Optimization of Cost Using Value Engineering in Building Construction

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Abstract- *The construction industry could be considered a very important sector for development all over the world and the construction cost is an important element in it. The construction industry aims to complete projects on time within the allotted budget. Cost optimisation is a perpetual goal for the construction industry. One way of reducing construction costs is to implement value engineering. This paper covers the role of cost optimisation using value engineering in residential projects. In this study site visit was conducted to know existing practices and change them with better alternatives using value engineering. This paper focuses mainly on new innovative materials adopted for masonry work. It is observed that value engineering plays an important role regarding quality, reliability, durability and enhancing performance throughout the life of the project without disturbing future needs.*

Keywords- Construction, Value Engineering, Projects, Cost, Values, Cost Reduction Substitutes.

I. INTRODUCTION

The construction sector plays a major role in developing the Indian economy, moreover, the cost is the keyword in the construction cycle. This study presents the basis of Value Engineering (VE) implementation at each stage that can be used to reduce the total cost of the construction project. Value Engineering is an important tool for companies in global market competition to provide demand. VE is a powerful methodology for reducing cost, improving performance and maintaining quality. VE defines as the systematic application of recognized techniques which identify the function of a product or service, establish a monetary value for that function and provide the necessary function reliability at the lowest overall cost.

The objective of VE is to achieve equivalent performance for lower cost without "reducing in the slightest degree of quality, safety, life, reliability, dependability and the features and attractiveness that the customer wants". The aim of VE is also to achieve an assigned target product cost by (i) Identifying improved product designs that reduce the product cost without sacrificing functionality or (ii) Eliminating unnecessary functions that increase the product cost and for which customers are not prepared to pay extra. Thus, VE is a form of cost-benefit analysis where functions are viewed as the beneficial characteristics of the product.

Value Engineering is a powerful methodology for reducing cost with improving performance and quality. The construction industry contributes to a major part of the global economy. Presently, VE not only influences the cost and quality of the project but also it proved to have a positive impact on the environment and the worldwide trend of green construction. VE takes into consideration both the initial and maintenance costs.

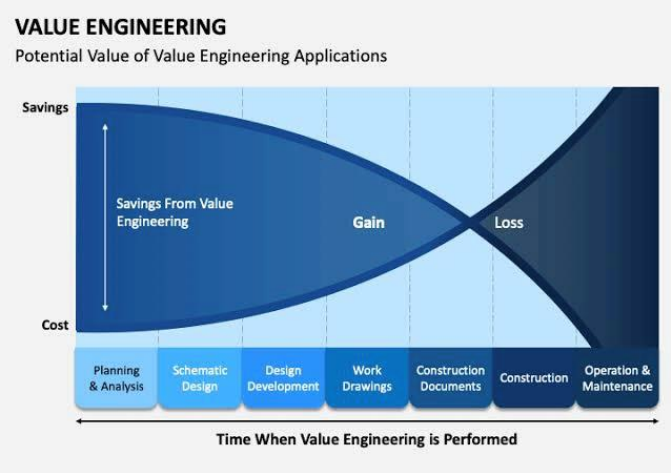

Fig 1: Graphical Representation of Value Engineering

As shown in Fig 1 the main target of VE is to achieve high value at low cost. Value Engineering also referred to as Value Methodology(VM) or Value Analysis (VA), is the systematic process to improve the value of the project through the systematic identification and eradication of unnecessary costs which results in the increased use of alternatives, cheaper materials and designs, less costly methods if construction etc, To provide the same performance quality and a decrease of overall unit cost and consequently greater profits. Value can be defined as a fair return or equivalent in terms of goods, services and money for the things interchanged. In other words, value is the ratio of function to

cost where the value is increased by either increasing the function or reducing the cost or both. It enhances the efficacy of work that is originally performed as it questions and investigates the purpose, design, method of manufacturing etc, of the product to pinpoint unnecessary costs, obvious and hidden which can be eliminated without negatively affecting quality, efficiency, safety and other customer requirements.

The Value Engineering methodology has a general approach; therefore it can be applicable to almost all types of construction activities. VE does not just have noteworthy advantages in functional improvements, cost reduction & enrichment quality, but also studies have demonstrated that it leads to more effective teamwork and improved communication among stakeholders. Individuals sometimes mix up between VE and cost reduction, however, they are significantly different. The sole purpose of cost reduction studies is cost reduction. The following are the objectives of the study:

- The main purpose of this study is to reduce the overall cost of any project by suggesting or proposing cost-effective alternatives to materials, technology and facilities by application of value engineering.
- And to investigate its implementation possibility in civil projects of the country and to achieve customer satisfaction.
- The organizational profit limits can be extended by the proper implementation of value engineering methods.
- To reduce the time required for construction by exercising effective monitoring and thereby reducing the cost incurred.
- To promote the reduction in the quantity of waste generated during construction activities and thereby achieving the optimum material usage.
- The main objective is to conduct a study on value engineering and to comprehend and pinpoint the areas of poor value in a structure, to understand saving that could be achieved after conducting the value engineering study.
- To discover the benefits of the application of value engineering in construction projects in terms of time, quality, competence and superior management.

II. LITERATURE REVIEW

1. Ferry and Fadil and Khairulzan, stated that the adoption of prefabrication construction methods, intelligent excavation works, reduce-reuse-recycle principles and simple environmentally aware on-sitepractices can minimize waste production and local environmental impacts emitted during project execution. Green building design shall encompass Value Engineering and Lean Construction concepts in order to achieve a sustainable construction industry.
2. Mr A. J. Velani and Dr A. R. Kambekar suggested a technique that can be applied to reinforced cement concrete work for reinforced concrete structures. They came up with the replacement of river sand with crushed sand & provided a detailed study on couplers to avoid lap length.
3. SuryaTeja Reddy and Satyanarayana Polishetty conducted a case study on residential buildings to study value engineering applications. The detailed cost of existing construction was studied and effective alternatives were suggested for various materials.
4. K.Ilayaraja and MD. Zafar Eqyaabal, has conducted a vast study on value engineering and the application phases have been analyzed in the thesis from the study. It is observed that value engineering is an authoritative problem-solving tool that is capable of reducing costs while preserving or improving performance and quality requirements.
5. MohamedAbdelghany, RachaRahwan, Abotaleb and Amr Fathy, presented three case studies of value engineering applications in the architectural and electromechanical disciplines in a real large-scale residential project. In these case studies, the methods and calculations of value engineering studies were presented. The overall estimated savings which resulted from the value engineering study were between the range of 20% to 50% of the principal cost; hence a significant reduction in the overall project cost was achieved. The paper then provided a semi-generic recommendation matrix for design alternatives in various disciplines and their summarized advantages on residential projects. The provided matrix shall support designers at very premature design stages to produce economically and aesthetically efficient design segments.
6. Khalid and Pandey suggested that a lack of management support is not a primary cause of the lack of use of VE as a construction management tool, senior management needs to appreciate its benefits. The decision made in the early stages of the project affects all its aspects, yet the industry spends the least on this stage.

III. METHODOLOGY

1. Information Phase:

The aim of this phase is to recognize the constraints which would influence the decisions involved in a project. The team collects data about project scope, schedule, budget, costs, risk, strategic objectives, and logistical needs by conducting site visits. Various software can be used for this phase. The

main outcome of this phase is to ensure that the team members have the same understanding of the project, leading to the better derivation of creative alternatives in later stages with minimizing mismatches.

2. Analysis Phase:

In the analysis phase, the information collected is scrutinized evidently. All the individual elements are taken into consideration and the main activities which consume more cost are shortlisted and also the total budget for the project is generated in the form of a report.

3. Creative Phase:

In this phase, alternative ideas for accomplishing the function of a system are made. The major work that is done in this phase is to fix the alternative materials and technologies which must be substituted with the existing materials and technologies in conventional construction. The concepts grown in this phase should be such that the quality must not be affected.

4. Evaluation Phase:

The ideas engendered during the creative phase are screened and evaluated by the team. The ideas which exhibit maximum potential for saving cost and project enhancement are chosen for further studies.

5. Report/Presentation Phase:

In the report phase, the alternatives which are evaluated are to be implemented and a report showing differences in cost for each and every activity is generated. The variation in cost is also presented in this phase.

Cost Reduction Substitutes:

Some of the materials used as cost-saving replacements through Value Engineering are as follows-

- **Silico Fix**: A new ready mix thin bock jointing mortar by the name of "Silico Fix" can be used for laying AAC blocks and concrete blocks, etc. It is a premixed cement-based product that requires just the addition of water to generate an easily applicable mortar, to give durable joints of 3mm. Silico fix has a combination of cement, graded sand and additives formulated after extensive research to provide the best adhesion and bonding strength.
  - Benefits:
    - Higher productivity: Fast-setting mortar allows uninterrupted laying and takes less time than conventional mortar united with good workability.
    - Increases speed of construction: Before the next stage, like plastering only 24 hours are needed.
    - Quick setting properties of this mortar.
    - Up to 80% fewer mortar materials wipe out the need for large quantities of sand and cement storage on site. Better adhesion, more stability and durability can be achieved.

Below is the tabulated data for the Rate Analysis per cubic. meter for ACC block masonry work:

-Table1:

PARAMETERS	**VALUE ENGINEERING TECHNIQUES**	
	Cement Mortar	**Silico Fix**
Material Cost	685	386
Labour Cost (per Sq.ft)	34	28
Total Cost	719	414

Table1: Rate Analysis Table

Thus from the above-tabulated result of the AAC block adhesive i.e. SilicoFix is less expensive and more cost-effective. SilicoFix has many advantages and is cheaper than conventional mortar due to its advantages, the cost of curing, transportation and labour also reduces. Hence, one must consider buying SilicoFix as the profitable option, while constructing with ACC Block.

- **Silico Plast**: Silico plast is a ready mix plaster which can be used for external plaster, internal plaster, ceiling plaster and waterproofing. It can be used efficiently on Red clay Ash brick, Concrete blocks and AAC Lightweight blocks and other types of light Weight blocks. It is a cement-based and water-resistant plaster which is prepared to use by just totaling the required quality of water at the site. The use of Silicoplast ready mix plaster as against traditional plastering helps in reducing leakage, shrinkage and crack. It is chiefly manufactured to replace the conventional site-mixed

plaster made of cement and sand, gypsum plaster, stucco plaster, or any other premixed/ready-mixed plaster offered in the country. The use of Silicoplast reduces time and labour costs as well as wastage and aids in easier material reconciliation even finishing on which filling, painting or marble/granite fixing can be done with speed and efficiency. It offers quality plastering which enhances durability and gives a smoother finish to the wall.

- Benefits:

  - Silicoplast Polymerized Dry mix plaster compromises great quality, sturdy and robust plastered surface which enhances the durability of the structure which improves the durability of the structure on which it is applied.
  - It is easier to use by adding the required amount of water.
  - It does not contain any impurities.
  - It offers a plaster mixture that is well-compressed and standardised, thanks to accurate gradation and automatic river sand proportioning.

Below is the tabulated data for the Rate Analysis of 100 sqm plastering of 12mm thickness:

PARAMETERS	**VALUE ENINEERING TECHNIQUES**		
	CEMENT MORTAR	**GYPSUM PLASTER**	**SILICO PLAST**
MATERIAL COST	10137	11148	9936
LABOUR COST	13150	13150	13150
TOTAL COST	23287	24298	23086

Table 2: Rate Analysis Table

From the above-tabulated result, silicoplast is compared with conventional cement mortar mix and a ready-mixed material called gypsum plaster. By analysis, it is observed that silicoplast is a cost-effective alternative. Due to its benefits and cost-effectiveness, silicoplast surpasses the other two mentioned materials.

- **Reinforcement Couplers**: For any concrete structure, reinforcement is significant as concrete also it is vital in huge quantities in construction projects. So, in the overall material cost, reinforcement costing is considered a major cost. For tumbling the quantity of reinforcement at the implementation stage, the use of reinforcement couplers can exclude the method of lapping of bars. Moreover, reinforcement couplers give more sophisticated strength than lapping bars at a feasible cost. In the overall project, reinforcement cost holds the major part of the material cost. Due to the lapping of bars, it becomes uneconomical, as in market reinforcement couplers are available with higher strength than the lapping of bars at a feasible cost.

SR.NO	**DIA OF REBAR(MM)**	**TOTAL COST OF LAP (Rs.)**	**COST OF COUPLER INCLUSIVE OF THREADING OF REBAR (Rs.)**
1	40	821.72	420.00
2	36	599.04	330.00
3	32	420.68	250.00
4	28	281.84	230.00
5	25	200.72	150.00
6	20	102.96	125.00
7	16	52.52	110.00
8	12	22.36	95.00

Table 3: Cost Comparison for Lap Length 40D

Thus from the above-tabulated datait can be said that by using reinforcement couplers instead of lapping the rebars a considerable cost can be reduced.

IV. CONCLUSION

Using cost reduction techniques like value engineering by a multidisciplinary team, value and economy are improved through the study of alternative design materials and construction methods without compromising functional requirements and quality. In this study, on the basis of site visits conducted it was observed that very few practitioners are

involved in ethical practices of value engineering. So, the development of VE in the Indian construction industry should continuously research and monitored in the future to ensure its future development and to achieve maximum benefits to the construction industry. In this paper, a detailed analysis was carried out to find some effective alternatives focusing on masonry and reinforced cement concrete work. It resulted that using a silico fix, the cost was reduced by 45%. Also on comparing silico plast with the conventional material and modern material i.e. cement plaster and gypsum plaster a considerable reduction of about 1% and 5% were observed respectively. Further, the study also stated that instead of using lapping of bars, if the use of reinforcement couplers is adopted effective cost saving can be achieved.

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