

Cost Comparative Study of Conventional and Cost-Effective Construction Materials

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ABSTRACT: Construction cost in India is increasing at around 50 per cent over the average inflation levels. It has registered increase of up to 15 per cent every year, primarily due to cost of basic building materials such as steel, cement, bricks, timber and other inputs as well as cost of labour. As a result, the cost of construction using conventional building materials is becoming beyond the affordable limits particularly for low-income groups of population as well as a large cross section of the middle -income groups. Therefore, there is a need to adopt cost-effective construction methods either by up-gradation of traditional technologies using local resources or applying modern construction materials and techniques with efficient inputs leading to economic solutions. This has become the most relevant aspect in the context of the large volume of housing to be constructed in both rural and urban areas and the consideration of limitations in the availability of resources such as building materials and finance. In this study cost effectiveness of various innovative materials with conventional materials is studied for a building by designing and cost estimation. Use of Expanded Polystyrene Wall panel and gypsum plastering has been included as the cost effective materials in place of laterite masonry and cement plastering.

KEYWORDS: Cost effective, Laterite masonry, EPS wall panel, Gypsum plastering, Cost estimation

I. INTRODUCTION

Cost effective building materials has taken off in recent year with many builders and new home owners looking for new and different methods of construction that can potentially offset energy cost. Construction of low-cost housing by using the low-cost building materials increases the access to buildings by low income group peoples. Low cost housing can be achieved by use of efficient planning and project management, low cost materials, economical construction technologies and use of alternate construction methods available. The profit gained from use of such methods can decrease the cost of construction and make the low-cost housing accessible to all. The use of low-cost alternate building materials also prevents the rise of construction cost due to use of scarce building materials which eventually increase the cost of the project. Some alternative building material can be made out of natural materials, while others can help to lower energy costs of the occupant once built. This study deals with the cost comparative study of cost effective materials and conventional materials by structural design and cost estimation of a building proposal at Malappuram, Kerala. The site is located at Kodassery, Pandikkad. In this study Expanded Poly Styrene (EPS) wall panel and gypsum plastering has been included as the innovative materials for achieving low construction cost.

II. LITERATURE REVIEW

Many studies have been conducted in introducing various low cost construction materials. Among these, EPS Wall panel and gypsum plastering have gained much popularity in the locality due to lesser dead load and quality of finishing. In various studies, it has been evident that EPS wall panel is a better alternative for the purpose of non-structural load bearing walls.

Expanded Polystyrene: Expanded Polystyrene (EPS) is a lightweight cellular plastic material consisting of small hollow spherical balls. It is an incredibly flexible material that is widely used for building and construction products. The technology has been found to be cheaper than the conventional method of construction using brick and mortar. The products consist of lightweight foam blocks made of EPS which are cut into panels (single or double depending on design requirements) prefabricated in the factory, and are stacked together to make up the desired wall shapes which are then coated with cement mix or filled with concrete. These materials are used to build single level and multilevel walls, slabs, retaining walls and under floor insulation panels for heating, cooling and sound insulation. EPS is a cost-effective material for thermal and sound insulation.

P. Poluraju, G. Appa Rao^[13] stated that axial compression strength of EPS wall panel depends on compressive strength of concrete and aspect ratio of the wall panel, whereas shear strength of EPS wire mesh panels depends on the number of diagonals (100 or 200 diagonals per square meters).



According to Piyush Bhandari ^[12] the strength of EPS panel is higher than the other conventional building material. Based on his studies, the use of Thermocol core along with wire mesh layers have helped to enhance property of precast wall panels and it is less time consuming & also cost effective than conventional building method. Also he found out that, it has less water absorption than conventional brick masonry.

Pradeepa. S *et al* ^[14] found that Reinforced Thermocol Panel offers high bending stiffness at low densities due to minimal compressive and flexural strength. The cost of the construction using thermocol lesser than conventional or traditional building material. .

Abhijit Mandlik *et al* ^[1] they performed experimental investigation of engineering properties such as compressive strength, modulus of elasticity, drying shrinkage and creep, of expanded polystyrene (EPS) aggregate concrete varying in density. Their studies showed that increase in the EPS beads content in concrete mixes reduces the compressive and tensile strength of concrete. All the EPS concrete without any special bonding agent show good workability and could easily be compacted and finished.

Liang Jichen *et al* ^[9] they performed experiment to determine the performance of gypsum of plastering in different conditions. All the Performance parameters meet the standard requirements of “gypsum plaster” (JC/T517-2004). WPM retarder can be used in gypsum plasters, which showed excellent characteristics and have bright future.

III. METHODOLOGY

Structural design and cost estimation were done for a proposed building using innovative cost-effective materials and conventional materials used in construction. A cost comparative study was conducted to find out the cost effectiveness in using innovative materials for construction.

A. Details of Building

A proposed commercial building located at Malappuram district of Kerala was chosen. The plot has an area of 2750.98m². The proposed building is two-storey building with total floor area of 763.25 m². The ground floor includes a supermarket with floor area of 259.25 m² and top floors consists of two apartments of area 118.275m² in each floor.

Table 1 Details of Proposed building included for the study

Area of Plot	2750.98 m ²
Type of Building	Commercial
Number of Floor	3 (G+2)
Total Floor Area	763.25m ²
F.A.R	0.277
Coverage	9.42%

B. Cost Effective Building Materials Used

Due to its availability, laterite stones are more popular in the locality and is being used for masonry purposes. But recently, due to many reasons the cost of laterite stones have been increased and this has resulted in the increase of cost of construction. Nowadays, people are enquiring about various cost effective materials to replace the laterite stones.

Plastering of walls is an integral part of structures for its aesthetic and protective features. Cement plastering has been the only choice of people in the locality for wall finishing purposes. Due to the increasing cost of cement and fine aggregate, the cement plastering has led to increase in the cost of construction.

There are many choices for cost-effective materials available in the market. In this study, the more popular cost-effective materials are included for the cost comparative study. Various materials used in this study are shown in the table 2

Table 2 Materials used in cost effective study

Conventional Materials	Cost effective Materials
Laterite Masonry	EPS Wall Panel
Cement Plastering	Gypsum Plastering

IV. STRUCTURAL DESIGN AND COST ESTIMATION FOR PROPOSED BUILDING

A. Structural Design



The proposed building was analysed using Staad.Pro software and various structural elements was designed manual according Indian standard specifications. Due to lesser dead load of EPS wall panel, the quantity of concrete and steel was found to be reduced compared to that of laterite masonry.

Table 3 Quantity of Steel and Concrete while using Laterite Masonry & EPS Wall Panel

Materials	Using Laterite Masonry	Using EPS Wall Panel	Difference (%)
Concrete	188.92 m ³	180.17 m ³	4.37
Steel	14825.86 Kg	13418.08 Kg	9.50

B. Abstract of Estimated Cost

A detailed estimate was prepared for the proposed building using both conventional materials and cost- effective materials. Rates as per Delhi Schedule of Rates (DSR) 2018 published by Central Public Works department of Govt. of India has been adopted to for the estimation. The abstract of estimated cost prepared is shown in table 4.

Table 4 Abstract of estimated cost

Sl. No.	Description of Work	Rate/unit	Conventional Material		Cost-Effective	
			Qty	Amount (Rs)	Qty	Amount (Rs)
1	Earth work Excavation	250.00	139.14 m ³	34785.00	135.00m ³	33775.00
2	PCC Work	8010.54	6.96 m ³	55753.36	6.76m ³	54151.25
3	Laterite Masonry	7873.36	255.01 m ³	2007754.04	0.00 m ³	0.00
	EPS Wall Panel	5300.00	0.00 m ³	0.00	255.01 m ³	1351550.93
4	Steel	115.00	14825.86 kg	1704973.90	13418.08 kg	1543079.20
5	Concrete	8000.00	188.92 m ³	1773935.00	180.17 m ³	1666015.00
6	Cement Plastering	367.00	3244.51 m ²	1190735.17	0.00 m ²	0.00
	Gypsum Plastering	471.42	0.00 m ²	0.00	3244.51 m ²	1529527.85
7	White Washing	104.04	3244.51 m ²	337558.82	0	0
8	Wall Putty	53.80	2034.36	109448.57	0	0
Total Cost			7190600.00		6178100.00	

3.5 Result and Discussion

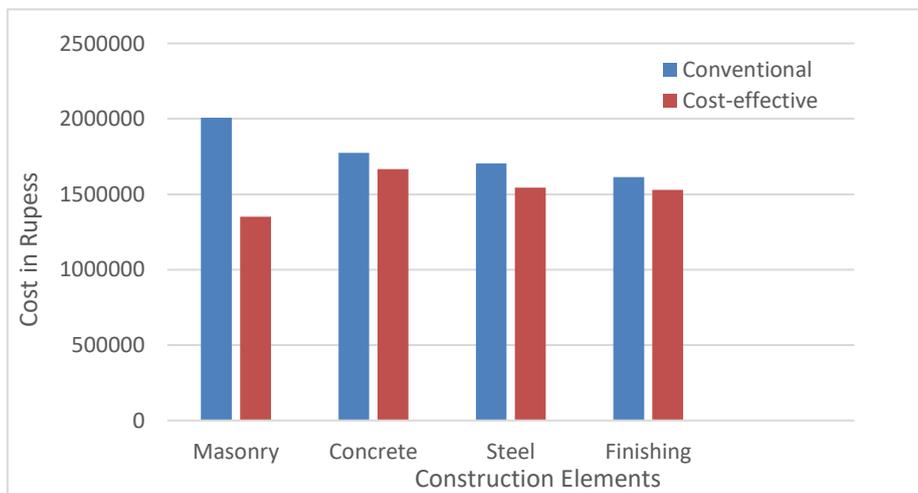


Fig 1. Graph showing cost comparison of various elements



Based on the cost comparative study, it was found that EPS wall panel is 33% less costly than laterite masonry. The difference in the cost is due to the lesser cost of EPS wall panel. Due to lesser dead load while using EPS wall panel, there was a reduction of 4.37% in concrete volume and 9.50% reduction in steel quantity. This has resulted in a reduction of 7% and 10% in the cost of concrete and steel respectively.

There is a 28.3% increase in the cost of gypsum plastering compared to cement plastering. But while using gypsum as a plastering material instead of normal cement plastering, white washing and putty works can be avoided due to its smoother finish. Hence there is a decrease of cost about 6% for wall finishing works while using gypsum plastering.

By using EPS wall panel and gypsum for masonry and plastering materials in place of conventional building materials, it was found that there is a reduction of 14.00 % in the total cost.

V. CONCLUSION

Due to the reduced availability and increasing cost, people have been forced to look for alternatives for conventionally used building materials for reducing and optimizing the construction cost. In this study, laterite blocks and cement plastering was compared with its cost-effective alternatives, EPS Wall panel and Gypsum plastering. Structural design and cost estimation was done by using both conventional and cost-effective materials for a proposed building. And a cost-comparative study was done. Even though many studies have discussed the structural integrity of these materials, local community are not convinced about the cost effectiveness. This study was done to state the cost-effectiveness while using these materials.

By using the EPS wall panel and gypsum plastering instead of laterite masonry and cement plastering respectively there was a 14.00% reduction in total cost. Hence by using the cost-effective material the construction cost can be reduced. Even though there are pros and cons to these cost effective materials and it may improve in future.

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