Application of Value Engineering System to a Residential Building – Case Study

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Abstract - Value engineering is one of the effective tools for reducing cost, time and to improve quality. It is also used as effective technique in problem solving. In current situation of construction industry there is need of such techniques which can not only influence project cost, time and quality but also to have positive impact on environment. This project analyzed the current practice of Construction activity and applied value engineering concept in case study taken for selected activity of construction. Construction coupler and conventional lap splice is compared. Dado tiles are provided without cutting the tiles to avoid wastage of time and cost. Compared Ecopro Door frames with regular wooden door frames. This study has attempted cost saving in selected activity after considering value engineering. Based on the research findings we can expect by applying value engineering concept we can reduce cost, time and improvement in functionality of construction work.

Key Words: Value engineering, Cost, Time, Quality

1. INTRODUCTION

Value engineering is a powerful approach for cost saving and quality improvement. Especially since the construction industry holds a significant weight with respect to the worldwide economy. Value engineering not only considers project costs and quality, but also it proved to have optimistic impacts on the environment and contributing in the green construction all over world. Value engineering takes into consideration from the initial its life-cycle costs. This study includes three actual site problems solving using value engineering approach. Value Analysis was developed in the late 1940s by Lawrence D. Miles. He worked in the purchasing department of General Electric Company in USA. Value Analysis was a response to the question: How had companies managed to innovate during World War II despite of rationed materials and war time shortages Miles presented a model on the idea that “All cost is for function”. Customers buy functions experienced through products and services Miles named his approach Value Analysis and later Value Engineering. Today it is also called Value Management.

Importance of Value Engineering
- Reduce cost.
- Improve quality.
- Increase reliability and availability.
- Enhance customer satisfaction.

1.1 Objective and scope

Applying value engineering concept in selected construction activity and investigating performance aiming following

1. Determine the best design in minimum cost.
2. Improve quality work.
3. Easily availability of material.
4. Improve customer satisfaction.

2. LITERATURE REVIEW

2.1 General

Various technical papers on value engineering in design and construction of building have been presented at research from which we referred many papers for study. Reviews of these papers are given below.

[1] Mohamed Abdelghany: He summarizes research undertaken at the American University in Cairo, Egypt. With application of value engineering use of acrylic paint with ceramic tiles in the walls of wet areas in residential compounds can improve value in residential projects.

[2] Singh R, Himanshu S. K: They summarizes research undertaken at the Department of Civil Engineering, Graphic Era University, Dehradun, Uttarakand, INDIA. They Shows that couplers are an effective and an economic replacement to lap splice. On the topic of Reinforcement Couplers as an
Alternative to Lap Splices they also did a case study on use of couplers in reinforced steel over a conventional lap splice.

[3] Andy Stratton, P.E.: This paper describes on Encouragement of the further economic growth in the corridor by providing more efficient transportation system. This research is under taken at the Colorado Department of Transportation, Denver on the topic of Value Engineering study in transport. Concept of value engineering understood.

[4] V. Gowrisankar Kongu: The paper is on the Value Engineering in Residential House Construction where they Used aesthetically pleasing and more durable materials without increasing cost. The cost is one of the important factors in the construction industry so this research paper suggests the use of the aesthetically pleasing and durable materials without any effect on the economy of the construction. So quality and even function might be sacrificed in the process. While on the other hand, the goal of VE studies is to increase value without sacrificing the function or the quality.

2.2 Concluding remark from literature survey:
In the present study, a number of papers published so far have been surveyed, reviewed and analyzed. A substantial amount of work has been conducted on value engineering in building construction to save money, time and improving quality of the construction. Current approach of value engineering is seen in the generals and research paper.

• The scope for the value engineering in building construction and design by using basic value engineering principles.
• Rates of construction of coupler and conventional lap splice in construction are not compared.
• The dado tiles are provided without cutting the tiles to avoid wastage of time and cost is not been discussed.
• Use of aesthetic, pleasing & more durable material without increasing cost.

3. METHODOLOGY
Under this research work various work are planned to execute selected activity for application of value engineering. Activity selected after observation on actual site. Selected activity under three different case studies is presented below.

3.1 Case Study 1: Study of Dado Tiles
Dado means tiles which are provided in surface and lower area of wall for prevention of wet and disturbance. Dado is used along the sides of the wall of bathrooms to avoid damage in walls due to water.

- A case study was conducted by our group of a City Pride School project in Ravet
- Size of one toilet 1.25X1.05X3m
- Number of toilet in one floor 16

<table>
<thead>
<tr>
<th>Standard Size of Tiles (mm)</th>
<th>Rate Per SQFT(Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 X 600</td>
<td>30</td>
</tr>
<tr>
<td>200 X 200</td>
<td>25</td>
</tr>
<tr>
<td>600 X 600</td>
<td>30</td>
</tr>
</tbody>
</table>

3.2 Case Study 2: Use of coupler in reinforcement
A case study was carried out at an undergoing School construction site (City Pride School) in Ravet. Performed estimations of the total lapping length for various diameters of bar (16, 20, 25mm) for columns for an entire site and calculated the total cost of the lapping length of steel. After value analysis, suggested a better alternative for lapping i.e. use of couplers.

We also made the estimation of coupler and compared its cost. During Value analysis we studied the use of couplers instead of lapping and its strength.

- The coupler system is designed to connect two pieces of rebar together in the field quickly and easily.
- The building consists of a basement, first floor and second floor.
- Building is constructed by using 16mm, 20mm and 25mm bars, so we have calculated the total cost of lap length and compared with the cost of coupler.

Generally couplers are manufactured from Mild Steel, but in some cases alloys of different metals can also be used.
- During manufacturing of couplers different basic steps such as cutting, boring, threading, finishing are consider.
- Based on Grade of concrete site method adopted for lap splices.

a) By Site Method:
The lap splice was selected as per the concrete grade used in the site work.

- M30: 46d
- M35: 40d
- M25: 39d
Where d is the diameter of the bar.

b) By IS-456 Method
As a standard method IS 456 specifies a formula for
determining the lap length in any structural member. As per IS code lap splice is given by the formula:

\[ L_s = 48d \]

(Where \(d\) is the diameter of the bar.) The reinforcement couplers not only provide strength to the joints but are they also an cost-effective means of connections of two bars.

![Coupler on site](image)

**Fig -2: Coupler on site**

The total savings after the using coupler instead of lapping are given below:

**Table -2:: Estimation of Splices**

<table>
<thead>
<tr>
<th>Dia. of bar</th>
<th>No. of bar</th>
<th>Unit weight</th>
<th>Total lap Length</th>
<th>Total weight</th>
<th>Steel rate per Kg</th>
<th>Total Cost(Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>804</td>
<td>1.58</td>
<td>643.2</td>
<td>1016.256</td>
<td>48</td>
<td>48780.28</td>
</tr>
<tr>
<td>20</td>
<td>1470</td>
<td>2.469</td>
<td>1270.4</td>
<td>3136.618</td>
<td>48</td>
<td>150557.6</td>
</tr>
<tr>
<td>25</td>
<td>2218</td>
<td>3.858</td>
<td>2335.5</td>
<td>9010.359</td>
<td>48</td>
<td>432497.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total</td>
<td></td>
<td>631835</td>
</tr>
</tbody>
</table>

**Table -3: Estimation of Coupler**

<table>
<thead>
<tr>
<th>Diameter of bar</th>
<th>Number of coupler</th>
<th>Cost of coupler per head</th>
<th>Total cost of coupler(Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>804</td>
<td>46</td>
<td>36984</td>
</tr>
<tr>
<td>20</td>
<td>1470</td>
<td>66</td>
<td>97020</td>
</tr>
<tr>
<td>25</td>
<td>2218</td>
<td>96</td>
<td>212928</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>346932</td>
</tr>
</tbody>
</table>

Total Savings In Rupees: **2,84,930/-** i.e around. 45% savings.

### 3.3 Case study 3: Study on Door Frames

Door frames are the jambs and upper transverse member enclosing the sides and top of doorways and usually supporting a door. Features of wooden door frames

- Robustness
- Termite resistance
- Optimum strength
- Crack resistance
- Simple to fit
- Immaculate finish

Features of Ecopro Door Frames (WPC Boards)

- Innovative composition
- Seamless workability
- Strong and durable
- Efficient product
- Environmental friendly
- Economical than Wooden Boards

WPC Boards: Now day's people are turning for such product which can eco-friendly with require output. WPC boards in India show as a green solution and environment-friendly in comparison to the substitutes used. The WPC boards consist of 70% virgin polymer, 15% wood powder and 15% additives. There is no use of wood in these products, hence being a remarkable step towards following the sustainable development goals. As a matter of fact, a tree is saved with the usage of 10 WPC in India.

![Wooden & Ecopro Board](image)

**Fig -3: Wooden & Ecopro Board**

**Proposed Wooden Door Frame**

- Running Length -18 ft.
- Cost of frame -Rs.100/running feet
- Number of doors in each floor 35
- Number of floor -4
- Total cost of frame -Rs.2,52,000/-

**Ecopro Door Frames**

- Running Length -18 ft.
- Cost of frame - Rs.80/running feet
- Number of doors in each floor 35
- Number of floor -4
- Total cost of frame-Rs.2,01,600/-

- Total savings in door frames – Rs.50,400/-i.e. 20% savings.

### 4. RESULT

Under selected activities after using vale engineering techniques following result observed.

- Case study 1 –Reduced dado tiles wastage and Total saving after recommendation= Rs.38,400/-
• Case study 2 – Use of coupler instead of splices in reinforcement. Total saving after recommendation = Rs. 2,84,930/-
• Case study 3 – Using Ecopro Board for door frames. Total saving = Rs. 50,400/-

5. CONCLUSIONS

1. The Value engineering is a dominant approach for cost saving by selecting appropriate alternative.
2. Value engineering is not just reducing the costs but also increases the design standards easy to build the project and saving time.
3. We can use value engineering techniques for optimizing other construction activities with use of eco-friendly material and method.

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