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EXPERIMENTAL STUDY ON EPS SANDWICH PANEL & COST ANALYSIS"- LIGHT HOUSE PROJECT

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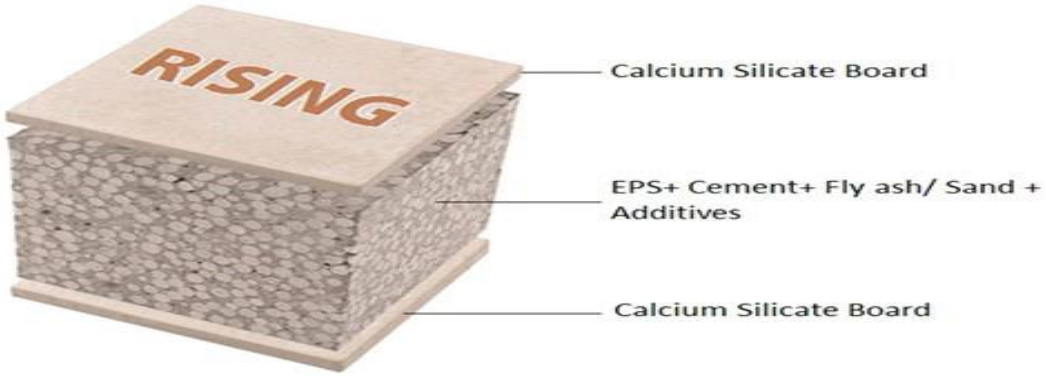
Abstract: One of the greatest problems, the world is facing today is of **"Environmental pollution and the demand for housing."** With the demand for housing and urban settlement growing, the demand for energy is also increasing with every passing year, and to cope with this increasing number of power plants are being set up. Coal based Thermal-Power plants may be cheaper, but cause huge pollution by generating poisonous gases and Fly Ash, a major source of pollution. Disposal of this **fly ash** is a huge problem today. In addition to this traditional clay bricks add to the problem. To solve these problems new technologies were needed urgently which would be environmentally friendly but should also be economical. Many organizations have been working to achieve this, and now new technologies / products have come in the market..In India, the Union Cabinet chaired by the Hon'ble Prime Minister, gave its approval for launch of **"Housing for All"** program and almost all the states, are now moving ahead with this ambitious program. Approval was given for rehabilitation of slum dwellers with participation of private developers using land as a resource; promotion of affordable housing for weaker section through credit linked subsidy; affordable housing in partnership with public and private sectors; and subsidy for beneficiary-led individual house construction or enhancement. The Technology Sub-Mission recommended to adopt design and planning based on innovative technologies and materials and green buildings with earthquake and disaster resistant technologies and designs for all projects hereinafter. The projects under **"Prime Minister Housing Scheme"** will surely use these technologies especially considering the time frame in which these house has to be made. . Rising EPS Panels Building Systems are now the favorite product of building industry world over. Be it a small house in a village or a sky scraper in modern city.

CHAPTER I INTRODUCTION

One of the greatest problems, the world is facing today is of **"**Environmental pollution and the demand for housing**."** With the demand for housing and urban settlement growing, the demand for energy is also increasing with every passing year, and to cope with this increasing number of power plants are being set up. Coal based Thermal-Power plants may be cheaper, but cause huge pollution by generating poisonous gases and Fly Ash, a major source of pollution. Disposal of this **fly ash** is a huge problem today. In addition to this traditional clay bricks add to the problem. To solve these problems new technologies were needed urgently which would be environmentally friendly but should also be economical. Many organizations have been working to achieve this, and now new technologies / products have come in the market.The Technology Sub-Mission recommended to adopt design and planning based on innovative technologies and materials and green buildings with earthquake and disaster resistant technologies and designs for all projects hereinafter. The projects under **"Prime Minister Housing Scheme"** will surely use these technologies

especially considering the time frame in which these house has to be made. This will help building industry and shall construct housing with environmentally friendly material. **This will use Fly-Ash or Sand as main raw material** thereby helping the society and Government to deal with the problem of disposal of fly-ash effectively and also save money. Rising EPS Panels Building Systems are now the favorite product of building industry world over. Be it a small house in a village or a sky scraper in modern city.



Rising EPS Cement Panels

1.4 Objective

1) LHPs are model housing projects with houses built with shortlisted alternate technology suitable to the geo-climatic and hazard conditions of the region.
2) This will demonstrate and deliver ready to live houses with speed, economy and with better quality of construction in a sustainable manner.
3) By reducing waste,pollution, and environmental degradation.
4) Better fire resistance & thermal efficiency.
5) Low maintenance,minimum life cycle cost.

CHAPTER II LITERATURE REVIEW

[1] Collins (1954) presented a project from the early 1900s. This is the earliest documented project completed using sandwich panel construction. At the time, the new tilt-up sandwich panel system was a novelty to designers and contractors. The panels were constructed by pouring a 2-in. layer of concrete while embedding steel ties into the concrete wythes. Steel tie configuration is unknown. After the concrete cured, a 2-in. layer of sand was poured across the panel on top of which a second 2-in. layer of concrete was poured. After an unspecified amount of time, the panels were tilted on an angle at which the sand was washed out of the panel with a fire hose leaving an air gap between the inside and outside wythes. This air gap created a simple thermal barrier. After the sand was washed out of the panel, it was tilted upright and fixed into place.

[2] Adams et al. (1971) outlined design procedures for precast concrete wall panels that standardized this procedure for designers. The design procedure covered the design of solid, ribbed, hollow core, and sandwich panel walls. The design approach to sandwich panel walls, as indicated by the committee, is to use an “effective section” approach. The recommendation was made that “shearing stress should not be transferred through the nonstructural insulation core. Compressive stress and bending stress should be carried by the concrete sections only (Adams et al. 1971).” The outside wythes of concrete were connected using mechanical steel shear ties or by monolithically cast concrete ribs. It was recommended by the committee that insulation used be either a cellular or mineral based aggregate in lightweight concrete.

[3]Mohammad Z. Kabir(Jul -2019) worked on, “Mechanicalproperties of EPS wall panels under shear and flexuralloading” EPS wall panels are used in construction ofexterior and interior bearing and non load bearing wallsand floors of building of all types of construction. Thepresent paper investigates the mechanicalcharacteristics of EPS wall panels under static shear andbending loads in order to improve better understandingof their structural components. The numerical model isloaded in increments to simulate the

tests and to allowdetection of failure in flexural tests for vertical andhorizontal bearing panels and also for direct shear aswell. The load displacement curves resulting from finite
element analysis are very similar to those testedspecimens.

[11] Nathan Koekoek (**2019)**worked on this paper has illustrated sandwich panel technology and Easy panel having a number of advantages over ordinary onsite production. Easy Panel has been designed to enjoy the advantages of sandwich panel technology - strength in combination with low weight - in accordance to the specific demands of property construction.This leads to greater efficiency and speed benefits.Fewer resources are being wasted and projects are finished sooner allowing for a quicker return on investment. Society also enjoys from these efficiencies, by reduced environmental impact as a result of more efficient production and better insulation. Also, Easy panel franchising model of turn-key delivery enabling the opportunity to quickly enter a local market when demand is being observed reduces potential inefficiencies related to transportation. All these make that negative implication of prefab offsite production could be reduced - or even disappear.

[4]Omid Rezaifar (2019)worked on ., "Nonlinear dynamic behavior of structural frames constructed with EPS wall panels with Vertical Irregular arrangement". The current study investigates the hysteresis behavior for combined systems, RC frame, and pre-cast EPS wall sandwich panels, in non-linear material properties. The seismic behavior of building constructed by EPS wall panels is studied for absorb of energy and dissipation of it with material nonlinearities. The results are compared regular bending RC frames to complete box type shotcrete sandwich panels system and present the differences of hysteresis behavior for each system and any of cases with irregularity in vertical stiffness such as soft story. In this study, material nonlinearity simulated with Drucker-Prager failure criteria.

CHAPTER II METHODOLOGY

The methodology worked out to achieve the above mentioned objectives is followed as shown in the flowchart below:

Performance Measures and Functional Integration

The following parameters should be considered to measure the performance of EPS panels, based on the physical characteristics:

1. Safety - Shear, axial, bending, tension, point loads, surface loads, impact loads, lifting & transportation loads etc.
2. Dimensions - Shape, size, thickness & tolerance
3. Durability - Surface material, degradation, moisture penetration & corrosion
4. Energy - Thermal conductivity (performance)
5. Fire - Smoke, fuel, flame spread etc.
6. Functions - Visual assess, acoustic, pipes, conduits, fixtures,
7. Aesthetics - Surface material, colour, texture etc.
8. Connectivity - With other walls, floors, roofs, openings etc. 9. Handling - Transportation, lifting, settling etc. To meet out the above requirements, various codes and manuals are available, as per the requirement, the relevant code may be referred. However, some standard tests should be done for the basic materials i.e. cement, sand, stone aggregate, water, reinforced cement concrete (RCC), steel bars, welding work, EPS, shotcrete etc., either in field or in laboratory as per requirement.

INSTALLATION OF EPS CEMENT PANEL & JOINTING

Installation of Panels

• Receipt and inspection of Panels Once the panels are received, it should be checked if the edges are safe and also there are no cracks or damages on the surface of the panels which can happen during transportation and handing.

• Laying of panels as per drawings Once panels received are as per the drawings, then it should be separated and laid down as per the drawings for easy installation and to avoid extra handling.

• Marking and sizing the panels Once panels are placed at the proper place, marking should be down as per drawing and proper sizing should be cut of the required panels as per the drawings.

• Actual installation as wall The panels are lifted and placed as per the drawings. For installation of the panels, following points should be considered: 2.1 Joining of panels with each other

• The panels shall be placed at the marked space and adjusted together. Dust should be cleaned on the tongue and groove of the panel to be installed. Cement mortar shall be applied and glue filled in the gaps on the panel joining parts and force them together to form one panel. Levels of both panels shall be checked.
• The panels shall be fixed with steel bar between each other or between the panels and the floor to lock them together.
2.2 Typical Joint between two panels side by side:
• The panels shall be fixed with dowel bars and the bars inserted in one panel at 45° and hammer it down to lock both the panels.
2.3 Typical joint with floor: • The panels shall be placed on floor, cement and glue applied between panels and floor and L type steel bars inserted through the panels edge at 45° in the floor. The panel will then be locked to the floor.
2.4 Typical L and T joint with panels:
2.5 Joining of upper and lower panels together:
• The panels shall be placed one over the other vertical/ horizontal after applying cement and glue. The steel rod shall be inserted from the sides of the panels into each other to join them together and locked.
• A wall of these panels shall be inter-connected with steel bars inserted at 45° and fixed with cement and glue in between panels.
2.6 Connecting panels with RCC pillar/RCC Walls/RCC beams:
• For connecting these panels with RCC pillars, the panels shall be placed with the pillar after applying cement and glue on the side of the panels and pushed to make the perfect position. Following are three types of connections depending on the situation: Steel rods/screw or bolt shall be inserted in the pillar and the panels locked with the help of the above. Thus the panel will be fixed and becomes part of wall connected with pillars. 2.7 Wall head fixing:
• Dowel bar of 250mm length and 8mm dia shall be fixed into pre-drilled hole of the panels and lock the panel to the overhead beams or RCC roof slab.
2.8 Fixing panels to the Steel frame (Pillars & Beams)
• Connection of wall panel to RHS column Steel L-angle/C Channel/Z channel shall be welded to the side of RHS column and the panel inserted inside the angle/channel and locked. The thickness of the panels shall determine the size of angle/ channel.

CHAPTER V EXPERIMENTAL PROCEDURE

5.1.4 Physical Specifications

Items Panels	**Length MM**	**Width MM**	**Thickness MM**	**Density Kg / m2**
Sandwich Panel	2440	610	60, 75, 90, 120 150, 180	45, 54, 63, 81, 99, 117
Solid Panel	2440	610	60, 75, 90, 120 150, 180	41, 51, 61, 81, 101, 121
Hollow Panel	2440	610	90, 120, 150, 180	33, 52, 65, 77

5.2.2Unit Weight Or Dry Density Test

SR.No	Size Of Panels L*B*T	Mass of Specimen (Kg)	Mean	Dry Density (Kg/m3)
1	2240*610*60	51.45	51.47	576.4
2		51.26		
3		51.7		
1	2240*610*90	79.13	78.68	587.4
2		78.4		
3		78.51		

1	2240*610*120	106.27	106.59	596.8
2		106.66		
3		106.75		

5.2.3 Flexural Strength Test

SR.No	Size Of Panels L*B*T	Flexural Strength Test After28 days	Mean (Mpa)
1	2240*610*90	1.53	1.53
2	2240*610*90	1.56	
3	2240*610*90	1.52	
1	2240*610*120	1.6	1.62
2	2240*610*120	1.65	
3	2240*610*120	1.61	

Cost comparison between brickwork and EPS panel

Sr No	Material Decription	Quantity	Unit	Rate	Amount	Remark
1	**BRICKWORK**					
	Bricks(100mm)	510	Nos	7	3570	2% Wastage
	Mortar(1:6)	0.2305	Cum		0	
	Cement	0.967309714	Bag	350	338.5584	2% Wastage
	Sand	0.227207143	Cum	1485	337.4026	15% Wastage
2	**PLASTER(12mm Thk)**	0.012	Cum		0	
	Cement	0.050358857	Bag	350	17.6256	2% Wastage
	Sand	0.011828571	Cum	1485	17.56543	15% Wastage
	Labour	1	LS	300	300	
	Water Including Curing		LS		916.2304	
	Total				5497.382	Per Sq.m

Sr No	Material Decription	Quantity	Unit	Rate	Amount	Remark
1	**EPS PANEL**					
	Panel(120mm)	1	Sq.m	1048	1048	2% Wastage
	Mortar(1:6)	0.0018	Cum		0	
	Cement	0.007554	Bag	350	2.64384	2% Wastage
	Sand	0.001774	Cum	1485	2.634814	15% Wastage
	PLASTER(12mm Thk)	**Not Required**	Cum			
	Cement		Bag	350	0	2% Wastage
	Sand		Cum	1485	0	15% Wastage
	Labour	1	LS	300	300	
	Bonding Aent	0.05	Lit	400	20	
	Water		LS		274.6557	2% of overall cost
	Total				1647.934	Per Sq.m

CONCLUSION

As we are compared the results of EPS Panel with conventional Brick Panel.The results of EPS Panel are better than the conventional Brick Panel.The Compressive Strength of the EPS Panel is more than the Conventional Brick Panel.The Flexural Strength of EPS Panel is more than the Conventional Brick Panel.Water Absorption of EPS Panel is less than the conventional Brick Panel; therefore we are assured that EPS Panel has less water absorption capacity.

This technology reduces cost of construction and significantly minimizes the building time. In the development of new low energy, low cost, environmentally, ecofriendly and ecologically sound housing solutions for the 21st century, EPS wall panel is the ideal product for re-housing and for new housing or industrial construction.

As compared to conventional building method it is less time consuming & also cost effective. Also it saves major building materials. It is very useful where the other building materials are not easily available. It is environment friendly. EPS wall panels are useful where there is need of quickly rehabilitation. It has also has less density than conventional methods. So it is more advantageous and light in weight.

The conventional method of construction using brick or stone masonry is more labor intensive, labor proved to be more costly than using EPS wall panel technology. EPS panels are most suitable for thermal insulated wall due to the presence of polystyrene in the panel. All the above properties make EPS panels as the best suitable replacement for conventionally adopted wall construction methods.

REFERENCE

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