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DEVELOPING A MODEL TO REDUCE THE COST OF CONSTRUCTION OF RESIDENTIAL BUILDING THROUGH VALUE ENGINEERING

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Abstract: Value engineering (VE) is a systematic method to improve the "value" of goods or products and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. It is a primary tenet of value engineering that basic functions be preserved and not be reduced as a consequence of pursuing value improvements. Value engineering is being a very effective approach , must be appreciated and understood at all level of the project management and must be accepted worldwide. This is one of the tools available for the engineer, and its application on projects and products guides the engineer's imagination, creativity, and synthesis of knowledge such that whole- life value is achieved for the project or product. Essentially, the project is viewed from its purpose and functions through to its conception, actualization or manufacture and usage. And simultaneously in a reverse order from its usage back to its purpose and functions. Although value engineering has its origin in the manufacturing industry, its methodology has been well developed for use in the Construction industry. The realization of whole- life value for a building project involves finding optimum combinations of initial project costs, maintenance cost, and cost associated with the time for completion of the project. Value engineering is technique directed towards analyzing the functions of an item or process to determine "best value" or the best relation between the cost and value.

Index Terms – Introduction, Methodology, Comparison between the value engineering and traditional method, Alternative Material Survey For Value Engineering, .Case Study Details, Alternative Material Survey For Value Engineering, Case Study Details, Abstract Sheet Of Project, Alternative Material Finding Techniques, Conclusion, References

I.INTRODUCTION

Application of value engineering/analysis is done by using job plan which is a systematic and organized approach. Value engineering job plan is the key of success for a value management exercise. It is through this plan that the already identified areas of value study are subjected to in-depth application to seek new and creative alternatives. The job plan required the formation of a multidisciplinary team representing a cross section technical field to conduct the program. A multi-disciplinary approach generates more and better ideas gives greater impact of decisions and costs on all services, and develops better communication among the members of team. There are different job plan existing and are selected as per suitability of the project and requirement which are entitled as

- Five phase job plan
- Six phase job plan
- Seven phase job plan
- Eight phase job plan

Formula of value engineering (VE) = Function/cost

II.METHODOLOGY

In the project following methodology have been decided to measure and manage the construction projects from the value engineering the 5-phase methodology is mostly preferable as per study which are-

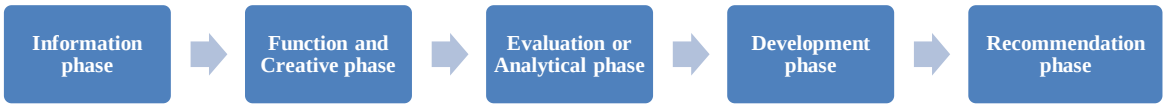


Figure No 1.1 Flow Chart of Methodology of Value Engineering.

1. **Information phase** – Detailed literature review will be carried out to study the value engineering concept. The importance of this phase lies in collection of as much possible information collection for understanding and assisting the problem.

2. **Function and Creative phase**-The important data will be collected required for functional analysis of value engineering from selected case study. alternative ideas will be developed during creative phase.

3. **Evaluation or Analytical phase-** The ideas generated during creative phaseare screened and evaluated. Ideas showing the greatest potential for cost saving and project improvement are selected for further study. Ranking of ideas.

4. **Development phase-** Research of selected ideas and prepation of description, sketches, and life cycle cost estimates to support the recommendation as formal VE proposal. Each designated ideas expanded in to workable solution.

5. **Recommendation phase-** The phase is important, as the selected alternatives will be presented with the full comparative position of costs as well as technical ranking. The major changes will be provided in design are also described briefly with model. Finalisation of VE report in order to incorporate the VE proposals developed during work.

III.COMPARISON BETWEEN THE VALUE ENGINEERING AND TRADITIONAL METHOD

Sr. no.	Criteria	Value engineering	Traditional Method
1	Focus	Value engineering is a systematic, organized approach to providing necessary functions in a project at the lowest cost. Value engineering promotes the substitution of materials and methods with less expensive alternatives, without sacrificing functionality.	Cost estimation in project management is the process of forecasting the cost and other resources needed to complete a project within a defined scope. Cost estimation accounts for each element required for the project and calculates a total amount that determines a project's budget.
2	Implementation	Best alternatives are taken into considerations for compare the best material without compromising the cost and the quality of construction.	No any alternatives of the materials taken into considerations that's why there is no comparison between effective cost and quality of material.
3	Timing	Proper study of the construction which include proper planning, and well discussion about the methodology and materials so the fast construction as compare to traditional method.	Lack of planning, lack of discussion about the materials and methodology leads to delay in construction.
4	Quality	Quality is improving by applying alternatives and compare it with its properties and cost	In this method if the Quality is adopted then cost is compromised and if the economy is adopted then quality will be compromised
5	Simplicity	It is not as simple as traditional method	It is Very Simple Method
6	Skill	Skill is required to adopt this method	Skill is not required to adopt this method

Table no. 1.1 Value Engineering VS Traditional Method

The above table no. 1.1 shows the comparison of traditional method and the value engineering so it clear that the knowledge of value engineering must be apply in the construction industry for the implementation and fast growth.

IV. REASONS FOR THE INCREASED UNNECESSARY COSTS AND POOR QUALITY

The study of value, including what it characterized by collective action between the specialist team is an opportunity to bridge the gap that may occur in the usual process design based on the individual work for each specialty on its own. Work is the individual tends to put upper limit of the factors of safety and efficiency and functional reasons for this:

- Lack of information
- Temporary conditions
- Erroneous beliefs
- False Customs and traditions
- Few ideas
- Change in technology.
- Change in the requirements of the beneficiary.
- Follow an old specifications and standards
- Time constraint
- Absence of ties or good coordination.

These are some reasons to increase unnecessary cost and causes of poor quality. For overcomes to this problems application of value engineering is necessary to achieve quality with cost effectiveness.

V.CASE STUDY DETAILS:

For Collecting the data for Cost of construction for various alternatives construction study plan is adopted for the estimation and the detailed study of value engineering has been done. Technical evaluation has done with the different alternatives and its different specific properties with details. And then the main part which is cost evaluation is done with quantity and the different rates of the alternatives. Cost evaluation and technical evaluation helps to choose the alternatives with the properties of economy, durability, time and quality of the material. And it is also very effective to differentiate to the traditional technique's vs value engineering.

	Do you think that-	
1	VE is effective methodology in construction industry?	
2	VE is applicable in residential project?	
3	VE reduces cost overruns?	
4	VE is easy to applicable?	
5	VE methodology is advantageous over Traditional method?	
6	VE is time saving technique?	
7	VE gives proper guidelines?	
8	Need of VE for effective practices?	

Rating scale-1=Strongly disagree 2=Disagree 3=No opinion 4= Agree 5=Strongly agree

Table no. 1.2 questionnaire survey of value engineering

VI. ALTERNATIVE MATERIAL SURVEY FOR VALUE ENGINEERING

The above table shows the questionnaire survey questions which asked to the contractors, engineers, architects and the owners and then the results of mean, standard deviation and variance are calculated. The survey findings confirm the belief that VE principles are sound and possess strong application prospects in the construction industry. On the other hand, many hurdles still stand in the way for VE practices to flourish. First, there is a lack of knowledge about VE in this region. Specifically, there is a huge necessity to educate. It is important to realize that concerns and conflict of interests can be largely resolved if all parties have a better understanding of the VE principles and appreciate the potential benefits derived from VE studies. For example, some owners perceive VE proposals submitted by contractors as an excuse to lower quality and functionality (which they assume as forming the basis of the cost reduction proposed). Ironically, contractors, who might well have a genuine intention to improve on an existing design, would eschew the risk of unsuccessful VE studies that potentially lead to losses. If only the two parties understand each other's concern, a win–win situation can be structured through proper design of contractual provisions in equitable savings and risks sharing. This, obviously, can only be realized when the basis and principles of VE are clear to them in the first place.Second, governments and building/construction authorities should play a lead role in promoting VE. Past experience of the US clearly demonstrates the importance of this factor. Specifically, incentives to apply VE should be built within the provisions of public contracts. Over time, this also helps to build up case precedence and form a database showing success and failure rates of VE applications. By referring to these evidence and precedence, private sector owners would feel more comfortable in adopting VE for their projects. Key lessons can also be learned from past failures so that practices are improved over time or customized to suit unique circumstances.

For evaluation ranking is done to each and every alternative item based on seven different functions which are cost, schedule, aesthetics, maintenance, durability, availability and efficiency which is shown in table below

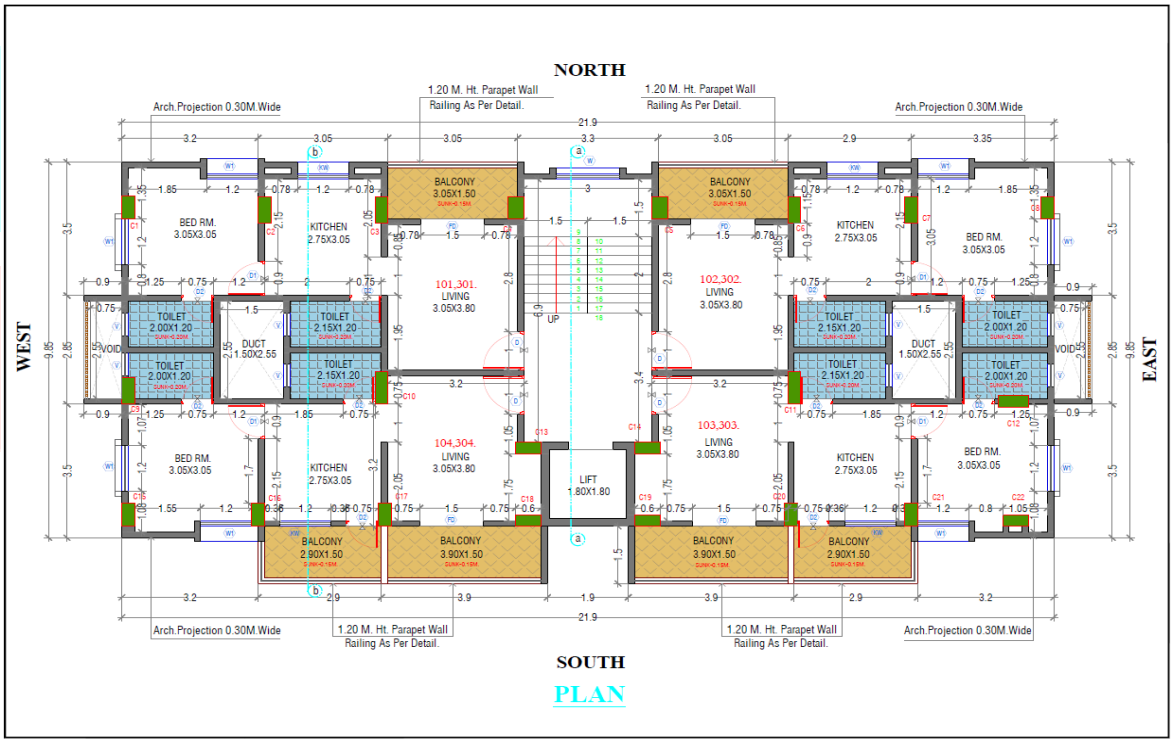
CODE	ITEM
A	Initial cost
B	Schedule
C	Aesthetics
D	Maintenance
E	Durability
F	Availability
G	Efficiency

Table no. 1.3 Evaluation of alternatives according to properties

VII.CASE STUDY DETAILS:

For Collecting the data for Cost of construction for various alternatives construction study plan is adopted for the estimation and the detailed study of value engineering has been done. Technical evaluation has done with the different alternatives and its different specific properties with details. And then the main part which is cost evaluation is done with quantity and the different rates of the alternatives. Cost evaluation and technical evaluation helps to choose the alternatives with the properties of economy, durability, time and quality of the material. And it is also very effective to differentiate to the traditional technique's vs value engineering.

For this case study the site plan is taken which is located in Pune city and estimation work is to be done of brickwork, plastering, wall putti, floor tiling, tile adhesion etc. and also find its alternatives for achieve the cost effectiveness. The area of the Proposed Building is 2491 Sq.ft. and this building is for residential and Commercial purposed. the Design description is G+4. And the strata of the site are Hard strata which is 7Ft. below. So, the fig no. 4.1 shows the detailed plan of site.



Case Study Site Plan

VIII.ABSTRACT SHEET OF PROJECT

In table below shows the abstract sheet of project. In that table includes the description of various item their quantity & amount. We have to calculate amount required to complete various items of project with their standard unit. Standard Rates per unit of various items taken from DSR. Finally, total cost required to complete project is calculated which include 4% Electrification cost, 3% Water Supply & Sanitation cost & 5% Supervision charges. The cost of project is 2869270.40 Rs. & considering all charges, the total project cost is 32,13,600 Rs.

Sr. No.	Description of Item	Quantity	Unit	Rate	Amount
1	Excavation for column pits in soft soil etc.	143.43	Cum	270	32988.9
2	P.C.C. for footing	13.26	Cum	2800	37128.00
3	Steel in R.C.C. footing	1.25	m tun	4000	5000.00
4	Basement column Steel	2.27	m tun	4000	9080.00
5	concrete in R.C.C column up to plinth	11.08	Cum	2800	31024.00
6	Ground level Conc. In R.C.C column	11.08	Cum	2800	31024.00
7	Steel in ground level column	2.27	m tun	4000	9080.00
8	1st floor column steel	1.78	m tun	4000	7120.00
9	1st floor column concrete	11.09	Cum	2800	31052.00
10	2nd floor column steel	1.78	m tun	4000	7120.00
11	2nd floor column concrete	11.09	Cum	2800	31052.00
12	3rd floor column steel	1.76	m tun	4000	7040.00
13	3rd floor column concrete	10.46	Cum	2800	29288.00
14	4rth floor column steel	1.76	m tun	4000	7040.00
15	4rth floor column concrete	10.46	Cum	2800	29288.00
16	1st top beam steel	2.98	m tun	4000	11920.00
17	1st top beam concrete	15.31	Cum	2800	42868.00
18	2nd top beam steel	2.63	m tun	4000	10520.00
19	2nd top beam concrete	15.91	Cum	2800	44548.00
20	3rd top beam steel	3.14	m tun	4000	12560.00
21	3rd top beam concrete	15.91	Cum	2800	44548.00
22	4rth top beam steel	3.14	m tun	4000	12560.00
23	4rth top beam concrete	15.91	Cum	2800	44548.00
24	Plinth beam steel	1.88	m tun	4000	7520.00
25	Plinth beam concrete	12.60	Cum	2800	35280.00
26	One way slab steel	0.28	m tun	4000	1120.00
27	One way slab concrete	6.62	Sq m	2800	18536.00
28	Two-way slab steel	1.46	m tun	4000	5840.00
29	Two-way slab concrete	30.28	Sq m	2800	84784.00
30	Total brickwork	270.501	Cum	5000	1352505.00
31	Total Plastering Work	800.68	Sq m	435	348295.8
32	Wall putti work	800.68	Sq m	200	160136.00
33	Floor Tiles	251.54	Sq m	1005	252797.7
34	Tile adhesion	251.54	Sq m	150	37731.00

Cost	**2869270.40**
4% Electrification	**114770.81**
3% Water Supply & Sanitation	**86078.12**
5%Supervision charges	**143463.32**
Total Cost Rs.	**3213582.84**
Say Rs.	**32,13,600.**

Table no. 1.4 Abstract Sheet of Project

The above table no 1.4 Sheet of project work shows the all-estimated quantity and its cost. The rate of R.C.C is not compressible it will remain same at every site condition but the other Cost like Brickwork, Painting, Tiling is varying because its quality, method of constructions, cost so the more than 50% cost for such quantities considered that's why we choose for evaluate the cost of value engineering the items are Brickwork, Plastering work, Wall putti, Floor Tiles, Tile Adhesion.

IX. ALTERNATIVE MATERIAL FINDING TECHNIQUES

Value Engineering includes different alternatives for the same work, to find out the best alternative from many, evaluation will be done for each and every alternative. This evaluation of alternatives is done by using the Decision Matrix Analysis technique. Decision Matrix Analysis is a useful technique to use for making a decision in which ranking of alternatives is done. It's particularly powerful where you have a number of good alternatives to choose from, and many different factors to take into account. This makes it a great technique to use in almost any important decision where there isn't a clear and obvious preferred option. To do the ranking of all the alternatives and find the best of them a simple methodology is carried out and the technique has its essence in the mutual comparison where each is compared with all others and points are given based on their differences from 1 to 3 where 1 is no difference and 3 is major difference. When the function A is evaluated with B, then A is evaluated with next function C and this is continued till all the functions are compared with all other functions and rated.

The below table shows the calculated estimated quantity of brickwork, plastering, wall putti, floor tiles and tile adhesion so with the help of this quantity the further calculations for alternatives is conducted. And the comparison of all the alternatives is to be done. The application of Pareto Law 20/80 states that around 20 % of the functions constitute around 80% of the cost. It was noticed that these 5 items forms 66% of the total cost.

Sr No.	Item	Quantity of Item
1	Brickwork	270.501 Cum.
2	Plastering	800.685 Sq.m
3	Wall Putti	800.685 Sq.m
4	Floor Tiles	251.548 Sq.m
5	Tile Adhesion	251.548 Sq.m

Table no. 1.5 Abstract Sheet of Project

X. CONCLUSION

In this chapter, the collection of data for value engineering is effectively done and also the problems identified which occurs during application of value engineering. So, the proper study and education regarding value engineering is very necessary for improving the quality and reduces the construction cost effectively.

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