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Application of Value Engineering Techniques in Residential Building

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Abstract: ***The Value Engineering is an intensive problem solving activity that focuses on improving the value of the functions that are required to accomplish the Goal or Objective of any service. Value Engineering is an effective problem solving technique. Value Engineering is essentially a process which uses Function Analysis, Team Work and Creativity to improve Value. VE can be applied during any stage of a Project's Design Development Cycle. But the greatest benefit and resource saving are typically achieved early in the development and conceptual design stages. VE may be applied more than once during the life of the project. Many a times VE is confused with cost cutting exercises in construction industry. The difference between conventional cost cutting and VE is that it involves reducing the cost by improving the functionality through less consumption of energy in terms of manpower, material and machines.***

Keywords: Value Engineering, Techniques, Residential Building, Cost Reduction, Function Analysis.

I. INTRODUCTION

Value Engineering is a technique to define the developed requirements of a particular product, concerned with the calculations and the selection of less costly conditions. By Value Engineering we aim to improve the function of products and reduce the cost while assuring quality. In order to make a particular product competitive in the market, the best value is determined by two considerations, namely function and cost of the product. The value of the product can be enhanced by increasing the function or decreasing the cost or both while maintaining the performance, quality and reliability. Construction industry is an index of growth of a nation. The real estate sector in India has assumed growing importance with the liberalization of the economy. Due to increase in business opportunity and migration of labour, the demand for commercial and housing spaces has also increased. According to the tenth five-year plan, the estimate of shortage in urban housing is accessed to be 8.89 million units. As of now, the housing and construction industry employs 30 million people and about 250 industries are associated with construction industry directly or indirectly.

II. LITERATURE REVIEW

Nitin L. Rane[1] in IJESRT(July 2016) described the use of crushed sand and reinforcement couplers instead of river sand and lapping of bars which helps in cost reduction upto 50%

Sayali Dhayalkar and Himanshu Ahire[2] in IJIR(2016) mentioned about GSB and WMM which were replaced with various techniques which implements cost saving and easy in working out and contributes to 9% saving.

Chaugule Mahadev Annappa and Shrikant Pandirao[3] in IJIR(October 2016) where he used two alternatives for traditional techniques and observed 19% and 14% cost saving in total for both techniques.

Amit Sharma and R.M.Belkar[4] in WCECS(October 2012) where he applied Value Engineering for change and use of existing material and observed saving of 38.64%

Surya Teja Reddy[5] in IJCRT(2016) mentioned about cost control required to maintain throughout the project life of building and described value engineering as an intensive problem solving activity that focuses on improving the quality.

III. NEED OF VALUE ENGINEERING

To find different alternatives which can be used to reduce the cost of construction project and to improve the quality of the project by the alternatives.

IV. OBJECTIVES

A. To find different Value Engineering techniques.
B. To reduce the cost of construction by application of Value Engineering.

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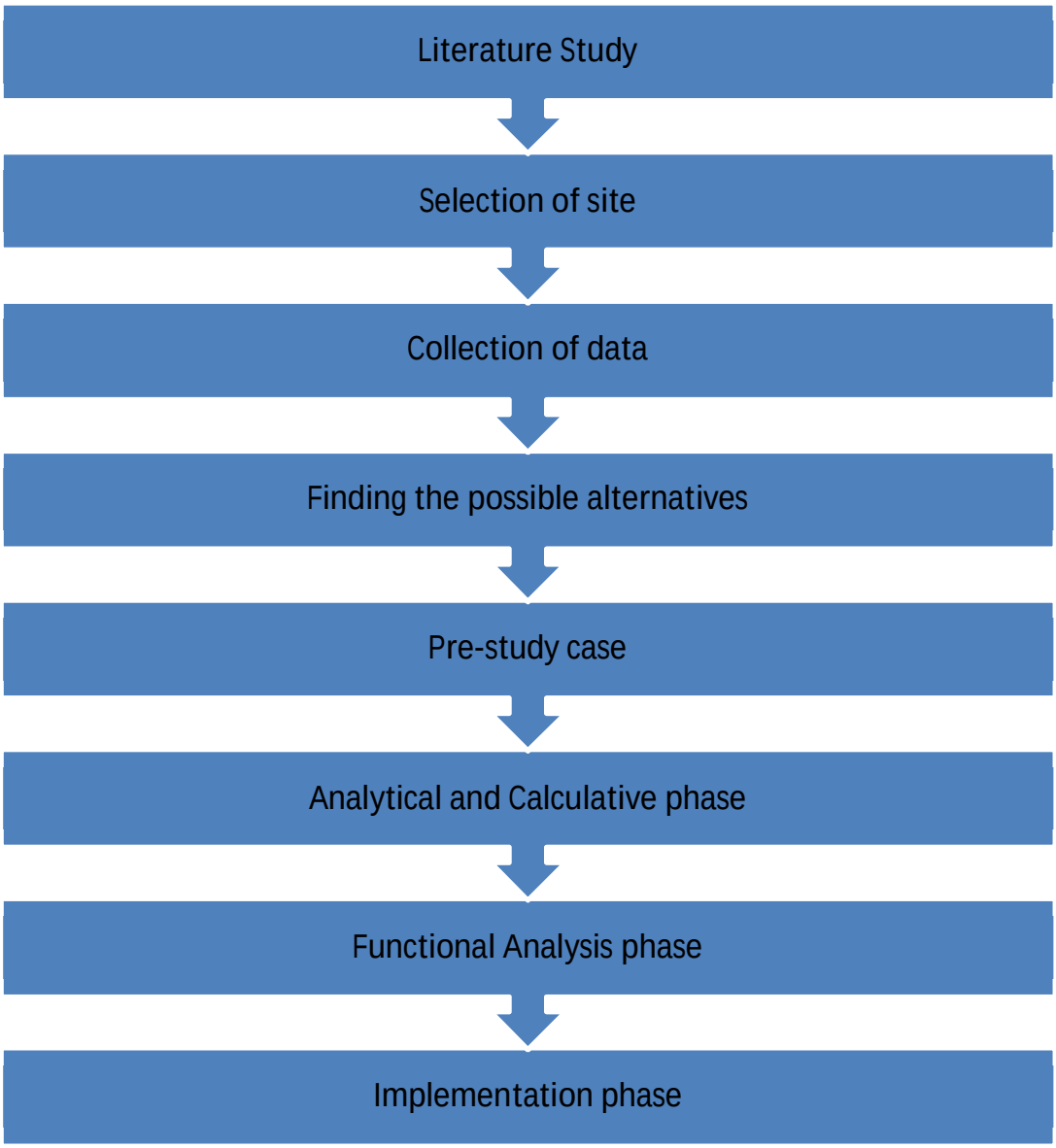
V. METHODOLOGY



The Work Breakdown Structure was as follows:

1) *Step 1:* Information Phase We collected information regarding the different Value Engineering techniques used in site, their cost model and their functional properties. We selected site located at Palghar (W) for our case study.
2) *Step 2:* Creative Phase We selected few VE techniques that can be used in the site and discussed about the merits and demerits of the selected techniques.
3) *Step 3:* Judgement Phase We finallized 5 techniques for our project and made a detailed analysis of the selected techniques, comparing the techniques with the traditional methods of construction.
4) *Step 4:* Analysis Phase We made the detailed cost calculation for our site by VE techniques as well as by tradtional methods of construction. Cost comparison was made and cost saving achieved by the application of VE techniques was calculated.
5) *Step 5:* Implementation Phase The results from our calculations were studied and acknowleged by the site engineers from the site and possiblities of real life application considering different factors was understood.

VI. SITE LOCATION

Site Location at Kanchan Universe, Palghar(West).

Fig. 01 Residential Site

VII. OBSERVATIONS

Comparison Between Traditional And Ve Techniques

ATTRIBUTE	CLAY BRICKS	AAC BLOCK
SIZE	210*150*90	600*200*150
PRECISION	5mm	1mm
COMPRESSIVE STRENGTH	25 - 30 kg/sq.cm.	35 - 45 kg/sq.cm.
DRY DENSITY	1950 kg/cum	550 - 650 kg/cum
FIRE RESISTANCE	2 hours	4 – 6 hours
PRICE	RS. 8.2	RS. 62
COMPOSITION	Clay, Sand, Lime	Lime, Sand, Flyash (65% – 68%)
SOUND DEDUCTION	40 dB	60 dB
WATER ABSORPTION	17 - 20 % by weight	10 % by weight
COLOR	Red	Grey

Table no. 1

ATTRIBUTE	SAND CEMENT MIX	FIXOBLOCKS
THICKNESS	10-15 mm	2-3 mm
CURING	Curing required	Self-curing
SHRINKAGE CRACKS	Shrinkage cracks at joints	No shrinkage cracks
DENSITY	2150 - 2250 kg/cum	1450-1500 kg/cum
WATER REQUIREMENT	W/C ratio = 0.4	25% by weight
COVERAGE	Cement = 80kg/cum Sand = 320kg/cum	41.5 kg/cum
COST OF MATERIAL	Cement = RS. 325/bag (50 kg) Sand = RS. 7000/brass (4528 kg)	RS. 750/bag (40 kg)
COST (for 10 cum of work)	RS. 1045.5/cum (per cum of brickwork)	RS. 825/cum (per cum of brickwork)

Table no. 2

ATTRIBUTE	ORDINARY PLASTER	READY MIX PLASTER
THICKNESS	12mm for Internal 18mm for External	10 – 12 mm
DENSITY	2200 kg/cum	1400 -1700 kg/cum
WASTAGE	High Wastage	Very Less Wastage
SHRINKAGE CRACKS	High shrinkage cracks	Very Less shrinkage cracks
QUALITY	Manual mixing Fast application	Consistent quality due to computerized mixing & tested raw material
APPLICATION TIME	More Time is Required	Fast application
COVERAGE (for 1 square feet)	Internal Cement=1.53sq.ft/kg, Sand=0.38sq.ft/kg External Cement=1.92sq.ft/kg, Sand=0.32sq.ft/kg	16-17 sq. feet/kg
COST OF MATERIAL	Cement = RS. 325/ bag (50 kg) Sand = RS. 7000/brass	RS. 400/bag of 40 kg
COST	Internal = RS. 8.46/sq. feet External = RS. 9.08/sq. feet	RS. 0.625/sq. feet
WATER REQUIREMENT	W/C ratio = 0.4	17 – 19 by wt

Table no. 3

ATTRIBUTES	ACRYLIC WALL PUTTY	COLOR PUTTY
BRAND NAME	ASIAN PAINTS	WALL PLAST
COMPRESSIVE STRENGTH	1.5 – 2 N/sq.mm	1.5 – 2 N/sq.mm
TENSILE STRENGTH	0.5 – 1 N/sq.mm	0.5 – 1 N/sq.mm
COLOR	White	Green, Yellow, Pink, White
COVERAGE	20 sq.ft./kg	15 sq.ft./kg
PAINT SAVING	-	Upto 50%
RECOMMENDED MIXING	Not Required	340 ml of water/kg
STATE	Liquid	Solid
PRICE	RS 60/kg	RS 29/kg
LAYER OF PAINT REQUIRED	2	1

Table no. 4

ATTRIBUTE	SAND CEMENT PASTE	TILE ADHESIVE
LAYER THICKNESS	Flooring: 20-25 mm Tiling: 12-15 mm	Flooring: 2-3 mm Tiling: 2-3 mm
ADJUSTABILITY	5-10 mm	10-15 mm
QUALITY CONTROL	Required	Less Required
HACKING	Required	Less Required
COVERAGE AREA	Flooring: Cement= 1.22 sq.ft./kg Sand= 0.35 sq.ft./kg Tiling: Cement= 1.53sq.ft/kg Sand= 0.38sq.ft/kg	2.5 sq.ft./kg
COST OF MATERIALS	Cement= RS. 325/bag (50kg) Sand= RS. 7000/brass	RS. 430/bag (40 kg)
COST	Flooring= RS. 11.04/sq. feet Tiling= RS. 8.46/sq. feet	Flooring= RS. 4.3/sq. feet Tiling= RS. 4.3/sq. feet
DENSITY	2000 kg/cum	1600-1700 kg/cum
WATER REQUIREMENT	W/C = 0.4	Flooring = 20 – 22 % by weight Tiling = 27 – 29 % by weight

Table no. 5

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VIII. CALCULATIONS

A. AAC Blocks

Total brickwork quantity required = 150.9124 cum
Cost of 1 clay brick = RS. 8.2
Cost of 1 AAC Block = RS. 62
Total no. of clay bricks required = 53250
Total no. of AAC Blocks required = 8400
Total cost of brickwork using clay bricks = RS. 436,650/-
Total cost of brickwork using AAC Blocks = RS. 520,800/-

B. Fixoblocks

Total cost of sand cement mix = RS. 1045.5 / cum
Total cost of Fixoblocks = RS. 825 / cum
Total quantity of brickwork required = 150.9124 cum
Total cost of brickwork using sand cement mix = RS. 160,000/-
Total cost of brickwork using Fixoblocks = RS. 124,500/-
Cost Saving = RS. 35,500/-
% Saving = 22.18

C. Ready Mix Plaster

Total quantity required for plastering(internal) = 25467.325sq.ft

	Ordinary Plaster	Ready Mix Plaster
Cost/sq.ft.	RS. 8.46/sq.ft.	RS. 0.625/sq.ft.
Total Cost	RS. 2,15,476.2	RS. 15,918.75

Total quantity required for plastering(external) = 17450.88sq.ft

	Ordinary Plaster	Ready Mix Plaster
Cost/sq.ft.	RS. 9.08/sq.ft.	RS. 0.625/sq.ft.
Total Cost	RS. 1,58,446	RS. 10,906.25

By Ordinary Plaster,
Total cost of PLASTERING of building = RS. 3,73,922/-
By Ready Mix Plaster,
Total cost of PLASTERING of building = RS. 31,856.25/-
Cost Saving = RS. 3,42,065.75/-
% Saving = 91.5%

D. Color Putty

Total color putty area required is 17,450.88sq.ft
Calculation of Cost
For Acrylic Wall Putty
Coverage=20sqft/kg
Total Material required = 17,450.88/20 = 872.544 KG
Cost= 872.544*60 = RS. 52,352.64
For Color Putty
coverage=15sqft/K
g
Total Material Required =
17,450.88/15 = 1163.392Kg

Cost= 1163.392*29 = RS. 33,758.56
%Saving = RS. 18,594.072 (35.5%)

E. Tile Adhesive

Total area of tiling = 3758.068sq.ft
Total area of flooring = 8753.45sq.ft
By Cement Mortar
Cost of flooring @ RS. 11.04 = RS. 96638.088
Cost of tiling @ RS. 8.46 = RS. 31793.255
Total Cost = RS. 128432
By Tile Adhesive
Cost of flooring @ RS. 4.3 = RS. 37639.835
Cost of tiling @ RS. 4.3 = RS. 16159.6924
Total Cost = RS. 53780
Total Cost Saving = RS. 74652 (58.12%)

Result Table

SR. NO.	VALUE ENGINEERING TECHNIQUES	COST BEFORE APPLICATION OF TECHNIQUES (IN RS.)	COST AFTER APPLICATION OF TECHNIQUES (IN RS.)	%SAVING OBTAINED
1	AAC BLOCKS	4,36,650	5,20,800	-
2	COLOR PUTTY	52,352.64	33,758.56	35.5
3	FIXOBLOCK	1,60,000	1,24,500	22.18
4	READYMIX PLASTER	3,73,922	31,856.25	91.5
5	TILE ADHESIVE	1,28,432	53,780	58.15

Table no. 6

IX. CONCLUSION

The case study indicates that the proposed value engineering techniques can be successfully applied to a real construction project. Based on our Literature Review study, the techniques which can be applied on site are as follows: Use of AAC blocks by replacing brickwork, use of fixoblocks, ready mix plaster, tile adhesive and color putty. After the application of the above mentioned techniques we achieved enhancement in properties of the building and cost reduction respectively. An overall of 33.5% of reduction in cost was obtained after the application of the mentioned finalized techniques.

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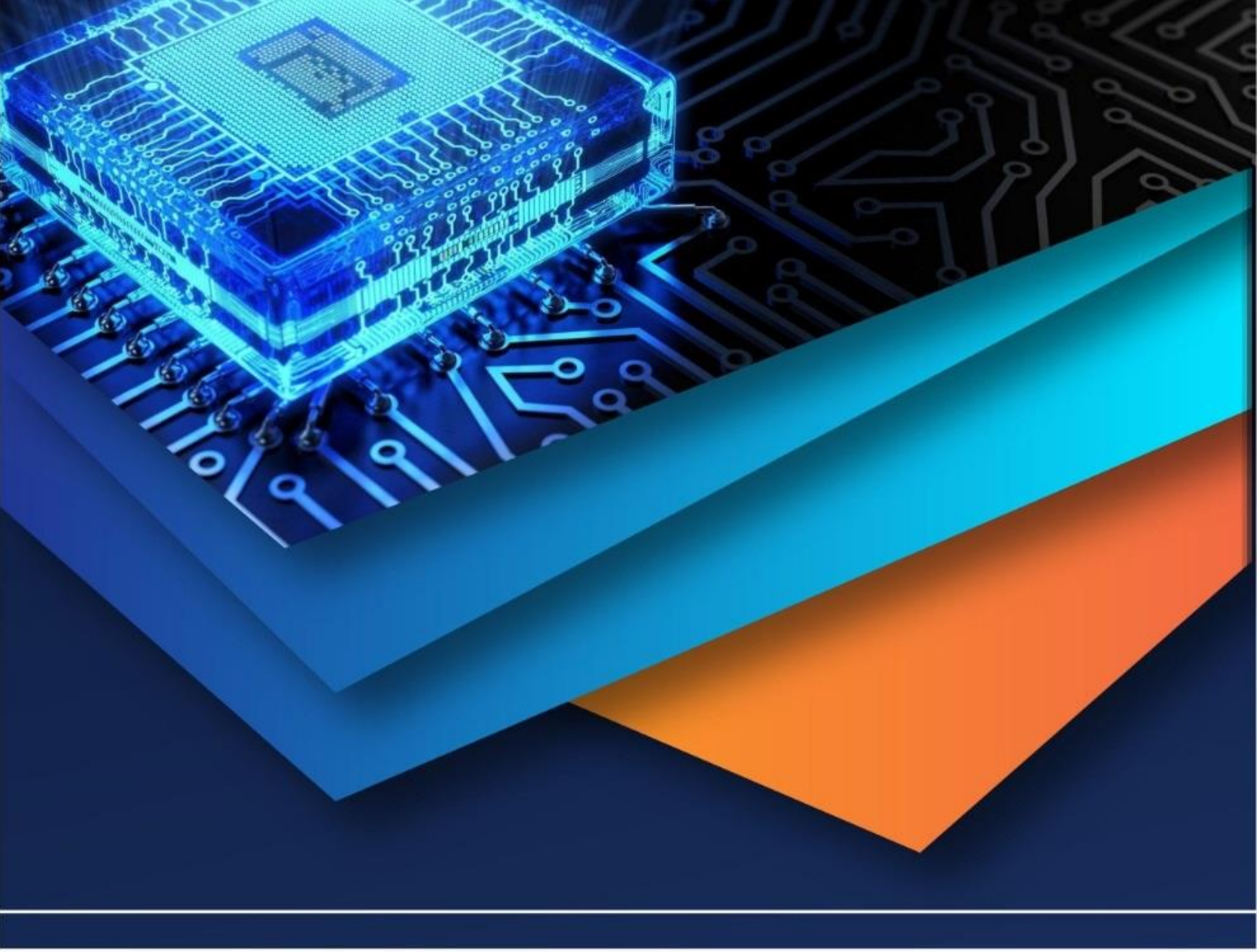

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