

# Application of Value Engineering in Construction Project: Case Study on Residential Project in Ahmedabad

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*Abstract*— saving money and, at the same time, providing better value is a concept that everyone can support. The benefits of spreading our invested rupee, building more for less money, increasing efficiency and cutting down our dependency on energy-intensive buildings and plant facilities need to be recognized today and pursued in the future. Value Engineering (VE) is not just “good engineering”, it is not a suggestion program or a routine plan review, but it is a new, fresh look at problems starting from basic functional requirements – an independent approach to the project. The paper discussed the concept of Value Engineering, its job plan and the analytically effective implementation of Value engineering concept through a different Study and its efforts have been put into the government construction project site. The material is chosen such that the cost is reduced without affecting the quality of the product and environment (Environment friendly materials). The best feasible solution from the available alternatives is chosen through the cost model and materials ranking. Through the application of Value Engineering profits are maximized without hindering the reliability of the product. With the effective utilization of the technique the final outcomes comes out to be a successful showcase of value engineering.

**Key words:** Value Engineering, Value Management, Construction Cost and Construction Materials

## I. INTRODUCTION

VE (value engineering) was developed at General Electric Corp. during World War II and is widely used in industry and government, particularly in areas such as defence, transportation, construction and healthcare. VE is an effective technique for reducing costs, increasing productivity and improving quality. It can be applied to hardware and software; development, production and manufacturing; specifications, standards, contract requirements and other acquisition program documentation; and facilities design and construction.

VE is a technique directed toward analysing the functions of an item or process to determine “best value”, or the best relationship between worth and cost. In other words, “best value” is represented by an item or process that consistently performs the required basic function and has the lowest life-cycle cost. In this context, the application of VE in facilities construction can yield a better value when construction is approached in a manner that incorporates environmentally-sound and energy-efficient practices and materials. Because “costs” are measurable, “cost reduction” is often thought of as the sole criterion for a VE application and indeed it is primarily addressed in this document. However, the real objective of VE is “value improvement” and that may not result in an immediate cost reduction. <sup>[1]</sup>

Value engineering (VE) is 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. <sup>[2]</sup>

Value Engineering define as “A specialized cost control technique, performed by a group of experienced professionals. The technique involves an intensive, systematic and creative study to reduce cost while enhancing reliability and performance. The technique is used to achieve the best functional balance between cost, quality and performance of a product, system or facility”. Figure No. 1 to clarify that VE is a functional balance between cost, quality and performance.

It may be successfully introduced at any point in the life-cycle of products, systems, or procedures. <sup>[3]</sup>

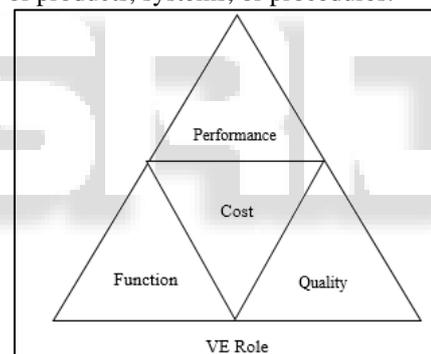


Fig. 1: VE as a functional balance between cost, quality and performance

## II. USAGE OF VE IN CONSTRUCTION SECTOR

Companies in the construction sector have a better chance of getting jobs when they use the resources of the country in which they work reasonably, keep their costs at the lowest level and decrease their offer price in comparison with their rivals. But the low offer price is not the only factor for a specific company to get the job. Project must have a high “value”. Value has different meanings for the producing company, owner, user or the designer. The builder company tries to finish the construction with the lowest cost to obtain high profit. Owner wants to get the biggest income from the building. User wants to be able to perform his works easily, while the designer gives more importance to his creation’s aesthetics or functions.

Purpose, time, quality and cost of every activity that will be realized during the construction process must be determined or estimated beforehand. Owner or user wants to know which feature they will have after the building is completed and with what cost they will have it.

Because construction process has many components such as concept, design and drawing details of the project, construction etc., and it is a long-term production, the risk of completion of construction in time, based on the estimated costs (first investment + usage cost) by providing features such as quality, durability, usefulness, continuity, feasibility, compliance, image and management convenience, increases.

Suitable precautions are taken by predetermination of problematic areas via various project planning and scheduling techniques. But none of these methods includes an examination in terms of the "value". After a building is completed or during the construction stage, comparing the building value with the costs that occur during its construction is not thought about. Although many buildings were built with high costs, desired functions were not provided. There is absolutely no direct proportion between a building's costs and provided benefits. In value engineering rationalist evaluation techniques are used considering the target features, and unnecessary costs are determined to be eliminated from the project, so that a building's value is increased and resources (money, material and workforce) are not wasted.

Some methods that increase the value in construction sector are explained as follows.

- 1) Reducing construction production costs
- 2) Finishing the job before Time Schedule
- 3) Quality improvement and correction
- 4) Reducing mistakes and deficiencies in project drawings to minimum. [4]

### III. VE METHODOLOGY AND APPROACH

The value methodology is a systematic process following the Job Plan and is applied by a multidisciplinary team to improve the value of a project through the analysis of functions.

Value engineering is often done by systematically following a multi-stage job plan. Larry Miles' original system was a six-step procedure which he called the "value analysis job plan." Others have varied the job plan to fit their constraints.

The Job Plan is an organized plan of action for accomplishing VE studies and assuring the implementation of the recommended changes. The Job Plan contains eight phases, five of which are performed by the VE team. The other three phases are carried out in accordance with the policies stated in the agency's VE program.

The VE methodology (referred to as the "job plan") can be applied to any subject or problem. It is a vehicle to carry the project from inception to conclusion. By adhering to certain formalities, the VE job plan ensures that consideration is given to all necessary facets of the problem. [5]

The VE job plan comprises five phases.

#### A. Information Phase

In this phase maximum information regarding problem is collected from various aspects of the project to clearly identify the problem to be solved and gather information on the background, function and requirements of the project. The importance of this phase lies in the collection of as much possible information collection for understanding and assisting the problem.

#### B. Creative Phase

The value engineering team lists creative ideas generated from its review of the project with the aim of obtaining a large number of ideas through brainstorming and association of creative proposals. The VE team is looking for the greatest quantity of ideas, which will subsequently be screened, in the next phase of the study. This issue is one of the most challenging for VE team members and participants.

#### C. Judgment Phase

Creative ideas are analyzed, and the team selects the best ideas for further development. The VE team evaluates the ideas developed during the creative phase. The VE team ranks the ideas. Ideas found to be irrelevant or not worthy of additional study are disregarded; those ideas that represent the greatest potential for cost savings and improvements are selected for development are selected for the further development.

#### D. Development Phase

The team prepares alternative designs with capital and/or life cycle cost comparisons of original designs and proposed alternatives. All recommendations are supplemented with written descriptions, sketches, basic design concepts, technical information and cost summaries. The selected ideas are developed into proposals that are clearly written so that the owner and other project stakeholders understand the intent of the proposal and how it benefits the project, and also to identify any potential negative factors associated with the proposal.

#### E. Recommendation Phase

The recommendation phase is important, as the selected alternatives are presented to top management with the full comparative position of costs as well as technical ranking. The major changes in design are also described briefly with sketches, drawings or models as appropriate. [5]

### IV. IMPLEMENTATION OF VE ON RESIDENTIAL PROJECT

#### A. Information Phase

The purpose of this Phase is to finalize the scope of the issues to be addressed, targets for improvement, and evaluation factors while building cohesion among team members. This work is normally carried out in the workshop setting and is therefore usually the first opportunity for all team members to be together. Consequently, it is important to use the Information Phase to motivate the team to work toward a common goal. Finalizing the scope of the issues to be addressed, targets for improvement, evaluation factors, and data collection are ideal endeavours for building that cohesion. The specific activities are described in the following subsections. [5]

The research work is on a residential tower of Focus Infrastructure as a case study for cost reduction by application of VE which is located at S.P. Ring Road, Vinzol, and Ahmedabad.

The project details are mention in table 1.

1	Name of Project	Shalin Heights 5
2	Name of contractor	Focus Infrastructure
3	Name of structural designer	Shreeji Structural
4	Name of Architect	Mr. Apurva Amin

5	Nature of project	2 & 3 BHK
6	Number of stories	G + 7
7	Number of building units	4
8	Number of flats	157

Table 1: Project details

The project has 4 towers of 7 stories which have 2BHK and 3BHK types flats. In that construction of block A & B is complete and block C & D are in the progress. Typical layout of the site plan is shown in figure 2.

To collect information, the researcher contacted the technical team of the owner engaged with the different activities of the project. The following information was provided to the researcher by the team:

- Concept of the project and the owner needs.
- History of the project
- Drawings.
- Site conditions (soil condition, soil borings, surrounding area, aerial photograph)
- Bills of quantities.
- Schedule of the project implementation.
- Site information and topography.
- Specifications.
- Elements of the design (process parts, construction components)
- Constraints imposed on the project
- Available utilities



Fig. 2: Typical layout of site plan

1) Cost Model

VE team applies uniformed cost model to determine the cost of each function. The VE team has to find out the classification of the cost consumed in the overall project and find out the most affected component in the building which has the higher value compare to other materials and components. For each project, there is a cost model depending on its component. Table no. 2 shows the cost of the all components of the building described. [5]

Sr. No.	Work	Total Cost	Percentage
1.	Infrastructure Development	₹ 64,75,000	10.93 %

2.	Consulting & other Fees	₹ 88,48,000	14.98 %
3.	Structural Work	₹1,18,33,188	19.98 %
4.	Masonry Work	₹1,13,92,518	19.23 %
5.	Electrical Work	₹ 82,85,036	13.99 %
6.	Finishing Work	₹1,23,97,979	20.93 %
Total Project Cost		₹5,92,31,721	100 %

Table 2: Percentage & cost of the work of Block A

In the Chart 1, at the top activities are described, the middle value shows the cost of that work before implementation of value engineering and last at the bottom, value shows the amount of that work if the value engineering concept implement.

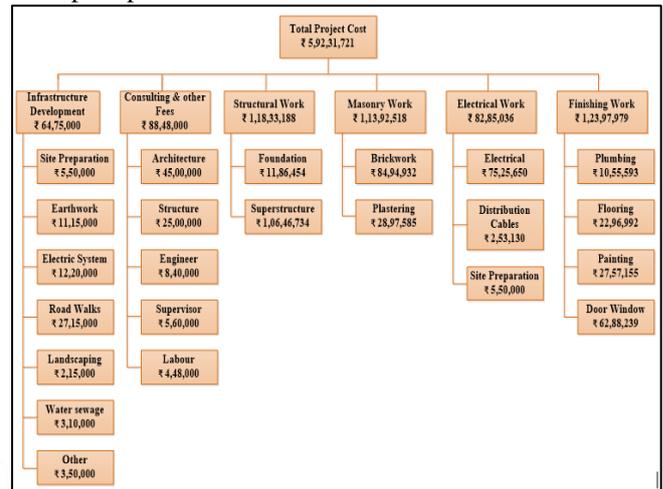


Fig. 3: Cost Model of Block A

2) Creative Phase

During the creative session, team members considered alternate methods of completing the functions required by the design in order to generate ideas to be considered for evaluation. Individual and group creative sessions provided a large quantity of ideas to augment the ideas generated while speculating on growth.

As per the details of the function analysis shown in the Table no. 2 and the cost distribution of the project in the different area, the Project manager/value engineering team should have to think about the different materials which can be replaced and fulfil the requirement of that materials. There are so many advanced materials which can be more beneficial for the project in terms of cost. So it is a major task to find out the best suited materials and also locally available. [5]

3) Judgement Phase

As per the details of the cost distribution of the project shown in chart no.3, the cost of the construction of the super-structure is more comparing others. The bricks are consume the more cost in the project. Around 38,250 numbers of AAC blocks are used in this site so if the blocks replaced by other type of other bricks having a same or higher quality and less cost than it is feasible and the overall cost of the construction of the site can be minimize.

Same as above the road was constructed by the RCC. So if it is changed by the paver blocks then obviously the cost of the road can be reduced but the purpose served as its main function.

4) Development Phase

After the market examination some materials found by depending its quality, cost and availability. Table no.3 shows the replacement materials.

Sr. No.	Materials used on site	Materials which can be replaced
1	AAC Blocks	Sand Blocks
2	RCC Roads	Paver Block Road
3	Overlapping Reinforcement	Coupler for overlapping Reinforcement

Table 3: Replaceable Materials Details

**B. First Replacement**

In the project there are large numbers of AAC Blocks are used for the construction of project. So by changing the Sand blocks which are locally available and it serves the all-purpose like AAC block and having a less cost comparing the AAC Block can also minimize the project cost. Table 4 shows saving in cost by using Sand blocks.

Sr. No.	Specification	Materials used on the Project site	Replaceable materials
1	Material	AAC Block (440 X 100 X 215)	Sand Block (600 X 100 X 215)
2	Numbers of bricks	38250	29350
3	Price/bricks	56	33
4	Total cost	₹ 84,94,932	₹ 66,95,226
5	Saving	₹ 20,37,882 (78.80%)	

Table 4: Saving in cost by using Sand blocks.

**C. Second Replacement**

In this development phase, the cost is minimized by just recommending the change of rigid pavement to Paver blocks. Concrete roads are highly durable and more environmentally friendly as compared to paver block roads. However paver blocks costs far less than concrete paving. Also, paver road provides a little better safety of the vehicle against snow and skidding. Table no.5 shows the saving by the paver blocks.

**D. Third Replacement**

Coupler add structural and economic advantages over laps make the benefit-to-cost ratio extremely attractive because Coupler give the structures added toughness and load path continuity that laps cannot offer. The reinforcement couplers not only provide strength to the joints but are they are also an economic means of connections of two bars.

A cost has been computed based on saving of steel in lapping which indicates couplers are an effective and an economic replacement of lap splice. Table 6 shows how couplers have effectively saved a huge amount of money by using Coupler joint.

Sr. No.	Specification	Materials used on the Project site	Replaceable materials
1	Material	RCC Road	Paver Block Road
2	Volume / Area	19350 Cu.Ft.	10860 Sq.Ft.
3	Price	5000	44
4	Total cost	₹ 27,15,000	₹ 5,11,289
5	Saving	₹ 22,03,711 ( 19.0% )	

Table 5: Replaceable material details

Sr. No.	Specification	Materials used on the Project site	Replaceable materials
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1	Material	Overlapping steel	Rebar coupler
2	No. of overlaps/no. of couplers	3780	3780
3	Price	95-195	35-70
4	Total cost	₹ 4,38,210	₹ 1,64,640
5	Saving	₹ 2,73,570 ( 37.60% )	

Table 6: Replaceable Rebar Coupler details

**E. Recommendation Phase**

After analysing the result of this three replacement, it can make the project cost down. For the larger project value engineering can make the more benefits in terms of the cost, time, quality etc.

As shown in the table no.7 in the development phase the project cost can be reduced just by changing the proper materials. Also total percentage of saving cost shown in table no. 8

Sr. No.	Replacement	Saving	Saving in Percentage
1	Sand Blocks	₹ 20,37,882	78.80 %
2	Paver Blocks	₹ 22,03,711	19.00 %
3	Rebar Coupler	₹ 2,73,570	37.60 %
Total Saving		₹ 45,15,170	

Table 7: Total cost reduction in the Construction Project

Project cost before VE implementation	Project cost after VE implementation	Percentage of Total Saving
₹ 5,92,31,721	₹ 5,47,16,558	7.62 %

Table 8: Total Percentage of saving cost

**V. CONCLUSION**

Success of a project, deciding on where and how a project will be built, completion of the structure according to desired design and building quality, within determined time and cost limits, are all possible with good estimations and solutions. The purpose of value engineering is not just reducing the costs, increasing the design standards, making it easier to build the project and saving time and money. Value engineering is a powerful tool in terms of the design improvements, performance of product and service, solve problems and cost control. Now a day's traditional cost control method and modern cost control methods are used generally but these methods have a lots of disadvantages compared with value engineering.

In the Case study discussed above, there are value engineering concepts used having a main focus to reduce the cost of the project by simply recommending the other advanced replaceable materials which are locally available to improve the value of the project. Just by changing the proper materials the project cost can be reduced around 8 % in which if the project having extreme construction cost, it can be consider as a large saving comparing the overall cost of the project.

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