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Comparative Study of Cost of EPS with Regular Construction Materials

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Abstract - Expanded Polystyrene (EPS) core based composite panel system is a promising construction technique for mass housing projects as these buildings are light weight, energy efficient and can be easily handled and erected. EPS core based composite panels consist of a layer of self-extinguishing EPS sheet (of variable thickness; not less than 60mm) sandwiched between two layers of concrete/structural plaster with welded wire mesh reinforcement of 2.5mm to 3mm diameter. The wire mesh reinforcement on the two sides is interconnected using galvanized steel wire connectors of 34mm diameter, pierced completely through the polystyrene core for increasing the strength. The panels are finished on the site by applying mortar or by shotcreting on both sides. The use of EPS at the core reduces the weight of the structure thus making it seismically more efficient and also acts as insulation against thermal, acoustics and vibration. The aim of the study was to determine the cost of an EPS model and compare it with conventional method of construction i.e. RCC construction. The methodology involved construction of a 161 sq.m. (G+1) 2BHK house using EPS, measurement of wastes generated and costing several elements of the building. The result of this research proves that the use of EPS for residential building construction is more economical in the long run and that much benefit will accrue to the stake holders in the built environment.

***Key Words*:** EPS, shotcreting, RCC, estimate, etc.

1. INTRODUCTION *(Size 11, Times New roman)*

Due to the rapid increase of population, the construction industry is facing a new challenge. This challenge is to construct new, cost-effective building systems to satisfy the tremendous demand for low-cost housing. The building systems must be structurally stable, should allow fast and easy erection with unskilled labors and provide good thermal and sound insulation. They must also make use of prefabricated elements produced on an industrial scale and use local materials (thus making it low- cost). Traditional building systems like concrete, steel or prefab only partly comply with these requirements. Due to these inadequacies of the existing traditional building construction systems, there is need for new kind of building construction techniques that will cater to the present needs. In the recent times, there has been inception of a few new methodologies in the construction industry. Of the various types of systems evolved recently, the composite panels are one that is widely used for serving the desired purpose. Composite panels are generally made of an insulating layer sandwiched between two layers of wythes. Composite sandwich panels are being extensively and increasingly used in building construction because they are light in weight, energy efficient, aesthetically attractive, and can be easily handled and erected. In the modern day construction industry, different types of composite systems are used for construction of load-bearing walls, slabs and other structural elements. This study is focused on the comparison of properties of composite panels with EPS core sandwiched between two layers of concrete wythes and welded wire mesh embedded in each concrete layer with the conventional concrete.

Fig –1: EPS Wall Panel

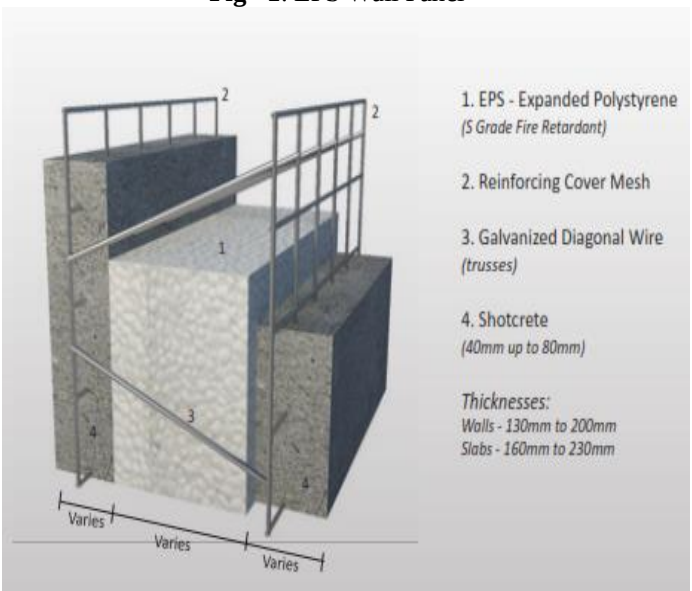


Fig –2: Cross Section of EPS Block

2. OBJECTIVES OF THE RESEARCH

i. To study the EPS core panel system for construction of affordable housing.

ii. To compare the cost incurred when construction done using expanded polystyrene panels and conventional methods.

3. RESEARCH SCOPE

The government of India has launched various ambitious welfare and development programs in order to provide housing for all by 2022. Under this scheme, affordable houses will be built in selected cities and towns using eco- friendly construction method for the benefits of the urban poor population in India. Expanded Polystyrene core panel system is one of emerging technology adopted to provide housing for all by 2022 in Pradhan Mantri Awas Yojana (PMAY). We can also suggest the local builders that they can also use the Expanded Polystyrene in the construction if there's a client wanted a house in pretty low cost. We also suggested our college an expansion of the canteen n expanded polystyrene and a staff quarter that will be a G + 1 Building.

4. CONSTRUCTION METHODOLOGY

i. Foundation and connection of wall - The EPS core based composite panel buildings can be built on any foundation. The first step in connecting the walls to the foundation is to cast the starter bars into the foundation according to the structural engineering requirements. The panel is usually placed so that the rebar is set between the reinforcing mesh and the polystyrene. This ensures easy and precise wall alignment. A damp proof layer is applied under the wall panel.

ii. Erection of wall panels - Erection of the panels always starts at the corners to achieve the required rigidity. Individual panels are connected together using a splice mesh on both sides. This is done by using a manual or pneumatic fastening tool

iii. Reinforcing panel splices - Panel walls are reinforced by splice mesh. This is normally required at the corners, between panels and around openings. This creates continuous mesh reinforcement. Reinforcing ties and bars are used at building element junctions to add strength to joints.

iv. Forming openings - Openings for doors and windows can be easily cut on site to specific size as per details. Splice mesh is placed at each corner for consolidation. Extra rebars need to be included for large openings. To reduce wastage, the panels remaining from openings can be easily used as filler panels in the wall segments.

v. Shoring and placing of slabs - The panels can be used as any roof and floor slabs between storeys. Shoring is to be carried out using adjustable props using tripods and beams. Slab panels are reinforced with adjustable reinforcing bars at the bottom, U-bars at the supports and splice mesh at the corners. Slab panels are lifted manually and placed on the wall panels.

vi. Shotcreting - Concrete is placed onto the walls and underside of the slabs using a shotcrete pump. Although the normal procedure is to apply shotcrete in two layers, the application can also be carried out in one single coat. Screed points of concrete are used as gauges to give correct thickness and lines. Hand trowel finishing of the second layer is required to give the appropriate finish and surface tolerance.

vii. Finishing - The final step is to apply finishing material. Various finishes can be applied, both internally and externally.

5. DESIGN PHILOSOPHY

i. The design shall satisfy the standards of IS 456, IS 1905, IS 11447, IS 875 (Part 1-5), IS 1893 (Part 1), IS 4326, IS 13920.

ii. Cutting drawings shall be prepared with clarity to facilitate the cutting at the manufacturing plant of the various wall or floor panels to appropriate sizes. In case of wall panels opening for doors, windows etc. shall be suitably marked in the respective panels.

iii. When the panels are to be cut at the factory in accordance with the cutting joints, these shall be suitably marked on the surfaces beforehand to facilitate correct identification for proper placement during erection at the construction site.

iv. In construction using EPS panels as load-bearing structural walling, the walls in the ground floor shall be typically founded on the reinforced concrete (RC) plinth beam.

v. Appropriate starter bars shall be embedded at the locations in a staggered way to a minimum specified distance. This ensures the connections of the super structure with the foundation spread over the entire wall length over the network of RC plinth beams.

vi. Plinth beams shall be supported on appropriate foundations, typically comprising spread footings or raft foundations suitably designed.

vii. In the case of multi-storey buildings in high seismic zone, the design and detailing shall ensure proper transfer of base shear at the interface of the foundation and the super structure.

6. PROVISIONS MADE IN THE ESTIMATE

i. Excavation in soil, SM, HM
ii. PCC for bedding
iii. RCC footing for columns
iv. RCC columns.
v. RCC beams lintels
vi. RCC slab
vii. BB masonry for plinth & super structure
viii. MS grillwork and MS rolling shutters
ix. Aluminum sliding shutters
x. Internal plaster, wall putty & outer plasters
xi. Internal & outer colour
xii. Vitrified tiles for flooring

7. ESTIMATE ANALYSIS

As many researchers many scholars have claimed that EPS as a material is very much cheaper than the conventional and regular material we decided to did an estimation analysis we prepare a detailed estimates to study those claims. Firstly our college's canteen was proposing the extension and that's why we decided to propose the estimate. Then incase in future if our college decides to build a staff quarter or a warehouse or even a guest house we decided to prepare a detailed estimate of G + 1 building.

i. Cost Comparison between canteen made in EPS material and in Regular Construction material sized 20 x 30 ft. which is an extension to the existing one of our college that is MGI – COET Shegaon.
ii. Cost Comparison between a Guest House / Staff Quarter G + 1 is Colleges plan to have such building in our college in the near future.
iii. Our Canteen owner wanted an extension to the existing one so we decided to do the estimation analysis.
iv. Then later on we decided if our college wants to have a guest house or a staff quarter and in order to that we did another estimation comparison of a G + 1 building with conventional materials and the Expanded polystyrene sheets and blocks.
v. The plan and the detailed estimates are mentioned in the upcoming annexure.
vi. The basic materials incorporated in SoR for innovative technology published under authority of director general, New Delhi are considered to be conforming to BIS Standards / CPWD Specifications / Materials of good quality generally available in the market. Based on Delhi Schedule of Rates (DSR) – 2018.
vii. For the cost analysis of RRC framed structure building SSR for Maharashtra state published under government of Maharashtra public works department effective from 19.09.2018.

Cost comparison of Canteen 20 ft x 30 ft extension to the existing canteen with the conventional material to the expanded polystyrene as shown in fig. -2.

Table -1: Comparison of Canteen Estimate

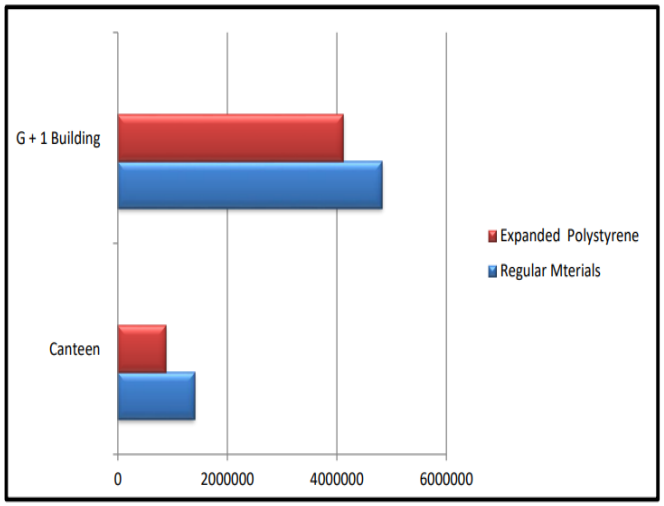
Material	Cost	% Difference
Regular R.C.C materials	1403010	
Expanded Polystyrene sheets	874028	

Cost comparison of G + 1 building of having covered area of 161 sq.m. with 2BHK on each floor extension to the ground floor with the conventional material to the expanded polystyrene as shown in fig. – 3.

Table -2: Comparison of Guest House Estimate

Material	Cost	% Difference
Regular R.C.C materials	1757226.51	
Expanded Polystyrene sheets	1449789.45	

Chart –1: Bar Chart Showing Cost Difference in %



8. CONCLUSION

After the cost comparison study many points were found out and the following comparisons were drawn:

1. EPS core panel system is a modern, efficient, safe and economic construction system for the construction of buildings. It has got the potential in achieving the Government of India's ambitious project "Housing for all by 2022"
2. The conclusion drawn from cost comparison between EPS core panel building and typical conventional RCC building of G+1 storey is that the EPS Core panel system is 19.00 % cheaper than conventional RCC construction.
3. The conclusion drawn from cost comparison between EPS core panel Canteen sized 20 x 30 ft. and typical conventional RCC Canteen is that the EPS Core panel system is 38.00 % cheaper than conventional RCC construction.

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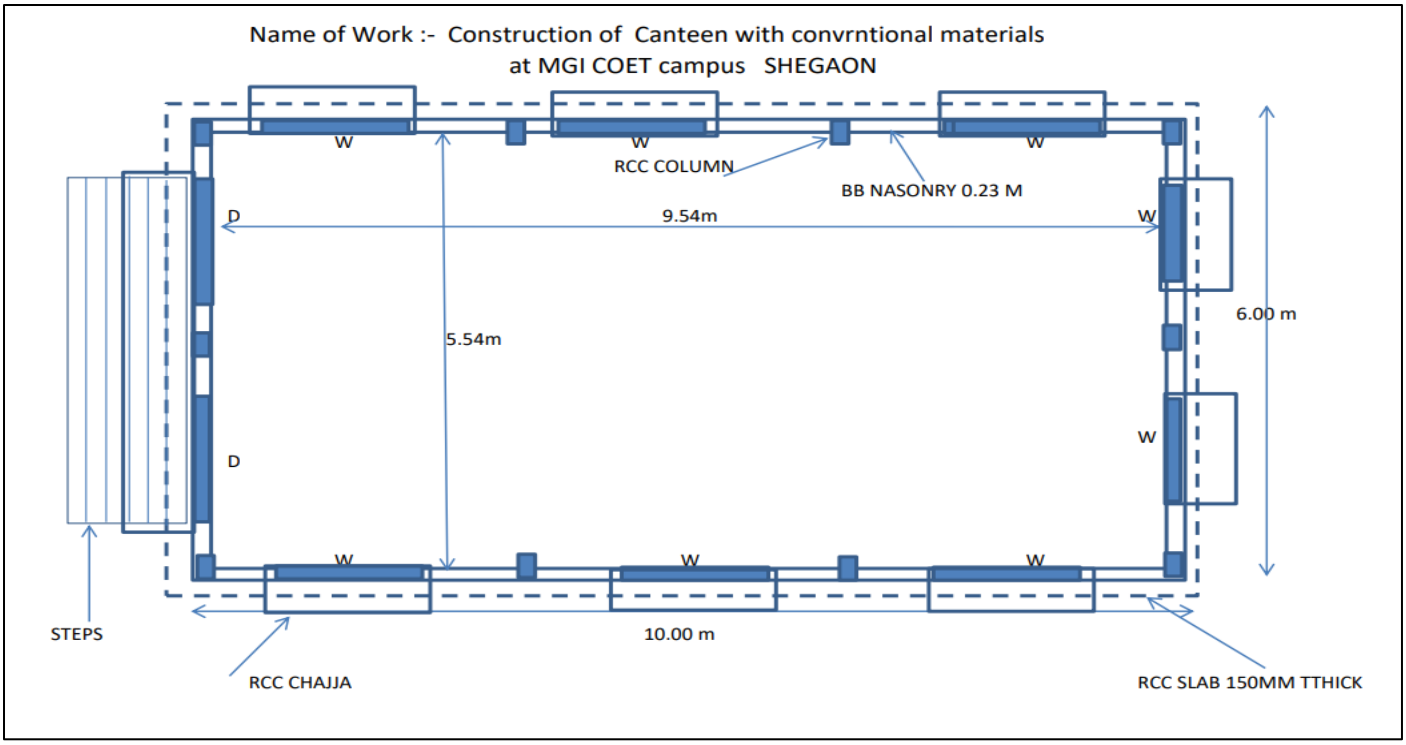

Fig –3: Plan for Canteen

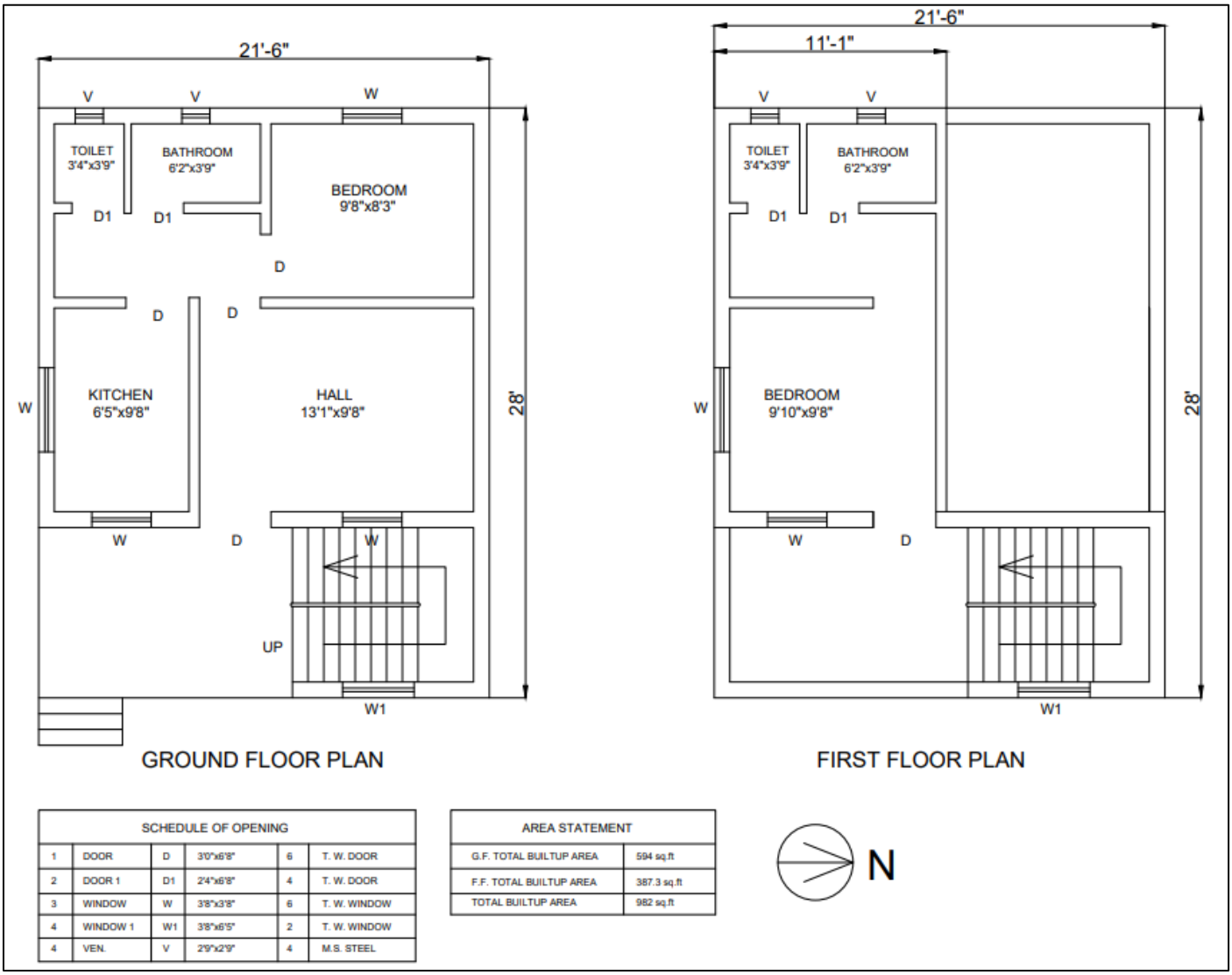

Fig –4: Plan for Guest House (G+1)

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