Cost Reduction in Residential Building by Application of Value Engineering

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Abstract— Value engineering is an organized technique to reduce the cost of a product without compromising with its quality, reliability, and performance. A case study is taken to show that implementation of value engineering has capability to bring down the cost of the project without affecting their basic function of providing shelter to the end user. This paper introduce application of different value engineering techniques in a residential building and observe outcomes of it. Different VE techniques like VE job plan, FAST diagram, evaluation matrix has been used in this research and better alternatives are recommended.

Key words: Value Engineering, Value Analysis, VE Job Plan, FAST Model, Decision Matrix

I. INTRODUCTION

The Construction business incorporates a larger impact on the economy of all countries. It's one amongst the sectors that offer crucial ingredients for the event of economy. Because of poor value and time management currently, the development business is facing an enormous quantity of cost. This has become quite a drawback for the development business. Poor value management and overrun square measure large drawback and extremely serious issue once it involves project value in each developed and rising countries.

To overcome this problem organization uses many cost reduction techniques like material management, budgetary control, Waste management, Lean technology, value stream mapping and value engineering. Amongst all the technique Value Engineering is most widely used technique and give enormous result in cost reduction.

Value engineering began at General Electric Co. during World War II. Because of the war, there were shortages of skilled labor and raw materials. Lawrence Miles and Harry Erlicher at GE looked for acceptable substitutes for materials. They noticed that these substitutions often reduced costs, improved the product, and in some cases, both. What started out as an experiment driven by necessity was turned into a systematic process. They called their technique "Value Analysis". As others adopted the technique, the name gradually changed to Value Engineering. [5]

II. NEED OF THE STUDY

All design projects have unnecessary costs designed into them. Studies invariably show that all design have unnecessary cost regardless of how excellent the design team may be. Different Reasons of unnecessary cost in construction industry are as follows [5]

- Low Time for Designing
- Lack of information
- Lack of Ideas
- Habits
- Lack of Experience
- Attitude
- Multi Concept

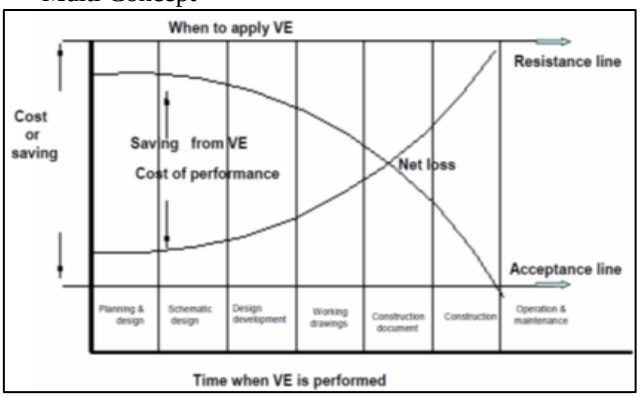

Fig. 1: Application of VE

In organization on have to apply VE as early as possible to ensure potential savings before commitment of funds, approval of systems, services or designs. Later application VE gave rise to increase in two things one is the investment required to implement any changes and second is resistance to change. VE must be applied after complete involvement of owner(s) and consultant(s) decision making, to achieve optimal results. Hence, optimum results can be expected when resources are set aside for VE early in the design process, focusing on owner and consultant impact

III. RESEARCH METHODOLOGY

The methodology consists of three stages pre workshop, workshop (value study) and post workshop. In pre workshop, project planning and data modelling has to be done. In this phase data modelling consists of different types of models like cost model, space model, quality model etc. is to be prepared, the reason behind prepare a cost model is that it assembles and breakdown total cost of the project into small functional units which helps us to quickly analyse costly area.

In workshop stage questionnaire is prepared and asked to the employees of the firm in which VE concept is to be apply, by that information we can produce a VE job plan which is 5 phase value engineering methodology which helps one to come up with the better ideas and alternative design than original which results in cost reduction without compromising its quality.

In last stage of post workshop final report is to be prepared with the finalization of better idea and alternate design which one have to implement in the project for better results.

IV. INFORMATION PHASE

In this section, I have selected the one of the 13 storey tower in Gujarat Housing Board scheme of Ahmedabad at Gota, as a case study to work-out and to show that implementation of

value engineering has capability to bring down the cost of the project (specially of selected tower under study) without affecting their basic function of providing shelter to the end user.

All the working drawing, site plan, structural drawings and other details are obtained from the contractor and cost breakdown structure of civil work is prepared.

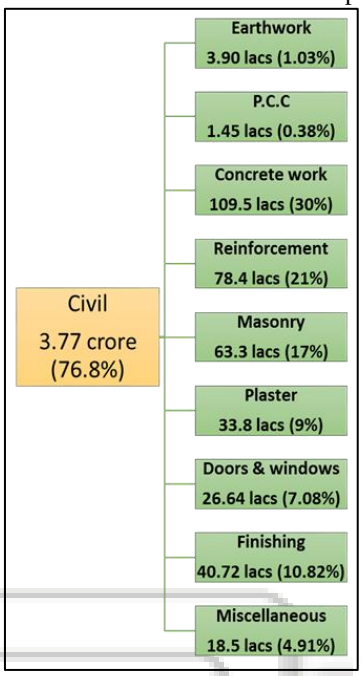

Fig. 2: Cost Breakdown Structure

V. FAST DIAGRAM

FAST diagram is the graphical representation of functions. It is a systematic road mapping of function, which provides organized method of exploring complicated process and determines in a step by step method the function required and means to arrive at that function. [1] Main function of this thesis is to bring down the cost of a building without affecting its quality its FAST model is represented below.

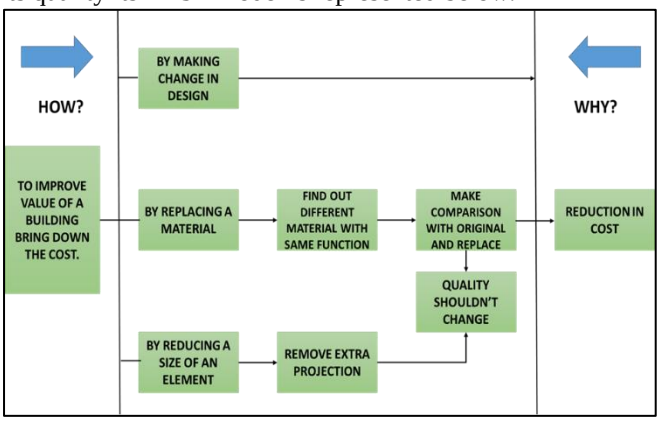

Fig. 3 FAST model

VI. CREATIVE PHASE

In this stage detailed inspection of each value improvement item is done and alternative method, creative ideas are introduced which will help to reduce the cost of that particular item without affecting its quality. There are many idea generation techniques like brainstorming, Gordon technique, checklist, morphological analysis etc. but I have selected a brainstorming method in which development of new ideas that go beyond the original concept are done by individual or in group thinking. Innovative ideas are listed below.

– Use of Polyurethane foam / self-adhesive cement / cement-sand mortar for AAC block masonry
– Use of Silica fume concrete / slag cement concrete/ fly ash concrete in place of conventional RMC concrete.

VII. JUDGEMENT PHASE

At this phase, screening of ideas developed in creative phase are carried out. Ideas are reviewed to check if they can be develop further. Advantages and disadvantages of each ideas are discussed.

VIII. DEVELOPMENT PHASE

This phase start with consideration of best idea(s) screened in judgement phase and further Develops into workable solutions. In this phase decision matrix has been selected for recommend better option. There are total five parameters that need to be justify before selection of option. After the consultation with project manager value of all the criteria are decided, 6 point given to the most important criteria following that based on importance points are given to the other criteria.

With the help of criteria value and weightages of option decision matrix is prepared of different ideas and option with the highest score are recommended which are explained below. For AAC block masonry there are four option and five criteria which are represented below.

Prioritization Criteria	Value	Cube bond mortar		PU foam		Self adhesive		Conventional	
Availability	4	5	20	4	16	3	12	5	20
Effect on enviromen	3	2	6	3	9	3	9	4	12
Cost effectivness	5	3	15	4	20	3	15	2	10
Durability	6	4	24	4	24	4	24	2	12
Skill requirement	2	2	4	2	4	2	4	5	10
Totals		69		73		64		64	

Fig. 4: Decision Matrix 1

In order to objectively appraise and select the best alternative, idea no 2 has the highest points score of 73 against other ideas in the decision matrix was recommended. Idea 2 will further develop in respect to cost parameter. Similarly for concrete decision matrix is prepared which is represented below.

Prioritization Criteria	Value	Conventional		High slag cement		Silica fume		Fly ash	
Availability	4	5	20	3	12	4	16	5	20
Effect on enviromen	3	2	6	3	9	3	9	3	9
Cost effectivness	5	2	10	3	15	4	20	3	15
Durability	6	3	18	3	18	4	24	3	18
Skill requirement	2	5	10	5	10	5	10	5	10
Totals		64		64		79		72	

Fig. 5: Decision Matrix 2

Out of four ideas idea no 3 silica fume concrete has highest points so it will be further develop in respect to cost estimate.

After selecting two ideas cost estimate of that ideas has to be done to see if it is economically viable or not.

Sr. No	Details	Description	Coverage	Quantity	Price	Cost
1	Original	Polymer Mortar	4.83 sqm / bag	6400	500 / bag	6,62,525
2	Proposed	PU foam	14 sqm / can	6400	550 / can	2,51,428

Table 1: Cost analysis of masonry

Total cost in material for AAC block masonry can be save up to 4.12 lacs. Similarly for concreting cost estimate is prepared.

The economic analysis reveals that the target mean strength of next higher grade concrete namely M25 is achieved in 28 days after replacing 10% of cement by silica fume from the designed mix proportion of M20 grade. It certainly confirms that the reduction in the cost of construction of M25 grade SF concrete by about 9.14% in comparison to that of the M20 grade normal concrete. [9]

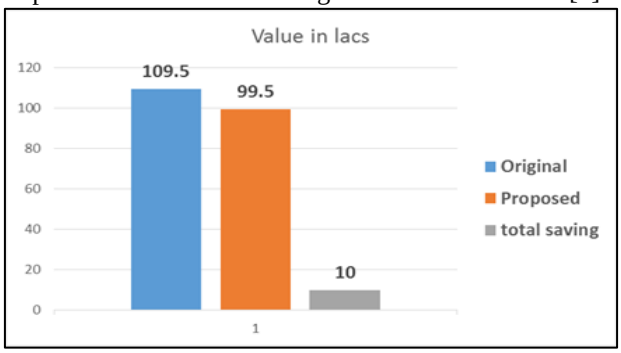

Fig. 6: Cost saving graph of concrete

IX. Recommendation Phase

After result of cost analysis of two materials we can recommend it over original material. One is use of Polyurethane foam in place of polymer mortar for AAC block masonry and second is silica fume concrete in place of conventional RMC.

X. Conclusion

From this paper it is conclude that value engineering has capability to bring down the cost of a project without compromising its basic function and quality. After performing all the phases of VE job plan from information phase to recommendation phase it is found that there are better alternatives than the original which helps us to reduce the cost of particular item to a greater extent. Total saving which can be incurred by implementation of above recommendation are 4.12 lacs for idea 1 and 10 lacs for idea 2.

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