. The overall performance or greenhouse-gasoline line cut price is much less than that is required.

Architects, designers, and builders normally format and assemble excessive-standard overall performance house with the usage of pretty some strategies, tools, and materials to make sure that, upon completion the constructing will eat a minimal amount of energy.

1.2 Aim

Making structure energy efficient by selecting proper material by analyzing it using Autodesk Revit Software.

1.3 Objectives :

- Analyzing the thermal insulation of the structure.
- Changing the material of the structure and analyzing it.
- Selecting suitable material to provide proper thermal insulation in the structure.
- Making the structure more energy efficient.

CHAPTER 02

LITERATURE REVIEW

LITERATURE REVIEW

2.1 Background Study

In this current scenario, there is an uptick in energy consumption which is a great cause of concern. In the housing space due to the inefficient availability of proper room temperature external cooling or heating appliances are being used to maintain that room temperature and the need is to focus in maintaining the temperature without external help.

From this literature review on the subjects, the majority of the research focuses on the changing or adding some naturally available ingredients to existing used materials and check the effect on the building on various aspects. Also, some study suggests to take maximum benefit to available sources of software's like AutoCad, Autodesk Revit, Green Building Studio etc. to analysis the effects of the future made buildings prior to its construction. The benefit of using the software is that wre can analysis its actual effect on the building and note what more changes can be made for the perfect output as thought.

However, it was observed that the analysis is made on changing the existing composition of the materials and obtain the result. So, this study is carried out to utilize the actually used materials only and see which of them gives out the best cooling effect and analyze it further. This study is the comparison between Red Brick, Concrete Brick and Autoclaved Aerated Concrete for analyzing its temperature effect among the three and find out which is suitable material.

2.2 Literature Review

1. Application of Sustainable Construction Materials for Urban Houses

Author : R. V. Relegoakar , H.R.Gavali, V.V. Sakhare, A Puppala and P.B.Aswath

Year of Publication : 2017

In this paper, the author briefs the application of energy –efficient materials whose efficiency is used for the construction of Urban Slums in the areas if Nagpur, Maharashtra, India. The material used was bio-fuel ash, cellular high weigh (M1-BFA-CLW) bricks which were locally available in the area. In general practice for the concrete roof, geofaom is recommended but in this case study, the material (M1-BFA-CLW) and roof treated with geofoam) and traditional material i.e (M2 –fly ash brick with concrete roof) are compared. This was analyzed by using BIM Software for cooling demand over the year. The result obtained that the studied model and materials were energy-efficient, cheaper and conserved 46 % of operating energy annually (Cooking demand) in comparison with traditionally used materials.

2. Evaluation of Energy –efficient design strategies: Comparison of the thermal Performance of Energy Efficient Office Buildings in composite climate, India.

Author : Farheen Bano, Vandana Singh

Year of Publication : 2018

This paper aims to survey the energy consumption in the mid-rise-high-rise-office building situated in Indian in the composite climate and compare their energy efficiencies. In this comparative study, energy –efficiencies, office building are considered. The study focuses on the strategies designed for reducing the heat, proper ventilation and air conditioning (HVAC) and lightning loads of this building's sliding.
Various factors such as building form, plan depth, envelope co is, ratio, n, ect, are taken into consideration, The comparative study was effectively carried out and compared with national energy consumption benchmarks for the composite climate. The result

indicated the design strategies were achieved performed well which led to a decrease in the consumption of energy of high-rise office building in composite climate.

3. Opportunity if Improving the Thermal Performance of High-Performance University Building based on Revit Software.

Author : Rapid Rashad Jassem A1 Doury, Thamir K. Ibrahim, Thamer Khalif Salem

Year of Publication : 2020

In this study, with the help of Revit Software, the thermal performance of the building is examined. BIM technology is further used to improve the overall efficiency of an existing building. On analyzing, simple changes like replacing a double glass window with triple glass led to reducing the annual energy demand and its cost around 24% & 25% resp. Thus, analyzing and effectively carrying out the changes leads to a green building which is the ultimate focus of this paper.

4. Using a data-driven approach to sort of the Energy Efficient Buildings

Author : Yuezhong Liu, Yi-Chum Huang, Dr. Rudi Stouffs

Year of Publication : 2015

In this paper the authors analyzed the development of energy –efficient building as a sustainable vision to tackle today's environmental issue. The outcome is suffered in all professions i.e., architectural designs and building engineering since the output of the buildings depends on their designs. The processed data has to be analyzed efficiently without any errors. It was earlier processed by traditional data analyzing methods, but the best way it to apply advanced data analysis methods for ease and convenience. Thus, the authors put forward their view is to use a data-driven approach to the carryout design process of energy efficient building.

5. The Analysis of the impact energy efficient techniques to enhance the building performance

Author : Perma Sharma, V.R. Prasath Kumar, R. Senthil Kumar.

Year of Publication : 2020

This paper's author suggests an upgrade in the area of low energy building problem. With the help or Revit, GBS, and Autodesk multiple stimulation can be carried out. Autodesk Software is best and commonly used for small- sized projects by designers. The authors aim for a zero-emission building and incorporation renewables into existing buildings. The conclusion suggest proper design and planning can help to increase the energy output and gross annual cost and cumulative consumption can be reduces to 12 % and 3.7 % resp. Ultimately different criteria evaluated for this study indicate improvement in the energy efficiency of the building.

6. Energy Performance Analysis of an Office Building Using BIM

Author : Md. Rakibul Hasa, Md. Saidul Islam,Jhumana Akter

Year of Publication : 2017

In this state, study hours aim to deal with BIM grounded energy performance analysis and optimize the utilization of Revit and Green Building Studio (GBS). Due to the increase in the trend of energy-efficient building worldwide especially in developed countries, the need arises to study this area according to the authors. The building model was developed in Revit and analyzed in GBS thus comprehensive data of performance i.e., heating load, cooling load, electricity consumption, and fuel consumption are studied.

7. Energy Analysis of Residential Building Using Revit

Author : Azmira Soma Aditya Naik, Mohsin Khan, Yangala Charishmanjali

Year of publication : 2019

In this paper this author has done study on the residential building made with naturally available straw bales. Due to properties like low destiny, low thermal conductivity, low specific heat capacity; straw bales are the best replacement to the walling materials. On analyzing the performance of straw hales in Autodesk Revit Software walling

material can reduce the peak cooling and heating load by 38.05 % and 32.37% resp. in comparison to the conventional red clay bricks.

2.3 Summary of Literature Review :

Sr. No	Title	Author	Journal and Year of Publication	Overview	Conclusion
1.	Application of Sustainable Construction Materials for Urban Houses	R. V. Relegoakar , H.R.Gavali, V.V. Sakhare, A Puppala and P.B.Aswath	International Journal of Environmental Science and Development Vol. 8, No.3 March 2017	In this paper, the author briefs the application of energy – efficient materials whose efficiency is used for the construction of Urban Slums in the areas if Nagpur, Maharashtra, India. The material used was bio-fuel ash, cellular high weigh (M1-BFA-CLW) bricks which were locally available in the area. This was analyzed by using BIM Software for cooling demand over the year.	It is concluded in the specific case that the use of BFA-CLW bricks is more appropriate as compared to FA bricks as a walling material. For the considered case, insulation the roof was a more suitable option rather than protecting vertical walls. The obtained results indicated that the proposes solution for waling roofing application is cost competitive and an energy efficient model than the present state of the art practice of constructing urban slum houses.

2.	Evaluation of Energy – efficient design strategies: Comparison of the thermal Performance of Energy Efficient Office Buildings in composite climate, India.	Faheen Bano, Vandana Singh	Solar Energy (International Solar Energy Society) Journal, Vol. 176, Dec 2018	This paper aims to survey the energy consumption in the mid-rise-high-rise-office building situated in Indian in the composite climate and compare their energy efficiencies. In this comparative study, energy – efficiencies, office building are considered. The study focuses on the strategies designed for reducing the heat, proper ventilation and air conditioning (HVAC) and lightning loads of this building's sliding.	The comparative study was effectively carried out and compared with national energy. Consumption benchmarks for the composite climate. The result obtained indicated the design strategies were achieved performed well which led to a decrease in the consumption of energy high rise office buildings in composite climate.

3.	Opportunity if Improving the Thermal Performance of High-Performance University Building based on Revit Software.	Rapid Rashad Jassem A1 Doury, Thamir K. Ibrahim, Thamer Khalif Salem	Journal of Mechanical Engineering Research and Developments, Vol. 43, No.6 Year :2020	In this study, with the help of Revit Software the thermal performance of the building examined. BIM technology is further used to improve the overall efficiency of an existing buildings.	Building Information Modeling (BIM) technology can lead to foresight the designed building performance that provides a real opportunity to decision makers to enhance the building performance in a way that minifies the energy consumption cost and pollution.
4.	Using a data-driven approach to sort of the Energy Efficient Buildings	Yuezhong Liu, Yi-Chun Huang,Dr. Rudi Stouffis	Journal of Information Technology in Construction January 2015	In this paper, the authors analyzed the development of energy efficient building as sustainable vision to tackle today's environmental issued. Thus they put forward their view is to use a data-driven approach to the carryout design process of energy efficient buildings.	It is anticipated that this work flow will help design teams to formally investigate the performance of many more alternatives during the different design phases, leading to improved built environments.

5.	The Analysis of the impact energy efficient techniques to enhance the building performance	Perma Sharma, V.R. Prasath Kumar, R. Senthil Kumar.	3rd Intrernational Conference on Advance on Advances in Mechanical Engineering Year 2020	This paper's author suggests an upgrade in the area of low energy building problems. Which the help of Revit, GBS, and Autodesk multiple stimulations can be carried out. The authors aim for zero-emission building and incorporation renewables into existing buildings.	The conclusion suggests proper design and planning's can help to increase the energy output and gross annual cost and cumulative consumption can be reduced to 12 % and 3.7 % resp. Ultimately different criteria evaluated for this study indicate improvement in the energy efficiency of the buildings.

6.	Energy Performance Analysis of an Office Building Using BIM	Md. Rakibul Hasa, Md. Saidul Islam,Jhumana Akter	Journal of System and Management Science Vol. 7 (2017) No. 3	In this state, study hours aim to deal with BIM grounded energy performance analysis and optimize the utilization of Revit and Green Buildings Studio (GBS). The buildings model was developed in Revit and analyzed in GBS thus comprehensive data of performance i.e. heating load, cooling load, electricity and fuel consumption is studied.	Energy efficient building has great impact to reduce the harmful effect of building energy consumption. The aim of this research was to documents the energy perforce analysis of existing building and comparative analysis of base run simulation and optimized simulation results.

7.	Energy Analysis of Residential Building Using Revit	Azmira Soma Sekhar Aditya Naik. Mohsin Khan, Yangala Charishmanjali	Proceedings of Sustainable Infrastructure Development & Management (SIDM) 2019	In this paper, the author has done a case study on the residential building made with naturally available straw bales.	Straw bale construction is found to be more economical and eco-friendly when compared toe conventional buildings. From this study it is found that buildings made of straw bale wall is more efficient in providing interior thermal comfort. Walling material can reduce the peak cooling and heating load by 38.05 % and 32.37 % resp. In comparison to the conventional red clay bricks.

CHAPTER 3

SUN PATH AND SUN PATH DIAGRAM

SUN PATH AND SUN PATH DIAGRAM

- Sun path refers to the apparent significant seasonal-and-hourly positional changes of the sum (and length of daylight)as the Earth rotates, and orbits around the sun.
- Sun – path diagram as the name suggests is something that is used to determine the location, in the sky, of the sun at any point of time during the day, throughout the year.

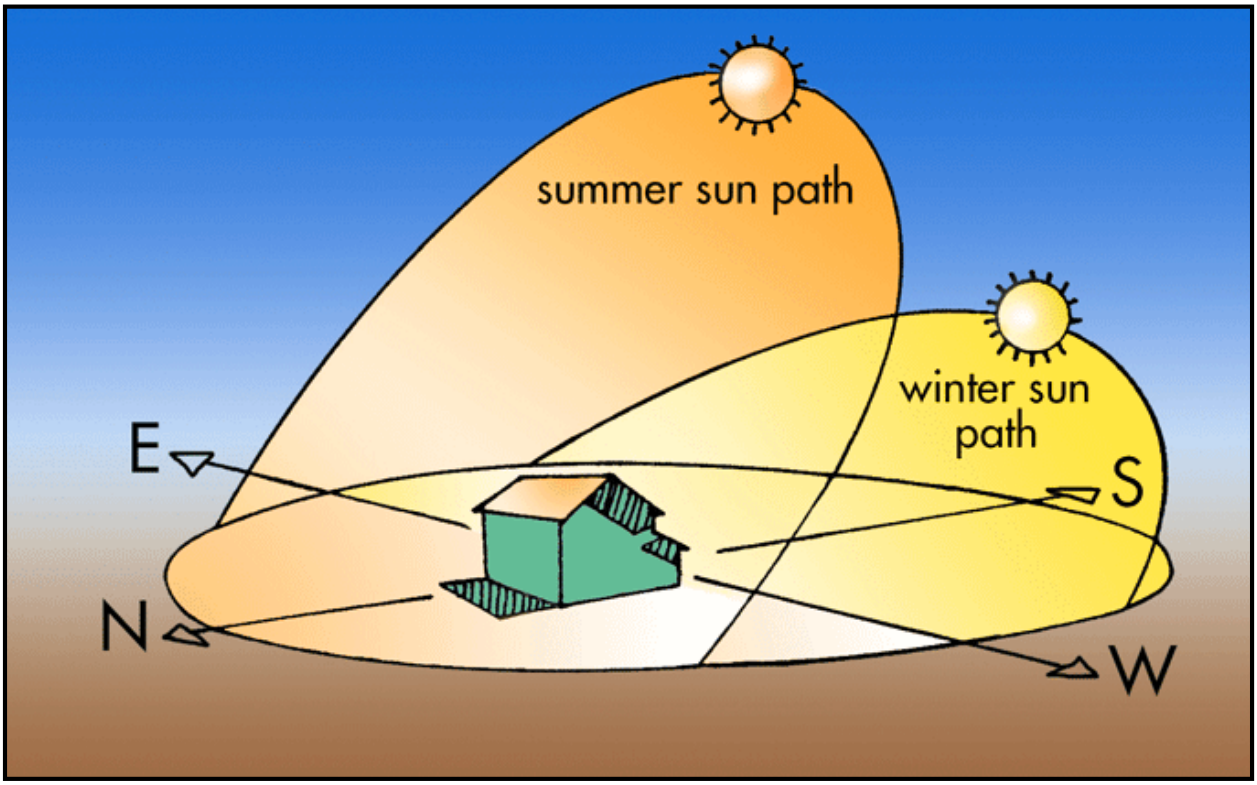

Figure 1. Sun Path Diagram

Orientation :-

- Orientation is the positioning of a building in relation to arch. Seasonal variations in the sun's path as well as prevailing wind patterns.
- Good orientation can increase the energy efficiency of your building making it more comfortable to live in and cost efficient to operate.

Principles of good orientation:-

Principles of suitable orientation:-

- Good orientation, mixed with different power performance feature, can lessen or maybe put off the want for auxiliary heating and cooling, ensuring in decrease power bills, decreased greenhouses fuel lime emissions and advanced comfort.
- It takes account of summer time season and wintry weather varsions eithinside the sun's route in addition to the path and kind of winds, including cooling breezes. Good orientation can assist lessen or maybe put off the want for auxiliary heating and cooling. Ensuing in decrees power bills, decreased greenhouse fuel line emissions and advanced.

Analysis for the best Orientation

- Priorities you're heating and cooling needs.
- Temperature ranges, both seasonal and diurnal (day night)
- Humidity ranges
- Direction of cooling breezes, hot winds, cold winds, wet arch winds.
- Seasonal characteristics, including extremes
- Impact of Local geographic features on climatic conditions (see Choosing arch site)
- Impact of adjacent building and existing landscape.

Orientation for passive Heating:-

Sun movement from high angle in summer to low angle in winter.

- Orientation for passive heating is about using the sun as a source of fee home heating by letting winter sun in and keeping unwanted summer sun out.

For Example

- In cold climates orientations west of north increase west of north increase solar gains in the Ach afternoon when they are arch most desirable for evening comfort, but east of north can warm the house more in the mornings, improving daytime comfort for those who are ate home then.
- In warmer climates, orientations east of north can allow better capture of cooling breeze.

Climate specific Responses:-

In high humidity climates and hot dry climates with warm winters, shade the building and outdoor living spaces throughout the year.

1) **Hot humid Climates :**

   In hot humid climate, it is essential to shade the walls year-round and highly advantageous to shade the whole roof.

   - Shade all external opening and walls including those facing south.
   - Use covered outdoor living A areas such as verandas and deep balconies to shade and cool incoming air.
   - Use shaded skylights to compensate for any resultant loss of natural daylight.
   - Choose and position landscaping to provide adequate shade without blocking access to cooling breezes.

2) **Hot dry Climates :**

   - Shade all external openings in regions where no winter heating is required.
   - Provide passive solar shading to north-facing opening in regions where winter heating is required. Avoid shading any portion o the glass in winter when winter heating is required – use upward raked eaves to allow full winter solar access, or increase the distance between the window head the underside of the eaves.

3) **Warm humid and ward/mild temperate Climates :**

- Provide passive solar shading to all north-facing openings, Arousing shade structures or correctly sized eaves.
- Use adjustable shade screens or deep overhangs to the east and west. Adjustable shade screens low angle sun the most effectively.

4) Cool temperate Climates :

- Do not place deep covered balconies to the north as they obstruct winter sun. Balconies to the east or west can also obstruct winter sum to a lesser extent.
- Avoid shading any portion of the north-facing glass in winter use upward raked-eaves to allow full winter solar access, or increase the distance between the window head and the underside or the Arch eaves.
- Use deciduous planting to the east and west. Avoid planting to the north that world obstruct solar access.

How does the sun position affect the building design?

Designing a building with the sun in mind can help reduce both heating and cooling loads. Sun shining into a building provides free heat and natural light. It can also create glare and when the heat isn't needed, discomfort and added demand for cooling. The sun rises in the east and sets in the west.

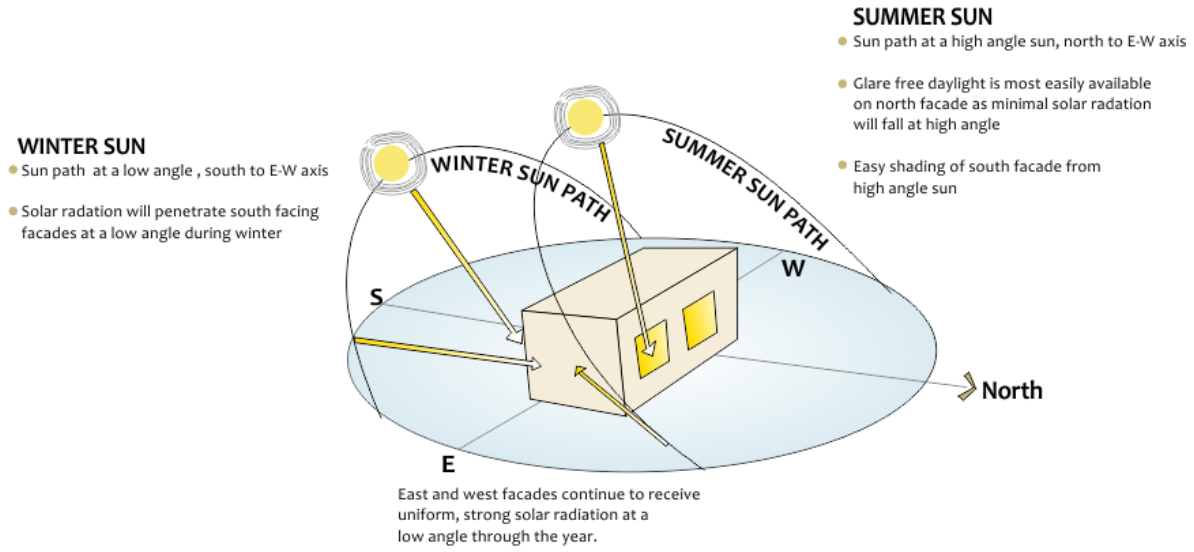

Figure 2 Effect of Sun Position on Building

CHAPTER 4

LOCATION MAP. AutoCAD And AUTODESK REVIT PLAN

LOCATION MAP

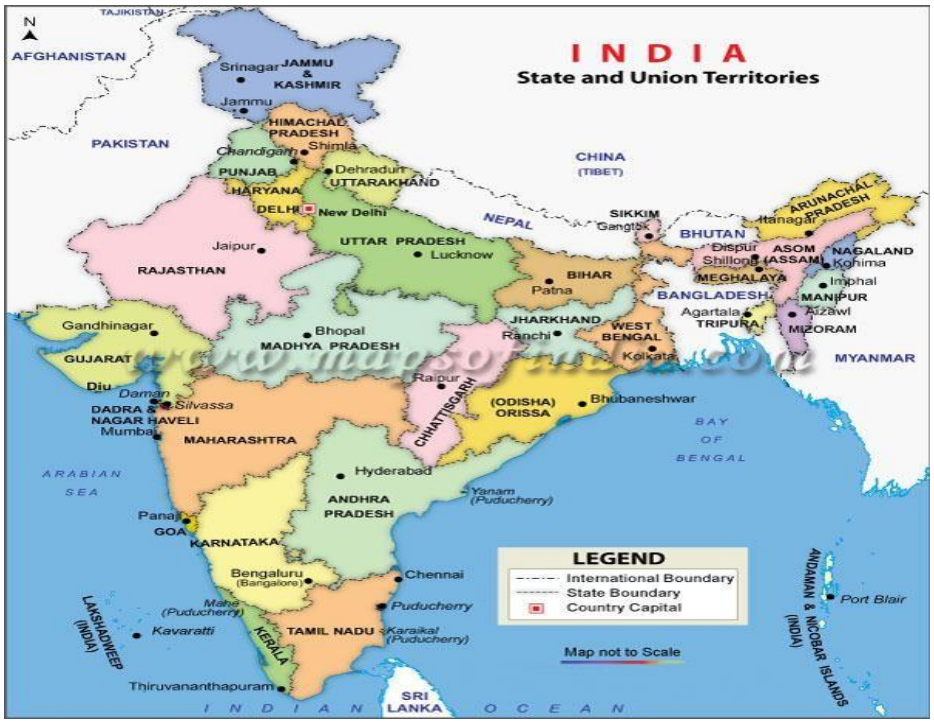

Figure 3 Location Map

Auto CAD 2D PLAN

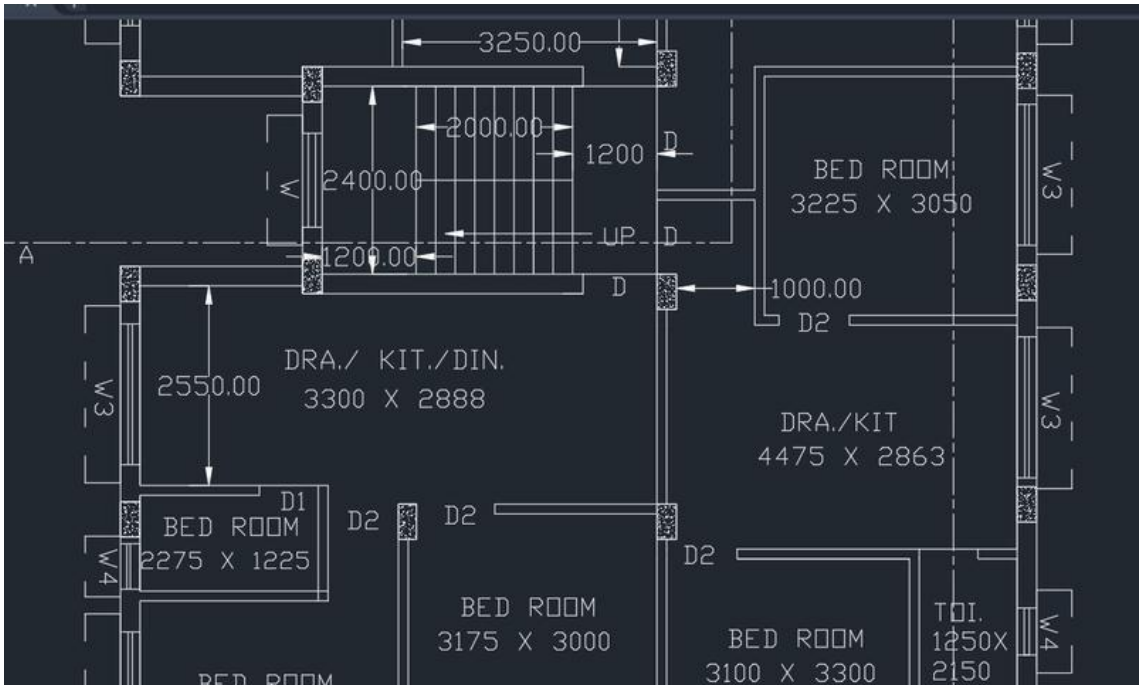

Figure 4. AutoCAD 2D Plan

AUTODESK REVIT 2D PLAN

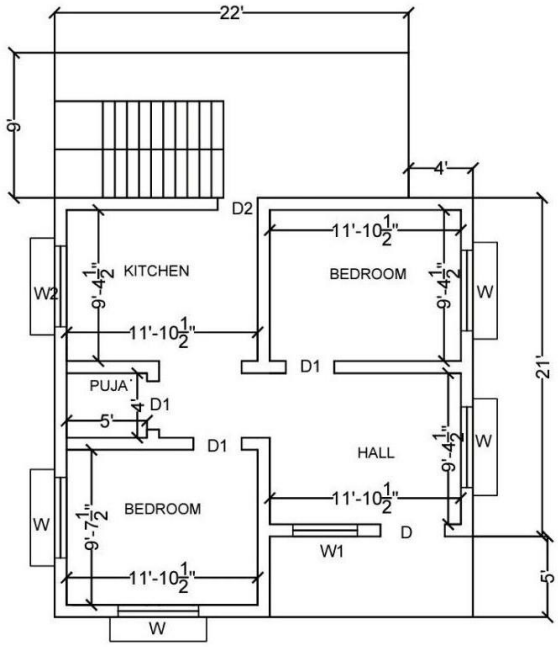

Figure 5 Revit Plan

AUTODESK REVIT 3D PLAN

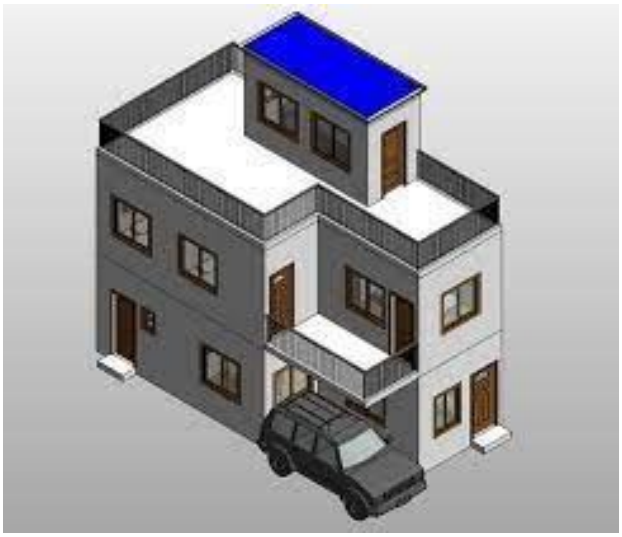

Figure 6 Revit 3 D Plan

CHAPTER 5

ENERGY EFFICIENT MATERIALS

ENERGY EFFICIENT MATERIALS

7.1) Red Bricks

7.2) Concrete Bricks

7.3) Autoclaved Aerated Concrete (A A C) Block

7.1 Red Bricks :

The term brick technically refers to a block product of dried clay, however it's progressively often used popularity to talk over with alternative with chemicals cured masonry blocks. Mortar, glue, or interlocking air all choices for changes of integrity bricks. Bricks are available a spread of classifications, types, materials, and sizes that fluctuate by place and age, and that they are created in massive quantities.

Red Bricks Different Properties :-

1. Red bricks use the following raw materials : Line clay or Alumina, Sand, Iron Oxide, Magnesia. The sand used for red brick manufacture in mostly obtained locally.
2. Red Bricks are available in modular sizes of 190 x 90 x 90 mm and 190 x 90 x 40 mm. And also, in non-modular sizes of 230 x 110 x 70 mm and 230 x 110 x 30 mm
3. The compressive strength various from one class to another and hence lied in the range between 3.5 to 35N/mm2.
4. The dry density also various depending on the class of brick. It normally ranges from 1600 to 1920 kg/m3
5. The water absorption of red bricks in recommended to be less than 20 % of its weight.
6. The thermal conductivity of red bricks in advised to have a value in the range of 0.6 to 1W/m.k
7. Red bricks utilize clay which in naturally available. This production hence depletes the top fertile soil. Red bricks also emit more carbon dioxide during its manufacture.
8. Red bricks alone are cheap. But overall cost including the cost of mortar and construction is high as it demands more mortar
9. Red bricks can be used as structural material for the construction of structures like buildings, foundations, arches, pavement and bridges.

7.2 Concrete Bricks :

Blocks or concrete masonry are the foremost common names for concrete bricks, that are typically pale gray, They are engineered of dry, small-aggregate concrete that is poured into steel moulds and compacted victimization either an “egg layer” or a static machine. Instead of being burnt, the finished blocks are available a spread of shapes, sizes and face treatments, several of that are designed to appear like clay bricks? Concrete bricks are available a spread of hues and are factory-made whith sulphate – resistant cement or the same, they’re appropriate for troublesome things like wet conditions and holding walls once created with enough cement.

Concrete Block Different properties :-

1. Concrete blocks use the following raw materials ordinary Ordinary Portland Cement, sand, gravels, water. In certain situation, fly ash can be use instead of fine sand.
2. Standers sizes of solid concrete blocks are length 400,500 or 600 mm height of 200, 100 mm and the width from 50,70, 100, 150, 200, 250 or 300 millimeters. The dimension differs from manufacturer to manufacturer.
3. The compressive strength of solid concrete block varies based on the grade of cement used. Its compressive strength varies from 4 to 5 N/mm.
4. The dry density of the solid concrete block is depended on the grade of block. This ranges from 1800 to 2500 kg/m3
5. Solid concrete blocks must not have a water absorption value not greater than 10 % of its weight.
6. Solid concrete blocks usually have a thermal conductivity in the range 0.7 to 1.28W/m.K
7. The amount of carbon dioxide emitted during the manufacture of solid concrete blocks is less.
8. Solid concrete blocks have flat and even surface that hence demand less mortar compared to red.
9. Solid concrete blocks require 7 to 14 days of curing which demand high amount of water compared to red brick.
10. The solid concrete blocks cost high as individual pieces. It consumes less mortar. It have the advantage that the same wall area can be consumes less number of solid concrete blocks than red bricks.
11. Solid concrete blocks are employed in construction to act both as load bearing and non-load bearing in walls, panel wall and partition walls. This can also be used as backing for piers, retaining walls, other facing materials.

7.3 AAC Blocks :

AAC (autoclaved acrated concrete) could be formed, light-weight foam concrete artefact that may be accustomed create concrete masonry unit-like blocks. AAC product are created from quartz sand, calcined mineral, lime, cement, water and Aluminum powder and are cured in an autoclave beneath heat and pressure. AAC was fictitious powder and are cured in an autoclave beneath heat and pressur. AAC was fictitious within the mid-1920s and provides structure, insulation, and fireplace and moulds resistance all at identical time. Blocls, wall panels, floor and roof panels, and product will be used for each interior and exterior construction and that they will be coated with siding materials like veneer brick or vinyl siding, or painted or coated with or plaster compound to safeguard them from the weather. Other than the very fact that they’re straightforward to put it.

AAC Blocks properties :

AAC Block Authoclaved aerated concrete.

1) It is lightweight precast, foam concrete building material suitable for concrete masonry unit.
2) it is Eco friendly in nature not producing pollution in environment and it is certified green building material.
3) It is load bearing in nature having high compressive strength 5N/mm2
4) It is fireproof Insulating building material having a resistance of about 4 an hour against fire.
5) Actually, it is aerated concrete have more air voids, due to presence of air void in between that's why it is high weight and easy for handling even it has high volume.
6) There us different size of AAC Block are available in market, but there are four common sizes are 600mm x 200mm x 100mm, 600mm x 200mm x 150mm, 600mm x 200mm x 200mm and 600mm x 200mm x 225mm

CHAPTER 6

RESULT

RESULT

Location : Nagpur

Table 1 : Result for Nagpur City

Type of Brick	Hall (W/month)	Kitchen (W/month)	W.C (W/month)	Bedroom 1 (W/month)	Bedroom 2 (W/month)	Total (W/month)	Decrease in Cooling Load %
Concrete Brick	5906	4706	1324	6514	6688	25138	0.00%
Red Brick	4479	3241	960	4512	4649	17841	29.02 %
Autoclaved Aerated Concrete Block i.e AAC Block	4148	2794	801	3910	4227	15880	36.82 %

Location : Delhi

Table 2 : Result for Delhi City

Type of Brick	Hall (W/month)	Kitchen (W/month)	W.C (W/month)	Bedroom 1 (W/month)	Bedroom 2 (W/month)	Total (W/month)	Decrease in Cooling Load %
Concrete Brick	5906	4706	1571	6688	6514	25138	0.00%
Red Brick	5561	4240	1277	5435	5509	22122	12.85 %
Autoclaved Aerated Concrete Block i.e AAC Block	5032	3564	1034	4571	4875	19076	24.85 %

Location : Hydrabad

Table 3 : Result of Hydrabad City

Type of Brick	Hall (W/month)	Kitchen (W/month)	W.C (W/month)	Bedroom 1 (W/month)	Bedroom 2 (W/month)	Total (W/month)	Decrease in Cooling Load %
Concrete Brick	5906	4706	1571	6688	6514	25138	0.00%
Red Brick	5630	4192	1259	5367	5461	21909	13.69 %
Autoclaved Aerated Concrete Block i.e AAC Block	4148	2794	801	3910	4227	15880	37.44 %

Location : Tripura

Table 4 : Result of Tripura City

Type of Brick	Hall (W/month)	Kitchen (W/month)	W.C (W/month)	Bedroom 1 (W/month)	Bedroom 2 (W/month)	Total (W/month)	Decrease in Cooling Load %
Concrete Brick	5906	4706	1571	6688	6514	25138	0.00%
Red Brick	4780	3439	1011	4520	4758	18508	27.09 %
Autoclaved Aerated Concrete Block i.e AAC Block	4387	2958	848	3927	4327	16447	35.50 %

Location :Shimla

Table 5 :Result of Shimla City

Type of Brick	Hall (W/month)	Kitchen (W/month)	W.C (W/month)	Bedroom 1 (W/month)	Bedroom 2 (W/month)	Total (W/month)	Decrease in Cooling Load %
Concrete Brick	5906	4706	1571	6688	6514	25138	0.00%
Red Brick	5665	4236	1273	5415	5479	22068	13.06 %
Autoclaved Aerated Concrete Block i.e AAC Block	4148	2794	801	3910	4227	15880	37.44 %

Table 6 : Combined Data of Required Cooling Load (Watt/Month)

	Nagpur (W/month)	**Delhi (W/month)**	**Hydrabad (W/month)**	**Tripura (W/month)**	**Shimla (W/month)**
Concrete Brick	25138	25385	25385	25385	25385
Red Brick	17841	22122	21909	18508	22068
Autoclaved Aerated Concrete Block (AAC Block)	15880	19076	15880	16447	15880

Table 7 : Combined Data of Required Cooling Load (%)

	Nagpur	**Delhi**	**Hydrabad**	**Tripura**	**Shimla**
Concrete Brick	0 %	0 %	0 %	0 %	0 %
Red Brick	29.02 %	12.85 %	13.69 %	27.09 %	13.06 %
Autoclaved Aerated Concrete Block (AAC Block)	36.82 %	24.85 %	37.44 %	35.20 %	37.44 %

CHAPTER 7

CONCLUSION

CONCLUSION :

The faster increase in global energy usage has developed some vital issues over supply problems, exhaustion of electricity assets and solar energy and heavy environmental impacts. About 40 % of the total energy in consumed by building. Therefore, energy consumption. Due to designing of energy-efficient and high-performance building equates that building performance and simulations tools are utilized. Energy is an important tool for the overall development and improvement of the quality of life. Energy Efficient Building means using less energy for doing the same amount or work. The meaning of energy efficiency is to reduce energy consumption, reduce greenhouse gases (carbon emission) and global warming and decrees the dependence of fossil fuel by taking the benefit of natural resources and minimizing the west of energy.

1. As per out research we conclude that AAC Blocks required 10 % and 30 5 less energy that of Red Bricks and Concrete Blocks respectively. Hence AAC Block are the most efficient material to use for the construction.
2. In the hotter cities AAC blocks serve as an energy efficient material as this saves a lot of energy required and fulfils the required cooling load.
3. The cities where the average temperature is less than 30- degree Celsius red brick can also be used as an energy efficient building material as there is not much difference in the required cooling loads at that type of cities.
4. Also, as AAC blocks are lighter in weight, it becomes efficient in transportation, labor work, etc. hence it saves energy as well money in comparison with the red brick and concrete brick.
5. It also efficient in making high rise building as its self –weight is lower than red bricks and concrete bricks.
6. AAC is aslo an eco-friendly material as it is made from the fly ash.

CHAPTER 8

FUTURE SCOPE OF WORK

FUTURE SCOPE OF WORK

1. The Present study is limited, as the use of three materials i.e. Red Brick, Concrete Brick and Autoclaved Aerated Concrete but these materials can be replaced by any other materials or materials can be added in it.
2. In present study only the use of AutoCAD and Autodesk Revit has been made but other software's like Green Building Studio can also be used for analysis.
3. In the present study analysis of only peek cooling load has been done but other parameters like peek heating load can also be analyzed.
4. In the present study we have considered only one direction, i.e., west facing entrance but other direction can be taken into considerations also the arrangement of rooms can be changed for future analysis.