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Implementation Of value Engineering in construction Management

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ABSTRACT
The building industry's transport infrastructure is crucial to the nation's socioeconomic growth. Due to the significance of the building sector to the nation's economy, professional construction techniques that are both cost- and time-effective are crucial. This article describes the fundamentals of cost estimation and the numerous time optimization approaches. Throughout the life cycle of a project, value engineering is crucial for enhancing quality, dependability, durability, and performance.
Keywords-*Construction, Construction Methods, Quality, Time Reduction, Value Engineering*

1. INTRODUCTION

Infrastructure development in construction industry is a key driver in socio economic development of the country. As construction industry play a vital role in economic growth and development of the country, it is in need to have proper construction techniques which are cost effective. Various cost reduction technique are as follows- "Thinner walls or single brick thick walls", "Load bearing brick work", "Brick on edge cavity wall", "Precast stone masonry blocks", "Modular brick masonry walls", "hollow clay blocks of shell type houses", "Sundried brick walls with waterproof treatment", "precast hyperbolic shell for roofing". All these techniques comes under "**Value Engineering**"

1.1 VALUE ENGINEERING?

Value engineering is a systematic application of recognized techniques which identify the functions of the product or service, establish the worth of those functions, and provide the necessary functions to meet

the required performance at the lowest overall cost. Value engineering concentrates on the effectiveness through stating functions, goals, needs, requirements and desires.

Where, V is Value, F is sum of total function performance and C represents cost paid for it. The relation of F and C shows that lower the cost for optimum function, better the value.

1.2 HISTORY OF VE:

Value engineering concept was started by Mr. Lawrence D. Miles during 1940's. He worked for General Electric Company (GEC), USA which faced scarcity of strategic material needed to produce their products during world war-II. Mr. Mile was appointed in GEC in purchasing department. At that time there was shortage of steel, copper, bronze and other materials. GEC wanted to expand its production of turbo supercharger for B24 bombers from 50 to 1000 per week. Miles was assigned the task of purchasing material to permit this. Often he was unable to obtain specific material, so he thought to obtain an alternative which can perform the same function. Miles observed that many of substitutes were providing equal and better performance at the lowest cost and from this incident evolved the concept of value engineering.

1.3 WHERE TO FIND MORE ABOUT VALUE ENGINEERING?

The best and most convenient way to learn the technique of Value Engineering and its application, is by becoming a member of Indian Value Engineering Society (INVEST).

INVEST is a professional society established in October, 1977 and dedicated to the advancement of Value Engineering through education. This provides a better understanding of the principles, methods and concepts of value technology. INVEST has members in virtually every state in India. It maintains a network of chapters throughout the country and provides its members with additional educational opportunities at the local level.

INVEST is affiliated to the Society of American value Engineers (SAVE).

1.4 SCOPE OF VALUE ENGINEERING

1. Job analysis distinctive way (function analysis).
2. Get appointed a large amount of good ideas that are applicable.
3. The action plan in place which consists of several sequential stages of a logical sequence.
4. Multi-disciplinary team working in the studies of collective values.
5. Ensure coordination between the relevant authorities in the project.
6. Quality is not compromise.

Some examples might be:

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- Looking at the cost differences between steel and concrete structural systems.
- Using different mechanical equipment with similar characteristics.
- Reducing the lighting levels due to day-lighting; combining office functions into one space.
- Changing the building shape to improve the exterior wall to floor area ration.
- Reducing finish allowances.

Value engineering is typically able to reduce the cost of a project by 5% to 10% beyond which more aggressive methods must be used Alternatives are portions of the work that can be deferred until later in the project when more is known about how much of the project contingency bidding can be applied to the desired work. Alternatives are often items that may have another source of funds such as Deferred Maintenance monies, which might be done separately. They might also be areas of planned programmatic growth that will not be needed when the building is finished and can be “shelled” for a future project. Alternatives are best applied at later stages of design because history has shown that many alternatives at this stage cannot be afforded later in the project, thus they become de facto scope reductions.

Scope Reductions are perhaps the most difficult aspect of any project because they are usually permanent reductions in quantity or quality of program space.

Scope reductions at this point might include:

- Reducing the number or size of rooms
- Eliminating special features that would enhance a program
- Reducing the volume of space
- Eliminating special mechanical systems or features
- Reducing the site area impacts.

There is often a tendency on projects to try to gain more scope within the budget. This is known as “scope creep” and so it is important to verify the design against the original program plan on which the budget was based. The first round of scope reductions tend to be areas where the design exceeds the original program plan before moving into other reduction areas. Ultimately, most projects are able to achieve a balanced budget. If that is not the case, additional funds might be diverted out of project contingency or it may be necessary to raise the total project budget through a program plan amendment. This requires documentation and submission back through the Approval Phase causing a delay of four to six months, thus it is important that project team work diligently to contain project costs. Anyone concerned with the cost of a construction project has heard of value engineering. Does the original vision of a palatial structure threaten to exceed the budget? The answer is often, "Let's value engineer that "Sometim es, value engineering looks like the solution to every budget problem, the magic wand that makes costs shrink and budgets balance. But what is it really? Is value engineering just a marketer's spin on cost cutting, a way to make settling for less palatable? If so, the term is being misused. As the federal government defines it, "Value engineering attempts to eliminate, without impairing essential functions or characteristics, anything that increases acquisition, operation or support costs." So reducing the size of a building by 10 percent or eliminating a media centre would cut costs - but it would not be value engineering.

The Federal Highway Administration, long a proponent of value engineering, calls it "an organized application of common sense and technical knowledge directed at finding and eliminating unnecessary costs in a project". Value engineering is not just a term of art in the construction industry. It actually got its start in manufacturing and is proof of the saying that necessity is the mother of invention. During World War II, General Electric was trying to do more with less – less raw material, less skilled labour and fewer component parts. Two GE engineers, Lawrence Miles and Harry Erlicher, were given the task of finding acceptable substitutes. They were so successful that they noticed a surprising result: Often the re-engineered product was better than the one originally planned or was at least equally good at a lower cost to produce. Couldn't the technique used to solve GE's immediate problems be applied to any manufacturing challenge, with beneficial results? Miles and Erlicher thought so, and they set about describing what they were doing as a systematic process. They called it value analysis. The idea spread, and as others began to use it, they changed the name to emphasize the context, not the analysis of a belief system, but engineering for improved value, or value engineering.

1.5 AIM AND OBJECTIVE

1.5.1 Aim of study

To perform value engineering for two Commercial building for better project tracking and cost efficiency

1.5.2 Objective of study

- To study value engineering and its implementation in construction industry.

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- To identify cases for cost overrun and it is reduction in construction activities.
  To compare projects cost and time schedule after application of value engineering

1.6 BENEFITS OF VE

Value engineering is used:-

- To determine best design alternative
- To reduce cost
- To identify problems and develop solutions for them
- To improve quality
- To increase reliability, availability and customer
- To save time
- To increase safety

1.7 ADVANTAGES OF VE:-

Value engineering is characterized by a branch of knowledge and practical methods to solve problems for other quality improvement in the following:

1. Job analysis distinctive way (function analysis).
2. Get appointed a large amount of good ideas that are applicable.
3. The action plan in place which consists of several sequential stages of a logical sequence.
4. Multi-disciplinary team working in the studies of collective values.
5. Ensure coordination between the relevant authorities in the project.

1.8 APPLICATION OF VALUE ENGINEERING

Value engineering is one of the most effective techniques available to identify and eliminate unnecessary costs in design, testing, manufacturing, construction, operations, maintenance, procedures specifications and practices. It involves the application of systematic planned procedure to obtain a desired effect by comparing the cost of component with respect to its purpose or functioning in the production or assembly. The most important aspect of VALUE is difficult to define and often confused with the term cost or price but it is applied to both the subjective qualities (determined by the emotions) and objective qualities (determined by external characteristics). Aristotle way back in the year 350 B.C. classified value in seven classes which are still recognized today; these are:-

1) Economic
2) Moral
3) Aesthetics
4) Social
5) Political
6) Religious
7) Judicial.

Of these, only the economic value can be measure in the external units and other classes are subjectively scaled.

VE can be applied at any stage in a project, even in construction. However, the earlier it is applied the higher the return on the time and efforts invested. Thus, the greatest benefit and resource saving is achieved in planning and conceptual stage. At this point major information is established but before major design and development resources are spent.

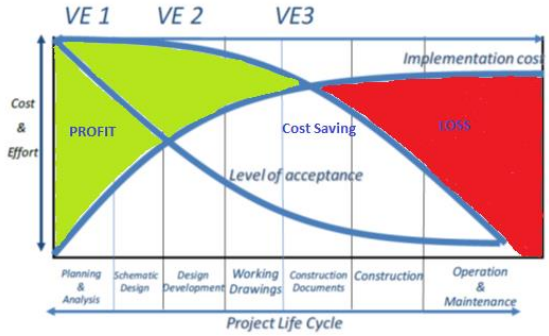

Fig.1: The stages of VE application

The three main stages of a construction project and VE application is as shown in figure1.

1.9 Planning and schematic design (VE1):

The first VE study VE1 is applied during the planning and schematic design stage to define the project goals, functions, objectives, requirements, design criteria and scope of work. Benefit of starting VE at this stage is that project will be developed with fewer changes, redesigns and greater understanding by all parties of what final function will be. Independent teams can bring alternative and creative solutions from other similar projects.

1.10 Design Development (VE2):

The second VE study VE2 is applied in design development stage to generate detailed VE proposals and alternatives to the design and to define technical systems. In this stage of VE, multiple design alternatives are considered and the most cost effective and overall efficient alternative is selected. Suggestions by other personal like constructor, designers are also taken for improvement

1.11 Construction (VE3):

During this phase value engineering is still possible though the use of VE change proposal. But application of VE at this phase is generally costly and difficult to implement due to resistance to change.

2. METHODOLOGY

Construction projects are implemented in different countries with heavy costs and some of the projects have been relatively or absolutely unsuccessful and

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even faced with irreversible losses after construction. Maybe, it is due to complexities related to projects or other social-economic phenomenon. The present study revealed that value engineering can be used as a helpful tool from the beginning of studies to the end of designing, constructing, exploiting, and maintaining processes and overcome civil designs' challenges and complexities. Value engineering is a method experienced in management that has an organized approach. Value engineering has a systematic and cooperative mechanism to analyse function and systems with the aim of achieving desirable function with the least costs. This study has attempted to briefly introduce concepts and executive process of value engineering in construction projects. Also, the study has attempted to investigate conventional methods of evaluating projects function and compare them convergence with value engineering to improve projects. Based on the research findings, it can be found that if we can expect to achieve projects objectives by spending the least cost and ensure the efficacy of investment in construction projects management sector as a main challenge of development plans in the third world countries through using engineering in appropriate time periods and in different phases.

We are using some alternatives in our case study, they are as follows:

2.1 PARTITION WALL:-

Almost all exterior walls are load-bearing, meaning they bear the weight of the structure above and transfer it through lower walls to the ground. Interior walls consist of both load-bearing walls and walls that don't bear weight, called partition walls. You can build a partition wall almost anywhere.

We are using CLC bricks instead of burnt clay bricks with less thickness as compared to burnt clay bricks. Generally normal thickness provided in building is 6", we are providing 4" wall thickness in our plan. It will reduce cost of concrete, bricks and even cost of labours. Load on beam and column will be Reduced, thus size of beam and column will also be reduced. And hence, we get more space for carpet area. Proper grouping is provided by partition wall.

2.2 CAVITY WALL: -

We are using hollow CLC bricks for cavity wall. It will reducing the overall load of structure. It will be more beneficial because it gives better insulation resistance. Leakage can occur through the outer leaf through joints between bricks and mortar. It avoids moisture passing through the wall.

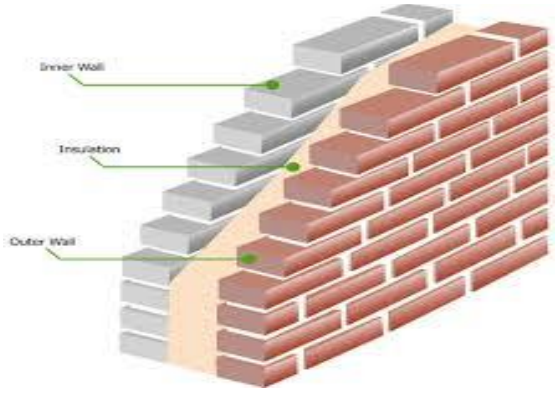

Fig.2 : Cavity wall

2.3 ECO-FRIENDLY PAINT: -

We are using eco-friendly paint on external wall. Cost of plastering is reduced, as no plaster is applied on external wall. As the cost of paint is high but it increases the life span of external wall and overall structure. It will also resist the atmosphere effects. This paint increases the life span of external walls by 10 years more than normal paints of external wall and cracks will be automatically healed.

2.4 CLC BRICKS: -

Use of CLC (Siporex) bricks, will increase the total cost of construction but, it decreases total dead load, as they are lighter in weight. At the time of earthquake, total load of the structure on the foundation, will be less thus, the intensity of earthquake would act to a lesser extent. Time required to construct any structure is less i.e., construction is easy & construction cost n labour cost also less.

Fig.3: CLC blocks wall

CLC blocks are light in weight with a density of 600 – 700 kg/cum. Due to this lightweight they are easy to handle and decreases the dead load on the structures thereby optimizing the reinforcement consumption. Its also easy to chisel for services (Electrical and Plumbing) installation. These blocks have very high dimension accuracy dimension accuracy. These blocks also have better thermal and acoustic properties. The amount of plaster they consume per sqft is also low as compared to other block/brick masonry.

Most construction today is not load-bearing masonry but frame structures of light but strong materials, that

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support floor slabs and have very thin and light internal and external non–load bearing walls Most modern multi-stored buildings are constructed with structural frames and non-load bearing walls. In a non-load bearing structure, Customization, Major alteration and Renovation can be done without affecting the parent structure. Non – Load bearing masonry construction is in-vogue because It performs very well in earthquakes as structural frames take care of same, is low labour & material intensive, very flexible in terms of internal floor layout

Fig.4 : Siporex brick

2.5 SOFTWARE USE:

3.6.1 MSPMicrosoft Project is a project management software programme created and distributed by Microsoft. It is intended to help a project manager create a schedule, allocate personnel to tasks, measure progress, manage the budget, and analyse workloads.

Microsoft Project was the third Microsoft Windows-based programme developed by the business. Within a few years of its release, it had established itself as the main PC-based project management software. Although it is a member of the Microsoft Office family, it has never been included in any of the Office suites. It is now available in two editions: Standard and Professional. The Microsoft Office enterprise project management (EPM) software is built around Microsoft Project and Microsoft Project Server.

Microsoft Project is a set of tools for competent and well-organized project assistance and management. This software tool can be used to assist any sort of project from various lines of work such as construction, manufacturing, pharmaceuticals, government, retail, financial services and health care. Although developed by Microsoft, the software is not a part of the Microsoft Office suite.

Microsoft Project is offered in standard and professional editions, depending upon the project requirements and management level. The format of a Microsoft Project file is .mpp. It is one of the most commonly used PC-based project management tools, and is designed to assist managers in tasks such as:

- Devising plans
- Setting realistic goals
- Defining resources
- Assigning tasks
- Recording progress and finances
- Monitoring workloads
- Scheduling meetings
- The software includes an easy-to-use assistance wizard that guides the user throughout the course of the project from creation to resource identification, assigning tasks and obtaining final results. Microsoft Project is also known as Microsoft Office Project.

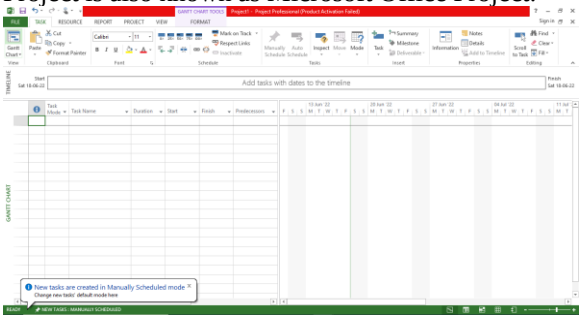

Fig.5 Microsoft Project Server

2.6 MS EXCEL FOR ESTIMATION

MS Excel is a commonly used Microsoft Office application. It is a spreadsheet program which is used to save and analyse numerical data.

In this article, we bring to you the important features of MS Excel, along with an overview of how to use the program, its benefits and other important elements. A few sample MS Excel question and answers are also given further below in this article for the reference of Government exam aspirants.

2.7 Features of MS Excel

Various editing and formatting can be done on an Excel spreadsheet. Discussed below are the various features of MS Excel.

Home: Comprises options like font size, font styles, font colour, background colour, alignment, formatting options and styles, insertion and deletion of cells and editing options

Insert: Comprises options like table format and style, inserting images and figures, adding graphs, charts and sparklines, header and footer option, equation and symbols

Page Layout: Themes, orientation and page setup options are available under the page layout option

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Formulas: Since tables with a large amount of data can be created in MS excel, under this feature, you can add formulas to your table and get quicker solutions
Data: Adding external data (from the web), filtering options and data tools are available under this category
Review:
Proofreading can be done for an excel sheet (like spell check) in the review category and a reader can add comments in this part
View: Different views in which we want the spreadsheet to be displayed can be edited here. Options to zoom in and out and pane arrangement are available under this category
MS Excel is a spreadsheet program where one can record data in the form of tables. It is easy to analyse data in an Excel spreadsheet. The image given below represents how an Excel spreadsheet looks like:

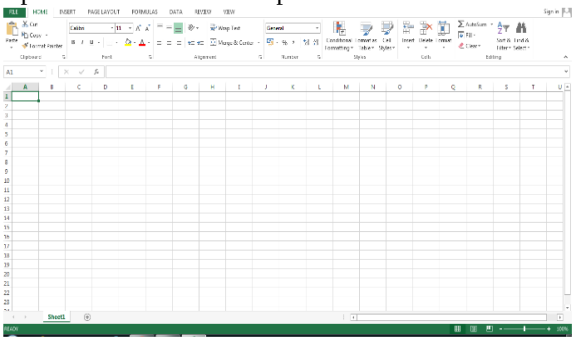

Fig.6 : Microsoft excel for estimation

3. CASE STUDY

3.1 STUDY AREA 1 CONVECTIONAL BUILDING: (COMMERCIAL)

18 LATITUDE

Fig.7: 3rd Eye view of actual site

SITE DETAILS

- Name of site :18 Latitude.
- Location of site : Punawale, Mulshi, Pune
- Site Engg: Manoj Gawade
- A proposed commercial building having 7 floor and102shops is taken for case study location is in Punawale, Pune.
- Design Team: Sanskruti construction
- Owner and Developer :G. D. Square and Akshay Chordiya
- Architect: Rajas Designers
- Cost of project : 16 Cr
- Structural Engineer : Structural Consultants
- Builder :G. D. Squareand Akshay Chordiya
- Area: 92000 sq. ft.
- Commercial building having No. of Towers: 1, No. of Floors: 7 Floors, No. of showroom:6.
- Present condition of the project: Under construction
- No. of Towers: 1, No. of Floors: 7 Floors, No. of showroom: 6

3.2 STUDY AREA 2 VALUE ENGINEERED BUILDING (COMMERCIAL)

SHIV SAI MILENIUM

Fig.8 : 3rd eye view of actual site

SITE DETAILS

- Name of site : Shiv Sai Millenium
- Location of site : Shiv Sai Millenium is a commercial development in Punawale, Pune. 411033
- Design Team : Shiv Constructions Pune
- Owner and Developer : Dipak Pawar
- Architect :manojtatuskar and vikasacharikar
- Cost of project : Offices, Shops & Restaurants
- Rs. 42.35 Lakhs * - 15.65 Cr*
- Size : 332.927 - 4632.029 Sq.ft.
- Builder : Shiv Constructions Pune
- Area : 1.44 acres
- Commercial building having No. of shops: 136, 1 Tower No. of Floors: 14 Floors,
- This project is based on sustainable structure
- Present condition of the project : Under Construction possessions from September 2022

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- No. of Towers: 1, Tower

4. RESULTS AND DISCUSSION

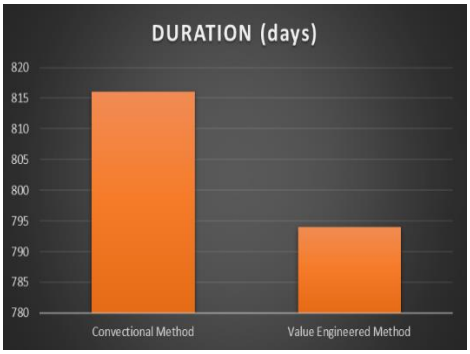
1 DATA ANALYSIS OF CASE STUDY - 1

Rate analysis is done to workout rates used in construction

From data collected from site WBS is prepared from working drawings and MSP schedule is prepared the important aspect of quality planning such as time, resources like machine and materials factors are added in MSP schedule for cost of quality.

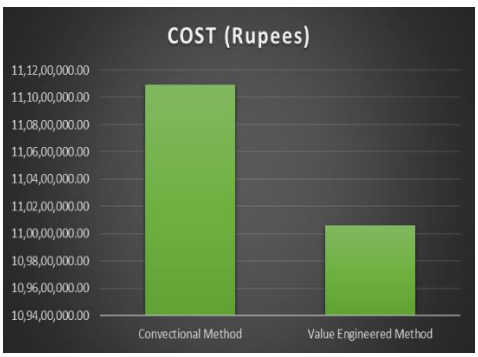
We have collected the drawings from the site and in MS- Excel we have found out all the quantities manually, the quantities are as listed below in the Table.

METHOD	DURATION (days)
Convectional Method	816 days
Value Engineered Method	794 days



Graph No. 1 comparison of time in days

METHOD	COST (Rupees)
Convectional Method	111,092,184.00₹
Value Engineered Method	110,062,084.00₹



Graph No. 2:- comparison of cost in rupees

Above graph shows Comparison of cost between convectional and value engineered method of building.

5. CONCLUSIONS

- It was discussed that using value engineering methods by multidisciplinary team, value and economy are improved through study of alternative design concepts, material and construction methods without compromising functional requirement and quality.
- A second look at the design produced by architect and engineers gives the assurance that all reasonable alternatives have been explored. From study it is seen that different parameters of value engineering alternatives helps to find best solution.
- Thus, value engineering assures best value will be obtained over life cycle of the building or structure. 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 solution.

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