Strategic Cost Optimization By Using Value Engineering In Building Construction

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Abstract- *This paper relates with applying the concept of value engineering in a residential building project; which would in turn assist to reach out better quality but with lower cost. It is the process of relating function, quality, and cost of the project in determination of optimal solutions for the project. In this study, first site visits were conducted to know existing practices on site in order to bring about, a reduction in overall project cost. By analyzing the data cost effective alternatives where inferred. This paper mainly focuses on new materials that can be adopted for masonry work in construction industry. It has been observed that maximum potential benefits can be achieved by adopting VE techniques in terms of economy, functionality, higher reliability and increased value of the building structure throughout its life cycle.*

Keywords- value engineering, site visits, cost effective alternatives, masonry work, silico fix, silico palst, couplers.

I. INTRODUCTION

Value Engineering is a authoritative approach for saving the cost and improving quality. Principally as the construction industry contributes to a major part of the worldwide economy. Presently, value engineering not only influences the cost and quality of a project, but also it proved to have positive impacts on the environment and the worldwide trend of green construction. Value engineering takes into consideration both the initial and maintenance costs.

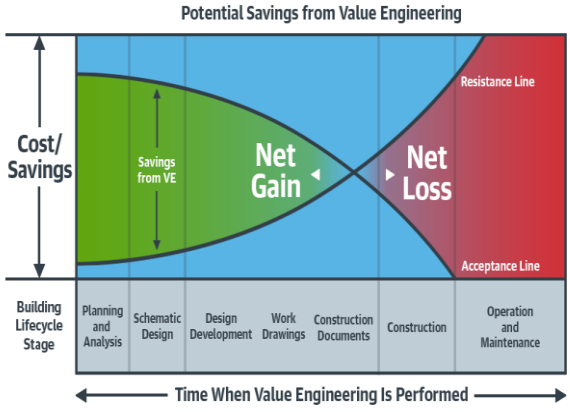

Fig. 1, Graphical representation of VE

As shown in Fig. No.1 The main target of Value Engineering is to achieve high value at low cost. Value Engineering (VE), also referred to as Value Methodology (VM) or Value Analysis (VA), is systematic process to improve the value of a project through the systematic identification & eradication of unnecessary costs which results in the increased use of alternatives, cheaper materials and designs, less costly methods of construction, etc. to provide the same performance, quality & in a decrease of overall unit cost & consequently greater profits. Value can be defined as a fair return or equivalent in terms of goods, services, money for the thing 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 by 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 with a view to pinpointing unnecessary costs, obvious and hidden which can be eliminated without negatively affecting quality, efficiency, safety and other customer requirements.

The VE methodology has general approach; therefore it can be applicable to almost all types of construction activities. VE not just has noteworthy advantages in functional improvements, reduction in cost, & 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 the cost reduction. 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 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 there by achieving the optimum material usages.
- 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 application of value engineering in construction projects in terms of time, quality, competence and superior management.

II. LITERATURE REVIEW

[1] SuryaTeja Reddy and Satyanarayana Polishetty, conducted a case study on residential building to study value engineering application. Detailed cost of existing construction was studied and effective alternatives were suggested for varies materials.

[2] MohamedAbdelghany, RachaRahwan, Abotaleb, 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 principle 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.

[3] Ferry and Fadil and Khairulzan, stated that adoption of prefabrication construction methods, intelligent excavation works, reduce-reuse-recycle principles and simple environmentally aware on site practises can minimize waste produce and local environmental impacts emitted during project execution. Green building design shall encompass Value Engineering and Lean Construction concepts in order to achieve sustainable construction industry.

[4] Khalid and Pandey, suggested that a lack of management support is not a primary cause of the lack of use VE as a construction management tool, senior management needs to appreciate its benefits. The decision made in early stages of project affects all its aspects, yet the industry spends the least on this stage.

[5] K.Ilayaraja and MD. Zafar Eqyaabal, has conducted a vast study on value engineering and the application phases has been analyzed in the thesis from the study. It is observed that value engineering is a authoritative problem-solving tool that be capable of reducing the costs while preserving or improving performance and quality requirements.

[6] Mr. A. J. Velani and Dr. A. R. Kambekar,suggested technique which can applied to reinforced cement concrete work for reinforced concrete structures. They came up with replacement of river sand to crushed sand & provided a detailed study on couplers to avoid lap length.

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

2. Analysis phase-

In the analysis phase, the information collected is being 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 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 creative phase are screened and evaluated by the team. The ideas which exhibit maximum potential for saving the cost and project enhancement are chosen for further studies.

5. Report/ presentation phase-

In 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 of cost is also being presented in this phase.

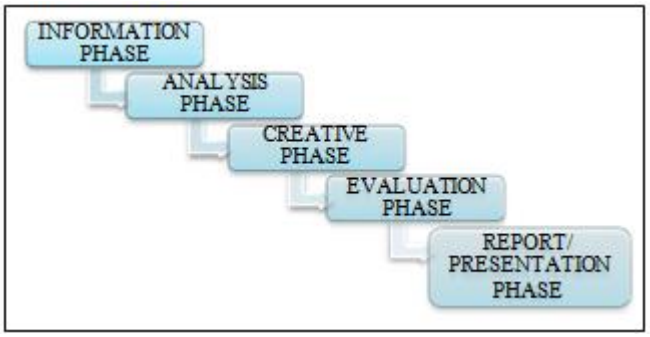

Fig. 2, Flow chart on methodology

A. Silico Fix

Fig. 3,SilicoFix-Block jointing material

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.

Product Features:

a) Grey colored dry, premixed powder
b) Quick drying and rapid setting
c) Easy to apply
d) Reduced shrinkage
e) Better water retention properties
f) Water-curing is not required after application
g) No raking of joints required before plastering

Benefits:

- Higher productivity – Fast setting mortar allows uninterrupted laying and takes less time than conventional mortar united with good workability.
- Increases speed of construction – Only 24hrs required before next stage like plastering.
- Quick setting properties of this mortar remove any limitations on the height of walls that can be built in a day.
- Up to 80% less mortar materials; wipe out the need for large quantities sand and cement storage on site. Seepage and percolation of water from the joints is insignificant. Better adhesion, more stability and durability can be achieved.

Rate analysis for per m^3 of AAC block masonry work;

TABLE I. RATE ANALYSIS TABLE

Parameters	Value Engineering Techniques	
	Cement mortar	*Silico Fix*
Material cost	685	386
Labour cost (per sq. ft.)	34	28
Total cost	719	414

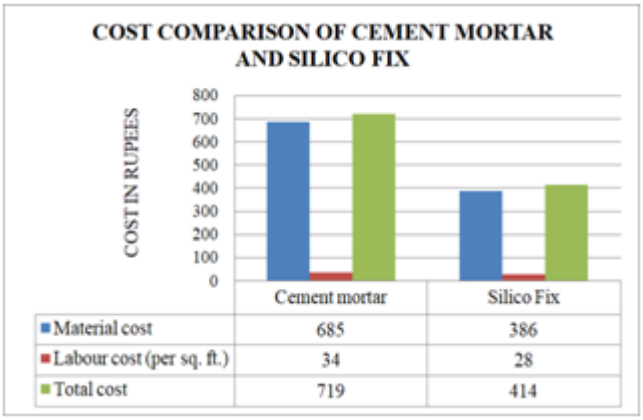

Fig. 4, Cost comparison

NOTE: Here wastage is not considered, if wastage is accounted then the cost would further increase.

Thus from above calculation 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 labor also reduces. Hence, one must consider buying SilicoFix as the profitable option, while constructing with ACC Block.

B. Silico Plast

Fig 5, SilicoPlast-Plastering material

Silico plast is a ready mix plaster which can be used for external plaster, internal plaster, ceiling plaster and water-proofing. It can be used efficiently on Red clay Ash brick, Concrete block and AAC Light weight Block and other type of light Weight block. It is a cement-based and water-resistant plaster which is prepared to use by just totaling required quality of water at 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 country. Use of Silicoplast reduces time and labor cost as well as
wastage and aids in easier material reconciliation even finish on which filling, painting or marble/granite fixing can be done which speed and efficiency. It offers quality plastering which enhances durability and give a smoother finish to the wall.

Product Features:

- Grey colored dry
- Easy to apply
- Reduced shrinkage
- Plaster thichness:8-20 mm/ coat
- Water-curing is required for 8 hours
- Initial setting time 60-90 minutes.
- Coverage – 1 bag for 26 to 28 sqft of 12mm thickness
- Water addition: 6.5-7 lit./40kg

Benefits:

- Slicoplast 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 structures on which it is applied.
- It is easier to use by just addition essential quantity of water at site. Silicoplast does not contain impurities like silt, clay, etc.
- It delivers a well compacted standardized mix of plaster, due to proper gradation, proportioning of river sand in automated process.
- It reduces wastage, shrinkage, leakage and cracks formation to very great extent. It ensures substantial saving of time and labour costs in all projects.

Rate analysis of 100m^2 plastering of 12mm thickness;

TABLE II. RATE ANALYSIS TABLE

Parameters	Value Engineering Techniques		
	Cement mortar	*Gypsum Plaster*	*Silico Plast*
Material cost	10137	11148	9936
Labour cost	13150	13150	13150
Total cost	23287	24298	23086

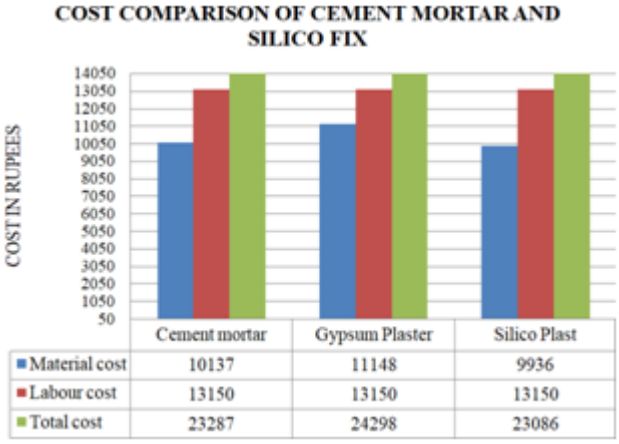

Fig. 6, Cost comparison graph 2

NOTE: Wastage is not considered here, if accounted then there would be a further increase in the cost.

In above calculation 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.

C. REINFORCEMENT COUPLERS

For any concrete structure, reinforcement is significant as concrete also it is vital in huge quantity in construction project. So, in the overall material cost, reinforcement costing is considered as a major cost. For tumbling the quantity of reinforcement at the implementation stage, use of reinforcement couplers can exclude the method of lapping of bars. Moreover, reinforcement couplers give sophisticated strength than lapping of bars at a feasible cost.

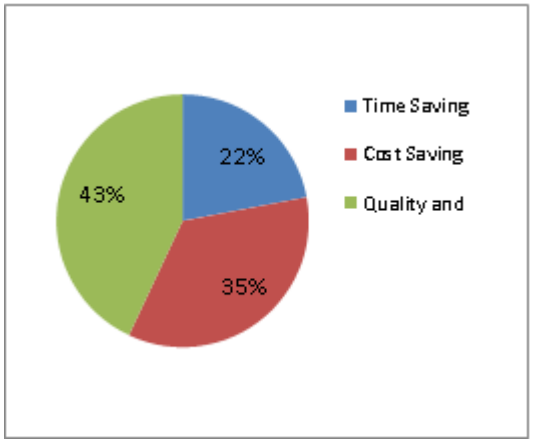

Fig. 7, Performance of Reinforcement couplers

Use of Reinforcement Couplers instead of Lapping of bars:

In the overall project, reinforcement cost holds the major part in the material cost. Due to lapping of bars it becomes uneconomical, as in market reinforcement couplers are available with higher strength than lapping of bars at a feasible cost

TABLE III. COST COMPARISON FOR LAP LENGTH 40D

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

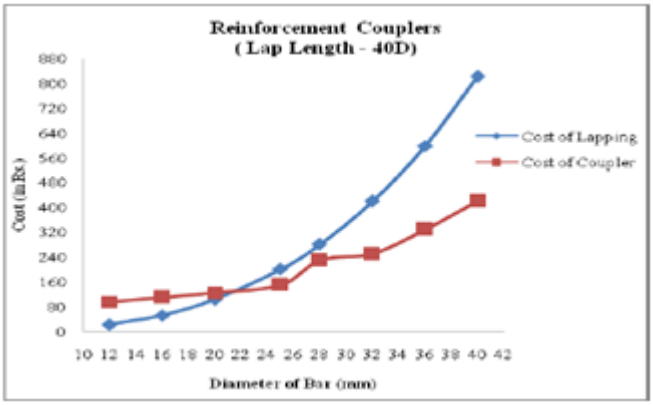

Fig. 8, Cost comparison graph 3

Thus it can be observed from the study that by using reinforcement couplers instead of lapping the rebars a considerable cost can be reduced.

IV. CONCLUSION

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 silico fix, 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 use of reinforcement couplers is adopted effective cost saving can be achieved.

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