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Application of Value Engineering in Construction Building

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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.*

Value Engineering is a methodology used to analyze the function of the goods and services and to obtain the required functions of the goods and service of the user at the lowest total cost without reducing the necessary quality of performance. The program seeks to improve the management capability of people and to promote progressive change by identifying and removing unnecessary cost.

I. INTRODUCTION

1.1BACKGROUND

The construction sector is one of the main players in economic growth. In India it is the second highest employer, after agriculture, employing over 32 million people. The construction sector in India accounts for 5% of the gross domestic product and 38% of the gross domestic investment. The construction sector is broadly divided into four areas; infrastructure (54%), industrial (36%), residential (5%) and commercial (5%). According to estimates, the construction business volume is about Rs. 2400 billion. Earlier the industry was growing at over 10%, which decelerated due to the economic slowdown. Now it is looking up again.

Construction industry is an index of growth of a nation. Today, the construction industry is the second largest employing skilled and semiskilled labour after agriculture and plays an important role in our nation's economy. Due to increase in business opportunity and migration of labour, the demand for commercial and housing spaces has also increased. According to the tenth five year plan (July, 2003), the estimate of shortage in urban housing is assessed to be 8.89 million units. As of now, the housing and construction industry employs 30nmillion people and about 250 industries are associated with construction industry directly or indirectly.

Keeping costs low with traditional methods has been a common practice to improve competitiveness. Saving money and, at the same time, providing better value is a concept that everyone emphasizes. Value Engineering is a practice whose goal is, always, to achieve value for money.

Value Engineering aims to deliver measurable value improvements through cost reduction and or improve quality and enhance design features for the customer. These disciplines cannot be ignored if a company is to continue meeting the rising expectations of its customer, who will always take their business to where they can get the highest quality at the lowest possible price.

PROJECT DETAILS OF STUDY

SP Info City IT Park at Perungudi has been designed as a green building as per world class systems & procedures

RESULTS AND DISCUSSIONS

2.1 GENERAL

The chapter provides an insight into various aspects of information Phase and Functional Analysis Phase – techniques like NEFR (Numerical Evaluation of Functional Relationship) Methods are used with the procedures involved with implementation of the same in the case study.

2.2 INVESTIGATION PHASE

The first phase of VE is called Information Phase. In this phase all the pertinent aspects of the project were studied. This phase involves defining the project, obtaining the background information, limitations and constraints during design and execution and sensitivity to cost involved in owning and operating a facility. The primary purpose is to obtain as much information as possible, of the project design.

The VE study should try to find the rationale used by the designers for the development of the project and the assumptions and design criteria established for selecting materials and equipments to perform the required functions. The intention is not to criticize but to come up with different alternatives aiming at reduction of project cost.

Several areas of information needed for the VE study during the information phase could are as follows.

i. Design Criteria (System requirement)
ii. Site Condition (Topology, Soil condition, Soil boring, Surrounding areas, Photographs)
iii. Background of the project
iv. Available resources
v. Requirements resulting from public participation
vi. Breakup of cost estimated.
vii. Architectural, structural, service and other drawings

The above information allows the VE study to empathize with the design and other criteria that defined the project development.

2.3 FUNCTION ANALYSIS PHASE

Functional analysis is the primary component of VE. It forces one to broaden the understanding of the project more comprehensively, by simulating intense discussion. A discussion is similar to "out of the box" thinking.

Typical evaluation criteria for assessing value are:
Initial cost, Energy cost, Return on profit, Functional performance, Reliability, Ease of maintenance, Quality, Saleability, Regard or esthetics and Environment owner requirements

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Safety.

2.4 IMPLEMENTATION OF FUNCTIONAL ANALYSIS

All the components of the building under consideration were listed, with their quantities and cost as shown in table 2.1

Table 2.1 Definition Worksheet

Sl. No	Description	Quantity	Unit	Cost Rs.
1	Total RCC work	38500	Cu.m	20,72,05,763
2	Total brick masonry work	22830	Sq.m	2,02,06,230
3	Internal Plastering	48000	Sq.m	48,00,000
4	External Plastering	42273	Sq.m	80,31,870
5	Doors (MS Frame with glass shutter, fittings & joinery)			2,35,67,300
6	Waterproofing work			75,25,000
7	Flooring	55740	Sq.m.	5,21,49,377
8	Painting (Internal)	48000	Sq.m.	62,34,400
9	Painting (External)	42273	Sq.m.	54,90,550
10	Windows & Glazing			3,56,75,450
11	Grills & Railings			1,25,34,545
12	Plumbing Works		L.S	83,55,750
13	Electrical Works		L.S	1,12,56,834
14	Fire fighting Works		L.S	54,00,000
15	Solar Unit Works		L.S	2,24,56,789
16	Lift Works	8	Nos	35,00,000

Source: SP Info City IT Park

FUNCTIONAL DEFINITION WORKSHEET

The individual components were analyzed for their functionality. A number of functions for each component were elucidated and based on the type of function it performs; they were designated as "B" for basic or "S" for secondary function.

From this functional analysis, the basic functions of each of the components were clearly understood.

Table 2.2 Functional Definition Worksheet

Sl. No	Description	Quantity	Unit	Cost Rs.	Function	Kind of Function
1	Total RCC work	38500	Cu.m	20,72,05,763	Facilitate Function	B
2	Total brick masonry work	22830	Sq.m	2,02,06,230	Exclude Elements Divide Space Facilitate Use	B S B
3	Internal Plastering	48000	Sq.m	48,00,000	Hide Defects Improve aesthetics Prevent Water	B S S
4	External Plastering	42273	Sq.m	80,31,870	Hide Defects Improve aesthetics Prevent Water	B S S
5	Doors (MS Frame with glass shutter, fittings & joinery)			2,35,67,300	Control Access Connect Spaces	B S
6	Water-proofing work			75,25,000	Prevent Water	B
7	Flooring	55740	Sq.m.	5,21,49,377	Increase Life Facilitate Use Improve Aesthetics	B B S
8	Painting (Internal)	48000	Sq.m.	62,34,400	Improve Appearance Hide Defects	B S
9	Painting (External)	42273	Sq.m.	54,90,550	Improve Appearance Hide Defects	B S
10	Windows & Glazing			3,56,75,450	Provide Ventilation Provide Light	B S
11	Grills & Railings			1,25,34,545	Provide Safety Provide Appearance	B S
12	Plumbing Works		L.S	83,55,750	Convey Fluid	B
13	Electrical Works		L.S	1,12,56,834	Provide Light Provide Points Improve Safety	B S S
14	Fire fighting Works		L.S	54,00,000	Provide safety	B
15	Solar Unit Works		L.S	2,24,56,789	Harness Renewable Source	B
16	Lift Works	8	Nos	35,00,000	Transport Vertically Increased Comfort Provide safety	B S S
Total = 43,43,89,858						

Source: SP Info City IT Park

2.5 TECHNIQUES USED IN FUNCTIONAL ANALYSIS

Functional Analysis Phase disintegrates the system or project into small components and searches for function that each facility or element performs.

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As explained earlier, the project can be based on hierarchy of function level. But in large complex projects, this gets increasingly difficult. Also in many cases, there may be unnecessary functions with respect to the scope of study.

The techniques used for functional analysis phase is
-- NEFR Method

2.6 NUMERICAL EVALUATION OF FUNCTIONAL RELATIONSHIPS

This is a technique, which is based on the concept of Function Analysis for the purpose of evaluation of the functions. Through this technique the interrelationship among the function and their hierarchical older can be very well identified.

After the function defined has been done and the function definition worksheet is ready, this technique starts. In our case study we have followed the NEFR technique for doing our analysis.

To do the ranking of all the alternatives and find the best of them a simple methodology is carried out and the technique has its essence in the mutual comparison where each is compared with all others and points are given based on the their differences.

Major difference in preference	:	4
Medium difference in preference	:	3
Minor difference in preference	:	2
No difference in preference	:	1

When the function A is evaluated with B, then A is evaluated with next function C and this is continued till all the 6 functions are compared with all other functions and rated.

2.7 IMPLEMENTATION OF NEFR TECHNIQUE

In NEFR technique, all the functions that were performed by various elements of the building were listed as shown in Table. Each one of the criteria was compared with all other criteria as shown in figure. They were scored based on the priority in comparison with others. For example, "facilitate foundation" having the symbol A was compared with "exclude elements" having the symbol B. To facilitate foundation was given more priority compared to exclude elements. Hence a rating "A" was given. The magnitude of priority was thought of to be 2. Hence, in the intersection of A and B, A3 was indicated. Once the scoring for the entire criterion was determined, all the scores of individual symbols were added to get the total raw score and a ranking based on the scores in ascending order. To derive the weighted score, the lowest raw score was given 1, the highest was given 10. All other criteria scoring in-between were interpolated to get the weighted score as shown in below table.

TABLE 2.3 NEFR WORKSHEET

Key Letter	Function
A	Facilitate Foundation
B	Exclude Elements
C	Hide Defects
D	Control Access
E	Prevent Water
F	Increase Life
G	Improve Appearance
H	Provide Ventilation
I	Provide Safety
J	Convey Fluid
K	Provide Light
L	Harness Renewable Source
M	Transport Vertically.

2.6 TECHNIQUES USED IN SPECULATION SPACE

Below are the methods that are commonly used creative techniques in the Value Engineering study.

1. The Gordon Technique
2. Synectics
3. Lateral Thinking
4. Checklists
5. Brain Storming

Other Techniques

Some of the other techniques that can be used in speculation phase are

i. Attribute Listing Techniques
ii. Crawford Slip Writing Technique
iii. Philips 66 buzz session

2.7 IMPLEMENTATION OF SPECULATION PHASE

In our Value Engineering study of the Speculation Phase, we have used the Brainstorming Technique. For each item and function separate worksheets have been prepared. Constant ranking of ideas is done at every stage. Alternative methods are tabulated in the worksheet of each item and the quantity and quality of ideas is alone taken in to consideration. The worksheet for each item and function are tabulated as follows.

The items under consideration are
Footings, Columns, Slabs, Walls, Staircase foyer, Flooring, Plastering, Service ducts cover, Ventilators and Parking Flooring.

i. SERVICE DUCTS COVER

Basic Function : Facilitate Use
Rate : Rs. 1159/sq.m. (Materials only)
Quantity : 360sq.m.

TABLE 2.4 SPECULATION WORKSHEET FOR SERVICE DUCTS COVER

Sl.No	Alternatives
1.	Concrete and Brickwork
2.	Jalli work
3.	Kudappa slabs
4.	Glazings
5.	Brickwork and Kudappa

2.8 IMPLEMENTATION OF EVALUATION PHASE IN STUDY

i. SERVICE DUCTS COVER

Basic Function : Facilitate use
Original Idea : Framed structure with brickwork masonry and concrete jalli of 2'6" X 3'6" at equal intervals.

TABLE 2.5 EVALUATION CRITERIA FOR SERVICE DUCT COVER

Code	Item
A	Initial Cost
B	Aesthetics
C	Maintenance
D	Durability
E	Progress rate in construction
F	Strength
G	Material Availability
H	Heat of moisture Resistivity

Now applying NEFR method to rate the ideas.

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	B	C	D	E	F	G	H	Total Score
A	B3	A2	A3	A1	A4	A1	A1	12
	B	B2	B3	B2	B4	B4	B4	22
		C	C3	E2	C3	C2	H3	8
			D	D2	D2	D1	H2	5
				E	E3	E3	E2	10
					F	F4	F3	7
						G	G3	3
							H	5

4 – Major Preference
3 – Medium Preference
2 – Minor Preference
1 – No Preference

FIGURE 2.1 COMPARISON OF EVALUATION CRITERIA FOR SERVICE DUCTS

COVER

TABLE 2.6 WEIGHTED EVALUATION CRITERIA FOR SERVICE DUCTS

COVER

Item	Code	Raw Score	Weighted Score
Initial Cost	A	12	5.45
Aesthetics	B	22	10
Maintenance	C	8	3.63
Durability	D	5	2.27
Progress rate in construction	E	10	4.54
Strength	F	7	3.18
Material Availability	G	3	1
Heat of moisture Resistivity	H	5	2.72

TABLE 2.7 WEIGHTED MATRIX SHEET FOR SERVICE DUCTS COVER

Criteria	A	B	C	D	E	F	G	H	
Raw Score	12	22	8	5	10	7	3	5	
Weighted Score	5.45	10	3.63	2.27	4.54	3.18	1	2.72	
Alternatives									Total Score
Concrete and Brickwork	2	4	3	4	3	4	3	4	111.09
	10.9	40.0	10.89	9.08	13.62	12.72	3.0	10.88	
Jalli work	3	3	3	3	2	3	3	3	93.83
	16.35	30.0	10.89	6.81	9.08	9.54	3.0	8.16	
Kadappa slabs	4	1	4	2	3	3	4	4	88.9
	21.8	10.0	14.52	4.54	13.62	9.54	4.0	10.88	
Glazing	4	5	4	3	5	3	5	4	141.25
	21.8	50.0	14.52	6.81	22.7	9.54	5.0	10.88	
Brickwork and Kadappa	3	2	3	4	3	3	4	3	91.64
	16.35	20.0	10.89	9.08	13.62	9.54	4.0	8.16	

Herringbone brickwork construction with a framework of concrete is selected for providing the cover for service ducts after analysis, which has a total score of 141.25.

CONCLUSION

It may be briefed here that Value Engineering aims to deliver measurable value improvements through cost reduction and/or improve quality and enhance design features for the customer. This has been systematically applied in the architectural, structural and material components of the building.

During the study, the alternatives and currently existing facilities were evaluated by conducting a fairly detailed rate analysis, technical feasibility and aesthetic survey.

The key areas where Value Engineering has been applied are

i. Column, beam and slab designs
ii. Safety to lift and staircase users
iii. Use of new and better technology materials for walls, windows
iv. Use of aesthetically pleasing and more durable materials without increase in cost
v. Making the building more user-friendly for physically challenged and old citizens, adding a touch of humanity.

With the development of the proposals and by projecting the increased values, the Value Engineering study comes to an end.

The enhancement in value as a result of VE can be seen in better arrangement of lift and foyer area providing better utility. The walls have been replaced by high quality, durable and light weight "Siporex" blocks. The provides increased comfort to user of the building as they are thermal resistant, meaning the temperature inside is lesser (upto 7°C) compared to external temperature.

The requirements of the user were kept in mind during the study, and hence ramps are provide in the entrance area so that physically challenged and old people can use the facilitate independently.

"NCL Seccolor" windows have been recommended as they have increased life, provide 100% opening and are extremely beautiful compared to aluminum windows.

The requirements of structural aspects have been looked into M30 grade concrete has been suggested in place of M35, as it was found to be sufficient to transfer the loads effectively.

These are some of the value-engineered elements that are believed to provide more comfort to the ultimate user without compromising on the quality, time or cost.

This proves the scope and application of Value Engineering in building construction is tremendous, from both the developers and buyers point of view. Until recent times, VE was applied only in large turnkey projects like waste water treatment plants.

It is sincerely hoped that this study opens new dimensions in the construction industry for the purpose of providing the best facility ultimately to the end user.

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