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EXPLORING ALTERNATIVE PRECAST WALLING AS SUSTAINABLE WALLING SOLUTION FOR ENERGY EFFCIENCY

[1]Nikita Mahesh Thombare 1st,[2]Sandeep Gunpal Dige 2nd,[3]Anjali Surat Jadhav3rd

[1]Pursuing Post-Graduation in Construction Project Management 1st, [2]Associate Professor S.P.S.M.B.H's College of Architecture, [3]Dr.Professor S.P.S.M.B.H's College of Architecture
Department of Construction Project Management,
S.P.S.M.B.H's College of Architecture, Kolhapur ,India

Abstract : A major worldwide issue that affects social, economic, and environmental aspects is sustainability. To lessen its effects, the construction sector, which uses a lot of resources and contributes to pollution, needs to embrace sustainable methods. Because of their inefficiencies, waste, and safety concerns, traditional construction methods are under review. A workable solution is to use sustainable materials that reduce environmental damage.

Whereas, Precast components are manufactured in a factory and then assembled on-site; precast construction increases sustainability. This study explores the potential of precast walling to revolutionize the construction industry by examining energy consumption and analyzing the light intensity of alternative precast walling with a simulation method that improves sustainability in construction.

Index Terms – Alternative Precast Walling, Sustainable Walling Solution, ,Energy Efficiency.

I. INTRODUCTION

Sustainability is vital in the construction industry, necessitating innovative approaches for better resource use, In the construction sector, sustainability is essential, requiring creative solutions for improved resource utilization, waste minimization, and preservation for the future.

Precast panel construction, which involves factory-made components assembled on-site, improves sustainability. This study explores alternative precast walling solutions and recommends walling methods that enhance environmental performance in construction sector.

II. RELEVANCE OF STUDY

Energy use and sustainability in construction are closely related, especially when it comes to walling materials. Selecting locally sourced or repurposed materials reduces the energy required for extraction and transportation.

- Thermal Performance: By improving insulation, sustainable walling materials lower the amount of energy required for heating and cooling.
- Durability & Longevity: Over time, energy is saved by durable materials requiring less upkeep and repairs.
- Embodied Energy: Sustainable materials save energy during production since they usually have lower embodied energy.
- Passive Solar Design: By retaining heat, some walling materials improve passive solar techniques and reduce energy use.
- Reduction of Waste: Prefabricated walling components help reduce construction waste and disposal energy. By implementing these sustainable techniques, the building sector may drastically cut energy use and create a more sustainable built environment.

III. NEED OF STUDY

A. Environmental sustainability (ENS)

Currently, the production of cement contributes 2.8 billion tons of CO2 to world emissions annually; if present urbanization trends continue, this amount might increase to almost 4 billion tons annually. Building and construction projects use between 25 and 40 percent of total energy and 30 percent of raw materials in countries that are members of the Organization for Economic Co-operation & Development (OECD), according to the Supply Chain Sustainability School. 30–40% of global greenhouse gas emissions Solid waste production ranges from 30 to 40%, and the building Construction has a direct impact on the environment for the reasons listed below:

The production of waste materials that pose a serious threat to people's health and the environment around them. Noise pollution is brought on by the usage of large vehicles and construction equipment. Construction-related effects: +/- 50% of all

B. Ancient Construction Techniques:

Figure 1:Ancient construction

- Masonry: Involves using stones, bricks, or mud bricks with mortar. Egyptians excelled at this, building pyramids and temples.
- Arches: Wedge-shaped structures that support heavy weights. Romans used arches extensively in aqueducts, bridges, and coliseums.
- Half-timbered Construction: A wooden frame filled with materials like brick or wattle and daub, common in Medieval Europe.
- Mud Brick: Made from sun-dried mud, used in ancient Mesopotamia, Egypt, and the Indus Valley. It's inexpensive but less durable than stone or fired brick.

These techniques, often labor-intensive and time-consuming.

C. Present Construction :

Figure 2: Present construction

- Slaked Soil: Soil weakened by excessive moisture can cause uneven foundation settling, leading to cracks in walls and floors.
- Poor Joints: Weak connections between materials like bricks or pipes can compromise structural integrity, resulting in leaks and potential collapse.
- Fungus and Cracks on Walls: Moisture-related cracks allow water infiltration, promoting fungus growth, which can damage structures and pose health risks.
- Leakage in Joints: Water seeping through gaps in materials can lead to water damage, mold growth, and structural problems.

Traditional on-site construction faces criticism for long timelines, low productivity, weather constraints, resource waste, environmental pollution, and safety issues. Precast walling has emerged as a sustainable alternative, promoting better environmental performance in the construction industry and offering significant benefits for construction.

IV. Different Walling Systems Used In Residential Buildings

Conventionally burnt clay bricks, hollow concrete blocks where largely used for constructing affordable and sustainable construction, but this methods are time consuming and also they put pressure on natural resources like soil and Sand. Recognizing these challenges, the BMPTC is promoting the use of new, cost-effective, and sustainable materials for mass building construction.

The shift towards sustainable construction requires ongoing research and development. By promoting and developing encouraging sustainable precast construction. The different constructions discussed here for research work are as follows-

A. Autoclaved Aerated concrete block construction. (AAC Blocks) (150mm Thk)
B. Expanded Polystyrene Panel(EPS Panel)(50mm-150mm Thk)
C. Prefabricated Fiber Reinforced Sandwich Panels(Aerocon Panels)(50mm,75mm Thk)

A. Autoclaved Aerated concrete block construction

Figure 3:Construction in AAC Block

Autoclaved Aerated Concrete (AAC) is a great green building material with numerous advantages.

- Sustainability Benefits: Certified Green Building Material, Use of Recycled Materials, Eco-Friendly Production.

- Performance Advantages**:** AAC blocks are 3-4 times lighter than traditional bricks, offering benefits such as, Reduced earthquake impact, Lower foundation requirements, Improved fire resistance, Enhanced sound absorption for a quieter indoor environment.
- Economic Benefits: - Reduced operation costs (20-30%),Faster construction time (15%),Larger and easier to work with than traditional bricks, Environmental benefits, performance advantages, and economic gains

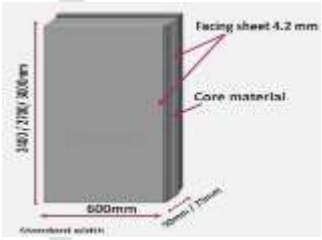
B. Reinforced Expanded Polystyrene Panel System (EPS Panel)

Typical cross section of wall panels *Reinforcing mesh expanded polystyrene core and diagonal wire*

Figure 4: EPS Panel

The Reinforced Expanded Polystyrene (EPS) core panel system is a contemporary, cost-effective, safe, and efficient building construction method. These panels are suitable for both load-bearing and non-load-bearing applications. A three-dimensional welded wire space frame with a polystyrene insulation core makes up an EPS core panel. After the panel is positioned, shotcrete is applied to both sides.

C. Prefabricated Fiber Reinforced Sandwich Panels(Aerocon Panels)



Aerocon panel Tongue and Groove Dimensions

Figure 5:Aerocon Panel

Aerocon panels are sandwich panels with two fiber-reinforced cement sheets surrounding a lightweight concrete core made from Portland cement, binders, and aggregates. They use a tongue-and-groove system for quick assembly and are fully cured in the factory. Made with Fiber Cement Board, they include fly ash, reducing raw material needs and landfill waste. As wood alternatives, they help conserve forests. Their lightweight, insulating core lowers heating and cooling energy demands, while prefabrication cuts construction time, energy, and waste. Fire, water, termite, and weather resistance extends their lifespan, and they are reusable, minimizing environmental impact and transportation emissions.

V. Analysis Of ENS By Comparing Simulation For Selected Construction Materials To Suggest Environmental-Friendly Walling Material For Proposed 1BHK Flat Model, Which Reduces Energy Use

Background for Analysis of ENS- In ENS, the analysis and comparison of selected three different walling solutions, are applied to the same suggested 1BHK flat model, and the ENS conclusion is made based on-

1. **Analyzing the illumination level (lux) or light intensity for selected walling materials for the suggested 1BHK Live Flat Model**
2. **By analyzing Energy Consumption Through Internal Equipment Lighting**

By comparing these values from simulation through Design Builder software, dissertation can achieve environmental viability and ENS in construction.

Background for simulation- Selecting materials and practices in construction that reduce environmental impact is key to sustainability. Analyzing lux levels, or light intensity, plays a crucial role:

a) Energy Efficiency: By maximizing natural light, less artificial lighting is required, which lowers energy usage .Effective insulation in materials lowers the need for heating and cooling, which saves energy..
b) Material Selection Low-impact materials that improve insulation and lower energy requirements are EPS panels and Aerocon. Sustainability is aided by recyclable materials with minimal embodied energy.
c) Indoor Environmental Quality (IEQ) :Daylight Integration by Improving IEQ through daylight optimization boosts productivity and well-being.& Glare Control By dispersing light, materials can reduce glare and make spaces more comfortable.

Day lighting requirements aim to achieve optimal illuminance (lux) in occupied spaces year-round. Designers use BEE-approved software to simulate daylight interactions with the facade and floor plan, generating lux level visuals. This analysis guides window placement, shading, and layout to maximize natural light, reducing artificial lighting needs, saving energy and improving occupant comfort.

1. Analyzing the illumination level (lux) or light intensity for selected walling materials for the suggested 1BHK Live Flat Model

1.1 Illuminance Level (lux) or Light Intensity Analysis of AAC Block Walling Construction for the 1BHK Model with Results

Daylighting in buildings with AAC block walls depends on several factors:

- **Material Properties**: AAC blocks' thermal and structural properties, with lower conductivity and density than concrete or brick, impact daylight transmission.
- **Wall Thickness and Composition**: Thinner AAC walls with larger voids may allow more light than denser, thicker ones.
- **Daylight Penetration**: Building orientation, shading, and surroundings affect how much daylight enters.
- **Illuminance Levels**: Influenced by window design, building placement, and geographic factors like climate.

In summary, AAC blocks impact daylight differently, but thoughtful design can ensure well-lit indoor spaces.

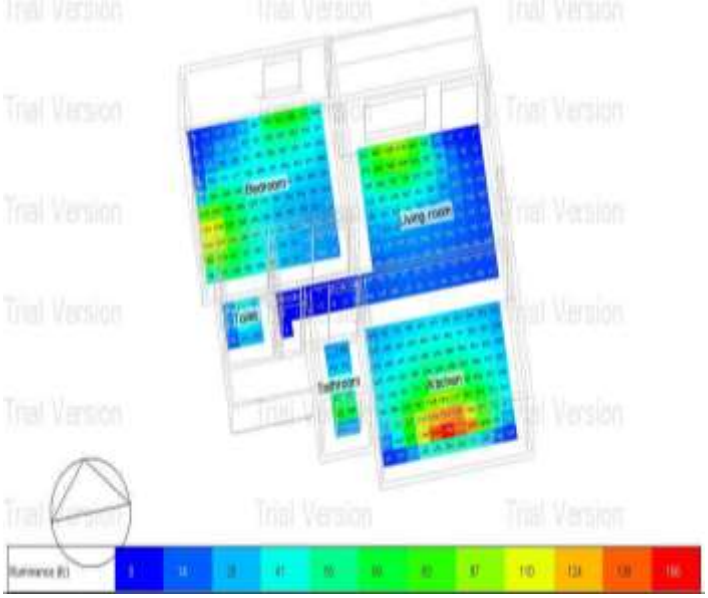
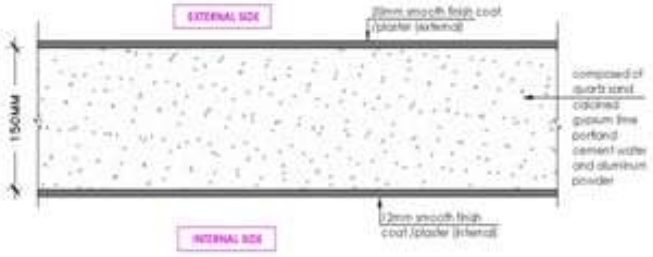


Figure 6- Illuminance Level For 1BHK flat (AAC Block)



Detailed wall Section for AAC Block (150mm thk.)

	Total	North (315 to 45 deg)	East (45 to 135 deg)	South (135 to 225 deg)	West (225 to 315 deg)
Gross Wall Area [ft2]	873.12	226.57	246.99	226.57	246.99
Above Ground Wall Area [ft2]	873.12	226.57	246.99	226.57	246.99
Window Opening Area [ft2]	107.65	42.67	0.00	34.88	30.10
Gross Window-Wall Ratio [%]	12.33	18.83	0.00	15.40	12.19
Above Ground Window-Wall Ratio [%]	12.33	18.83	0.00	15.40	12.19

Table 1:Window-Wall Ratio(Source: Snapshot Design Builder software)

Result

Sr.No	Areas	Required Standard Ave. Illuminance	Simulated Ave. Illuminance
1	Living Room	100~150 lux.	108 lux.
2	Kitchens	250~300 lux.	166 lux.
3	Bedrooms	60~100 lux.	97~110 lux.
4	Toilets/Bathrooms	150~300 lux.	55~97 lux.
5	Hallways, Passages and Corridors	30~60 lux.	46 lux.

Table 2 :Light Intensity/Lux. level Analysis of AAC block

These illuminance levels are suitable for residential spaces with AAC Block walls, ensuring a balanced and comfortable environment for various activities while optimizing energy efficiency and visual comfort.

As Per Simulation Report -Illuminance level is166 lux.

- Living Rooms (ambient): Comfortable for general activities like watching TV or relaxing.
- Dining Areas: Adequate for eating and socializing.
- Passages, Hallways and Corridors: Safe navigation without excessive brightness.
- Bedrooms (ambient): Relaxing, suitable for winding down before sleep.
- Kitchens (ambient): Suitable for general kitchen activities, with additional task lighting for food prep.
- Bathrooms: Enough for safe use and general tasks.

For tasks requiring more light, such as reading, cooking, or applying makeup, use additional task lighting like reading lamps or under-cabinet lights. Staying within the 45-185 lux range creates a comfortable and inviting atmosphere for general home use.

1.2 Illuminance Level (lux) or Light Intensity Analysis of EPS Panel Walling Construction for the 1BHK Model with Results

Day lighting in buildings with EPS panel walls is influenced by:

- Orientation and Placement: The building's direction and window positioning affect daylight amount and quality.
- Window Design: Size, type, and placement of windows/skylights determine daylight distribution.
- External Shading: Overhangs, louvers, and shades control direct sunlight, reducing glare and heat.
- Internal Layout: Room, wall, and partition arrangement affect daylight travel; open layouts enhance light distribution.
- Surface Reflectance: Interior surface colors and finishes influence daylight reflection and diffusion.
- Glazing Material: The type of window glass (e.g., tinted, low-emissivity) impacts daylight penetration and heat load.
- EPS Panel Properties: EPS panels' thermal insulation and reflectivity affect indoor light levels and temperature control.
- Building Shape and Volume: The building's form and size influence daylight penetration and distribution.

These factors collectively determine the effectiveness of day lighting strategies in buildings with EPS panel walls, impacting energy efficiency, comfort, and indoor environmental quality

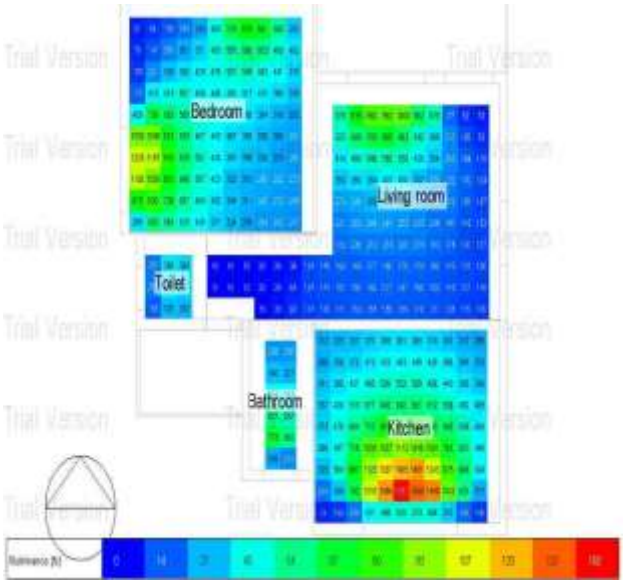
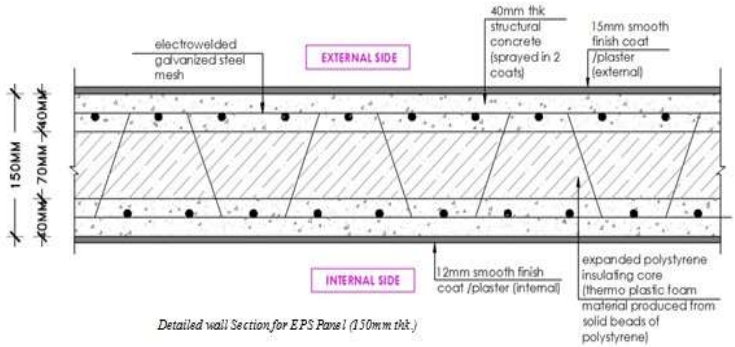


Figure 7:Illuminance Level For 1BHK flat (EPS Panel) software)



Detailed wall Section for EPS Panel (150mm thk.)

	Total	North (315 to 45 deg)	East (45 to 135 deg)	South (135 to 225 deg)	West (225 to 315 deg)
Gross Wall Area [ft2]	973.12	239.57	246.99	239.57	246.99
Above Ground Wall Area [ft2]	973.12	239.57	246.99	239.57	246.99
Window Opening Area [ft2]	107.65	42.67	0.00	34.88	30.10
Gross Window-Wall Ratio [%]	11.06	17.81	0.00	14.56	12.19
Above Ground Window-Wall Ratio [%]	11.06	17.81	0.00	14.56	12.19

Table 3:Window –Wall Ratio (Source: Snapshot Design Builder software)

Result

Sr.No	Areas	Required Standard Ave. Illuminance	Simulated Ave. Illuminance
1	Living Room	100~150 lux.	93 lux.
2	Kitchens	250~300 lux.	160 lux.
3	Bedrooms	60~100 lux.	80~107 lux.
4	Toilets/Bathrooms	150~300 lux.	93 lux.
5	Hallways, Passages and Corridors	30~60 lux.	40~54 lux.

Table 4: Light Intensity/Lux. level Analysis of EPS Panel

These illuminance levels are suitable for residential spaces with EPS panel walls, ensuring a balanced and comfortable environment for various activities while optimizing energy efficiency and visual comfort.

As Per Simulation Report -Illuminance level is160 lux.

- Passages, Hallways and Corridors**:** Provides safe navigation without glare.
- Bedrooms (Ambient Lighting): Creates a calming atmosphere.
- Living Rooms (Ambient Lighting): Comfortable for reading, TV, and socializing.
- Kitchens (Ambient Lighting): Adequate for cooking and food prep.
- Bathrooms: Ensures brightness for grooming and safety.

1.3 Illuminance Level (lux) or Light Intensity Analysis of Aerocon Panel Walling Construction for the 1BHK Model with Results

Day lighting with Aerocon wall panels can be optimized through:

- Orientation & Window Placement: Align windows to maximize light and minimize heat gain.
- Window Design: Use high-performance glazing for light efficiency and comfort.
- External Shading: Add overhangs or awnings to control heat and glare.
- Interior Reflectance: Light-colored surfaces enhance diffusion and reduce artificial light needs.
- Day lighting Controls: Use sensors and dimming for responsive lighting adjustments.
- Building Form: Design spacious layouts to improve light penetration.
- Health Benefits: Promote circadian rhythms and reduce artificial light reliance.

These strategies support sustainable, energy-efficient, and comfortable interiors with Aerocon panels.

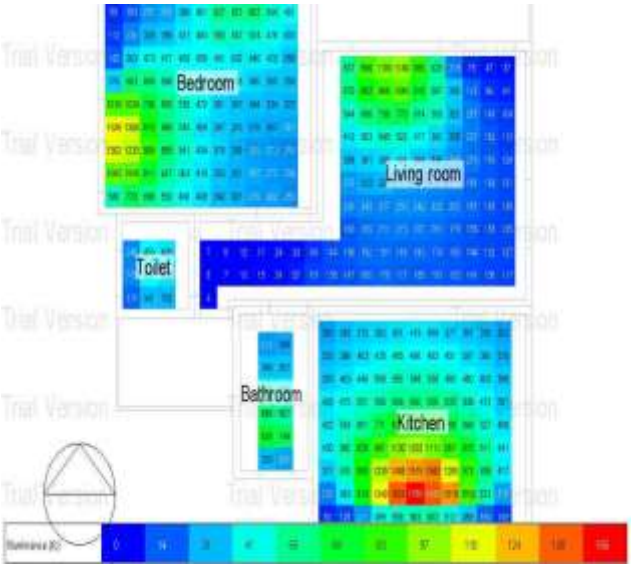


Figure 8:Illuminance Level For 1BHK flat (Aerocon Panel)

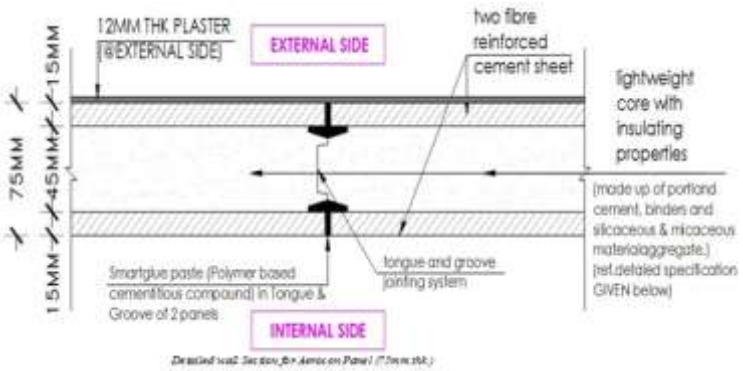


Table 5:Window –Wall Ratio (Source: Snapshot Design Builder software)

	Total	North (315 to 45 deg)	East (45 to 135 deg)	South (135 to 225 deg)	West (225 to 315 deg)
Gross Wall Area [ft2]	973.12	239.57	246.99	239.57	246.99
Above Ground Wall Area [ft2]	973.12	239.57	246.99	239.57	246.99
Window Opening Area [ft2]	107.65	42.67	0.00	34.88	30.10
Gross Window-Wall Ratio [%]	11.06	17.81	0.00	14.56	12.19
Above Ground Window-Wall Ratio [%]	11.06	17.81	0.00	14.56	12.19

Result

Sr.No	Areas	Required Standard Ave. Illuminance	Simulated Ave. Illuminance
1	Living Room	100~150 lux.	108 lux.
2	Kitchens	250~300 lux.	185 lux.
3	Bedrooms	60~100 lux.	97~110 lux.
4	Toilets/Bathrooms	150~300 lux.	55~97 lux.
5	Hallways, Passages and Corridors	30~60 lux.	46 lux.

Table 6:Light Intensity/Lux. level Analysis of Aerocon Panel

These illuminance levels are suitable for residential spaces with Aerocon panel walls, ensuring a balanced and comfortable environment for various activities while optimizing energy efficiency and visual comfort.

As Per Simulation Report Illuminance level is166 lux.

- Hallways, Passages and Corridors: Sufficient light for safe navigation without being too bright.
- Bedrooms (Ambient Lighting): Creates a calming environment suitable for relaxation and sleep.
- Living Rooms (Ambient Lighting):Provides comfortable illumination for activities like reading, watching TV, and socializing.
- Dining Areas: Ensures ample light for dining and social gatherings.
- Kitchens (Ambient Lighting): Provides adequate illumination for cooking and food preparation tasks.
- Bathrooms: Ensures ample brightness for grooming and tasks like shaving or applying makeup.

1.4 Comparison and Result for ENS: By Simulating the Maximum Lux Level or Light Intensity of Selected Walling Materials for the Suggested Live 1BHK Flat Model

Sr.No	Wall Material	Required Standard Ave. Illuminance for Residential Building useful light (As per ECBC 2017)	Simulated maximum. Illuminance
1	AAC Block	100~2000 lux.	166 lux.
2	EPS Panel	100~2000 lux.	160 lux. .
3	Aerocon Panel	100~2000 lux.	166 lux.

Table 7: Comparison and result of lux levels for ENS By Simulating the Maximum Lux Level for 1bhk flat

Result

As per simulation, AAC block,,EPS Panel and Aerocon Panel maximum,suitable illuminance levels are 166 lux.,160lux. & 166 lux. Respectively which is suitable for residential spaces(As per ECBC 2017)which is **Between 100 lux and 2000 lux, which is useful daylight**, ensuring a balanced and comfortable environment for various activities while optimizing energy efficiency and visual comfort.

2. Energy consumption analysis through internal equipment lighting

Background-Yearly energy consumption and the selection of wall materials are intricately connected to environmental sustainability. The materials chosen for building walls influence both the energy efficiency of the building and its overall environmental impact. Energy consumption for wall material simulation calculates the energy needed for indoor comfort based on wall materials' thermal performance:

- Thermal Properties: Define U-value, R-value, thermal mass, and specific heat capacity.
- Building Model: Create a model with geometry, orientation, windows, doors, and shading devices.
- Climate Data: Use local data (temperature, humidity, solar radiation, wind speed) to simulate conditions.
- Heat Transfer Simulation: Calculate heat transfer through the building envelope.
- Internal Gains and Occupancy: Include internal heat gains and consider the occupancy schedule.
- Heating and Cooling Loads: Determine loads for maintaining desired indoor temperatures.
- Energy Consumption Calculation: Calculate energy consumption for HVAC systems.
- Comparative Analysis: Compare different wall materials to identify the most efficient ones.

- Optimization: Optimize wall design and material selection to reduce energy consumption.
- Reporting and Visualization: Provide detailed reports and visualizations like energy consumption graphs and comparative tables. These simulations improve building energy efficiency, reduce costs, and enhance sustainability.

2.1 Electrical Layout for Energy Consumption Through Internal Equipment Lighting for AAC Block and EPS Panel

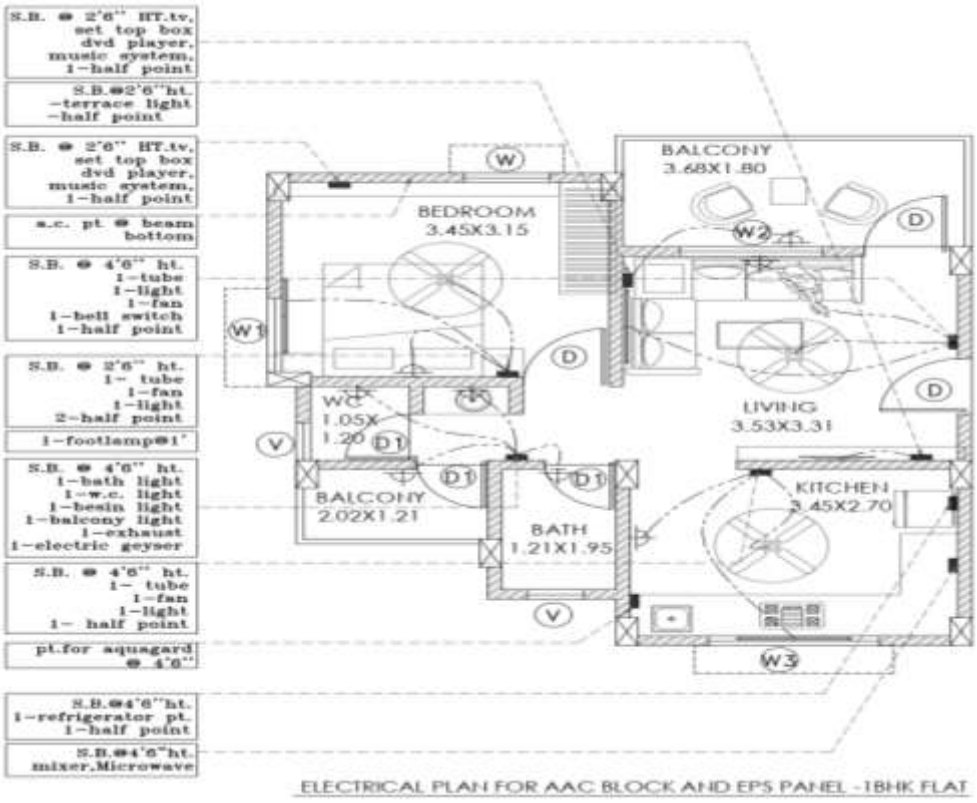
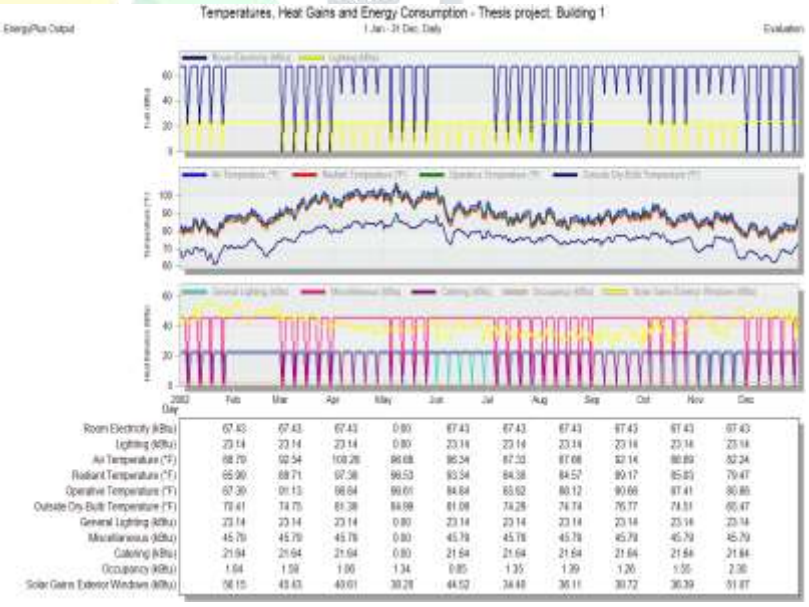


Figure No.9:Electrical Layout For AAC block & EPS Panel walling Construction for simulation

2.1.1 Yearly Energy Consumption Through Internal Equipment Lighting for AAC Block Walling

	Electricity [kBtu]	Natural Gas [kBtu]	Gasoline [kBtu]	Diesel [kBtu]
Heating	0.00	0.00	0.00	0.00
Cooling	0.00	0.00	0.00	0.00
Interior Lighting	7248.17	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00
Interior Equipment	20888.22	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00
Total End Uses	28136.39	0.00	0.00	0.00

Table 8:Yearly Energy Consumption in kw/hr. for 1Bhk Flat (For AAC Block) (Source –Design Builder Software of Simulation)



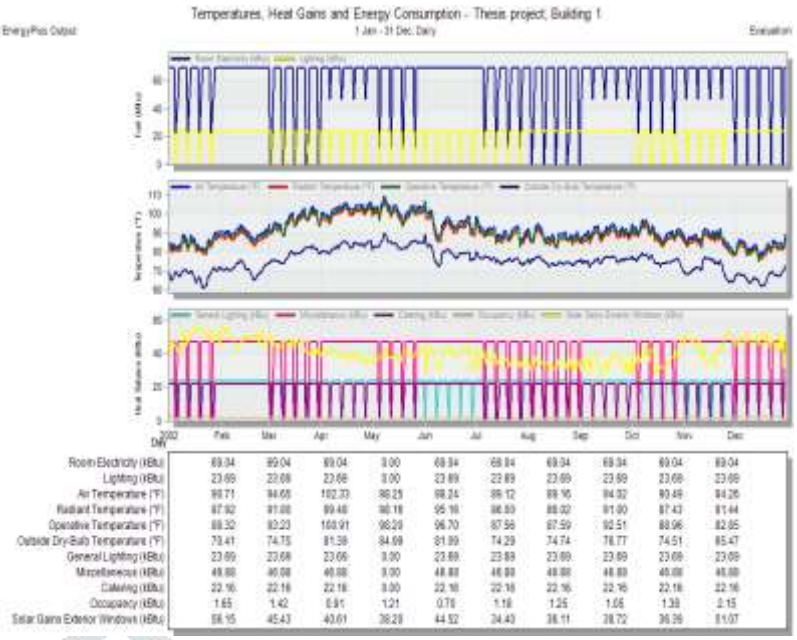
Graph 1:For -Temperature, Heat Gain and Energy Consumption for 1Bhk Flat (For AAC Block) (Source –Design Builder Software of Simulation)

Yearly energy consumption through internal equipment lighting as per simulation Report it is 28136.39 kBtu.

2.2 Yearly Energy Consumption Through Internal Equipment Lighting for EPS Panel Walling

	Electricity [kBtu]	Natural Gas [kBtu]	Gasoline [kBtu]	Diesel [kBtu]
Heating	0.00	0.00	0.00	0.00
Cooling	0.00	0.00	0.00	0.00
Interior Lighting	7752.85	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00
Interior Equipment	22342.62	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00
Total End Uses	30095.47	0.00	0.00	0.00

Table 9:Yearly Energy Consumption in kw/hr. 1BHK Flat (For EPS Panel) (Source: Design Builder Software of Simulation)



Graph 2:For -Temperature, Heat Gain and Energy Consumption for 1Bhk Flat (For EPS Panel)(Source –Design Builder Simulation)

Yearly energy consumption through internal equipment lighting as per simulation report it is <u>30095.47 kBtu.</u>

2.3 Electrical Layout for Energy Consumption Through Internal Equipment Lighting for Aerocon Panel

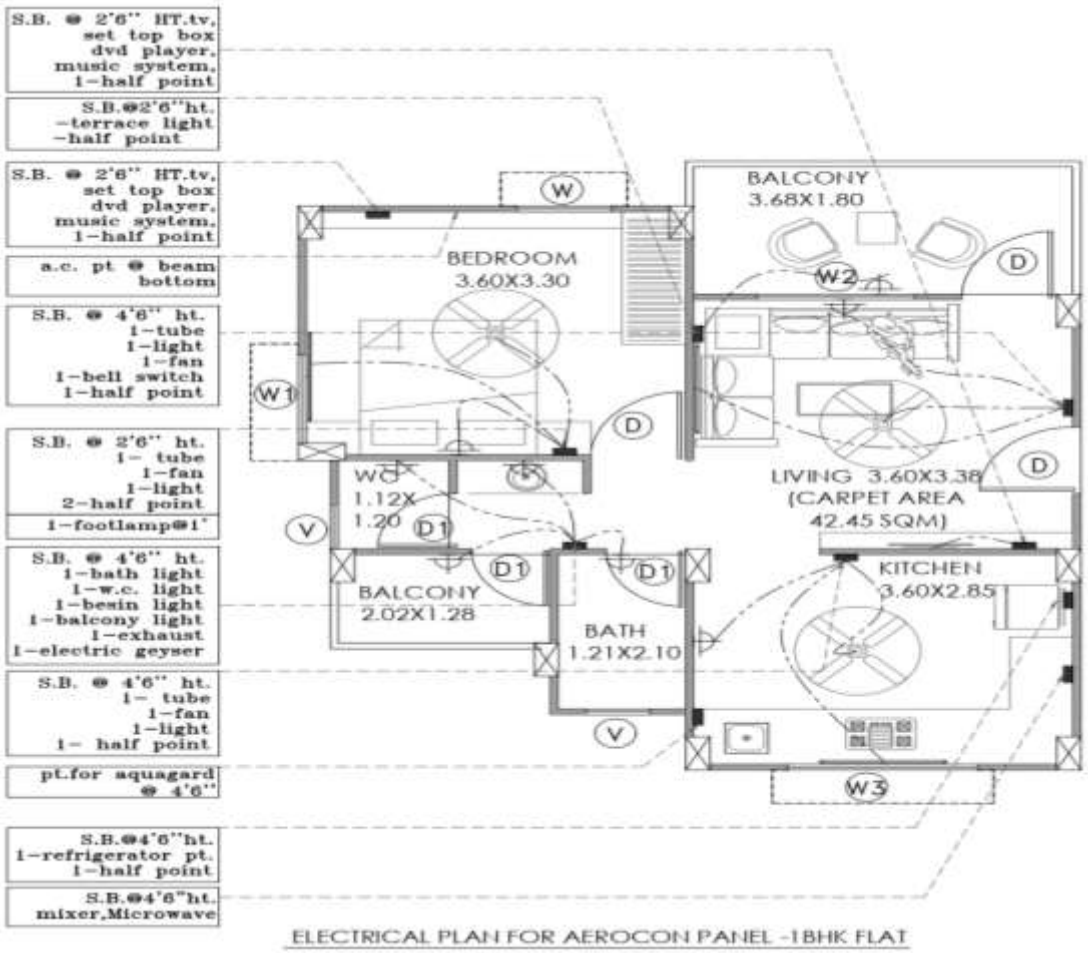
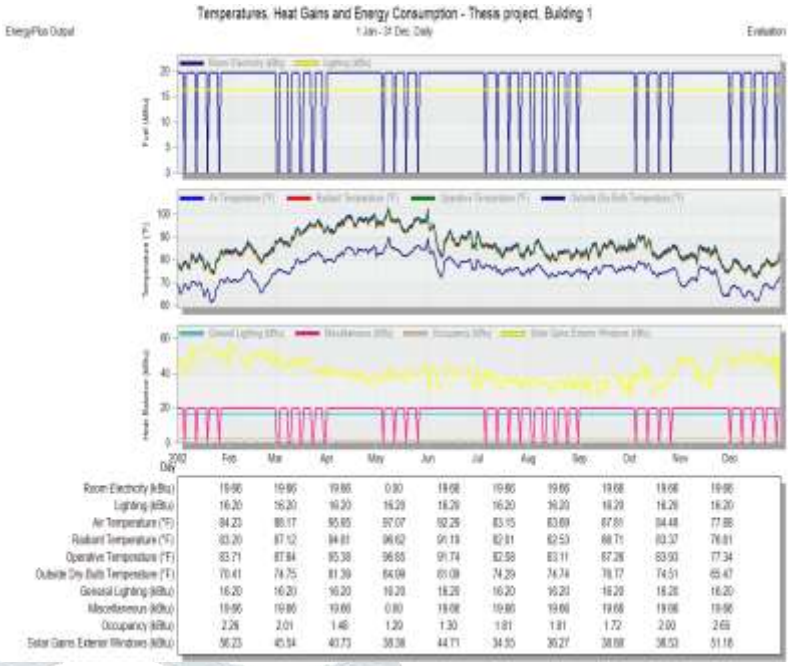


Figure No 10: Electrical Layout For Aerocon Panel walling Construction for simulation

2.3.1 Yearly Energy Consumption Through Internal Equipment Lighting for Aerocon Panel Walling

	Electricity [kBtu]	Natural Gas [kBtu]	Gasoline [kBtu]	Diesel [kBtu]
Heating	0.00	0.00	0.00	0.00
Cooling	0.00	0.00	0.00	0.00
Interior Lighting	5916.12	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00
Interior Equipment	6393.66	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00
Total End Uses	12309.78	0.00	0.00	0.00

Table 10:Yearly Energy Consumption in kw/hr. for 1Bhk Flat (For Aerocon Panel) (Source –Design Builder Software of Simulation)



Graph 3:For -Temperature, Heat Gain and Energy Consumption for 1Bhk Flat (For Aerocon Panel)(Source –Design Builder Software of Simulation)

Yearly energy consumption through internal equipment lighting as per simulation Report it is 12309.78 kBtu.

2.4 Comparison and Result for ENS: By Calculating the Yearly Energy Consumption of Selected Walling Materials

Sr.No.	Wall Material	Yearly Energy Consumption in kBtu
1	AAC Block Construction	28136.39 (Refer 2.1& 2.1.1)
2	EPS Panel Construction	30095.47 (Refer 2.1& 2.1.2)
3	Aerocon Panel Construction	12309.78 (Refer 2.3& 2.3.1)

Table 11: Comparison and Result for ENS: By Calculating the Yearly Energy Consumption of Selected Walling Materials

Result

Aerocon panels have shown to be more energy-efficient for internal equipment and lighting, with a yearly consumption of 12309.78 kBtu. which is minimum as compare to other two wall materials. Therefore The lower energy consumption with Aerocon panels highlights their effectiveness in enhancing building energy efficiency. Also energy consumption can lead to cost savings and a reduced carbon footprint over the building's lifecycle.

VI. Conclusion

From the results (Refer 1.4 and 2.4):The conclusion for simulating the lux level or light intensity for the suggested 1BHK flat model and yearly energy consumption through internal equipment lighting of selected walling materials for the suggested 1BHK live flat model is that

- The lux levels are 166 lux, 160 lux, and 166 lux, which are suitable **for all three selected walling materials** (refer to 1.4)
- Yearly Energy Consumption Through Internal Equipment The lighting of selected walling materials shows **that Aerocon panels consume 12,309.78 kBtu annually for internal equipment and lighting, the lowest among the other three wall materials** (Refer 2.4).This efficiency enhances building energy performance, leading to cost savings and a reduced carbon footprint.

From the above conclusion of ENS, Aerocon panels present a superior precast walling solution compared to EPS panels and AAC blocks. They offer lower costs, better light transmission, and superior energy efficiency. While EPS panels excel in insulation, their environmental drawbacks including non-biodegradability, styrene emissions, and high energy consumption make Aerocon panels, crafted from natural materials with efficient production, the more sustainable choice.

VII. Refrences

- Prefabricated Fibre Reinforced Sandwich by BPMC PACS
- Manual for Expanded Polystyrene(EPS) Core Panel System and its field Application Sponsored By Ministry of Housing and Urban Poverty Alleviation, Government of India.