Comparative Preliminary Cost Analysis of Materials in Construction Work: A Case Study

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Abstract—This thesis provides an introduction to the Principles of construction Management, basically related to cost saving. This research shows that how we can reduce the overall project cost by replacing the old material with the new one. Cost is an important factor in construction management. Before starting a Project we Estimate the total project cost and according to this estimation we plan about budget of our project.

I. INTRODUCTION

The case to be studied is introduced. It relates to the comparative preliminary Cost Analysis and Shows the difference of costing in work. This case study is related to the Ambience Tiverton project, sector-50, Noida of Ambience pvt. Ltd company. Duration of this project is 2014 to 2018. This project is currently running. A comparative preliminary cost estimate of work related to the material used in the project is attempted here. Which shows the benefit of adopting the replacement of material in work. And how it can affect the cost of the project. Throughout the case, a conscious effort is made to apply and identify the implications of the several factors and effects that have been discussed in the next sections of this document. This is my own research basically related to site. At site we are using:-

*AAC BLOCKS in place of Bricks
*External UPVC doors & windows in place of wooden

In my research I want to show that why we are replacing material and what are the benefits of using them and what are the difference between them by a comparative reports with the estimation process.

FLY ASH/ AAC(AUTOCLAYED AERATED CONCRETE) BLOCKS( in place of clay bricks)

- In these blocks, fly ash is a major waste product as a raw material up to 60-70%. Fly ash is used as an aggregate material in these blocks. Which makes them light in weight. And fly ash is environment friendly because we are using a waste material (which contains carbon and it causes pollution) as a usable material. This is a main factor of consideration of fly ash using as a civil engineering material. But bricks manufacturing causes degradation and erosion of agricultural layer of soil which is not good for our environment.
- Due to light weight, it reduces the structural steel cost with the reduction in dead load of structure. But bricks are heavy in weight if we use bricks in place of blocks it increases structural steel cost because dead load is increased.
- This is also a time saving material in work and it gives the smooth & even surface after masonry work.
- Costing of block work is minimum than brick work. Basically there main factor is cost. Which is explained by cost analysis report.
- There are various benefits of using blocks which are shown below in tables:-
## Comparative Preliminary Cost Analysis of Materials in Construction Work: A Case Study

<table>
<thead>
<tr>
<th>Parameter</th>
<th>AAC Block</th>
<th>Clay Bricks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Length X Height X Thickness 625mm X 250mm X 200 Mm</td>
<td>Length X Height X Thickness 220mm X 105mm X 65mm</td>
</tr>
<tr>
<td>Precision In Size</td>
<td>Variation 1.5 Mm ( +/- - )</td>
<td>Variation 5 Mm ( +/- - )</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>35 - 40 Kg / Cm2</td>
<td>25-30 Kg / Cm2</td>
</tr>
<tr>
<td>Dry Density</td>
<td>550 - 650 Kg / M3 ( Over Dry )</td>
<td>1950 Kg / M3</td>
</tr>
<tr>
<td>Wet Density</td>
<td>Approx. 800 - 850 Kg.</td>
<td>Approx. 2400 Kg.</td>
</tr>
<tr>
<td>Fire Resistance</td>
<td>5 To 6 Hour</td>
<td>2 Hour</td>
</tr>
<tr>
<td>Sound Reduction Index (DB)</td>
<td>45 For 200 Mm Thick Wall</td>
<td>50 For 230 Mm Thick Wall</td>
</tr>
<tr>
<td>Thermal Conductivity</td>
<td>Approx. 0.16 -- 0.17</td>
<td>Approx. 0.81</td>
</tr>
<tr>
<td>Adaption To Various Surface Finishes</td>
<td>All Kind Of Finish Like In Brick Work Is Possible</td>
<td>Same</td>
</tr>
<tr>
<td>Mortar Consumption</td>
<td>0.1339 Per M3 With 1:4 / 0.765 Bag Of Cement</td>
<td>0.3647 Per M3 With 1:4 / 2.084 Bag Of Cement</td>
</tr>
<tr>
<td>Construction Time</td>
<td>2.66 M3 work per day 50 % Time Saving.</td>
<td>2 M3 With Brick Others As Conventional</td>
</tr>
<tr>
<td>Energy Saving</td>
<td>32 % (App.) Air-Condition Load Both Both Heating And Cooling Will Come Down</td>
<td>No Saving</td>
</tr>
<tr>
<td>Cost Benefit Factor</td>
<td>Depending Upon Project, Dead Load Reduce Then Saving In Structural steel Cost using light weight block.</td>
<td>No Saving</td>
</tr>
<tr>
<td>Contribution To Carpet Area</td>
<td>2 - 3 %</td>
<td>No Saving</td>
</tr>
<tr>
<td>Chemical Composition</td>
<td>Sand Used App.60 % Which Reacts With (Lime &amp; Cement ) To Form AAC Which Is An Inert Material</td>
<td>Soil Is Used Which Contains Many Inorganic Impurities Like Sulphates Etc. Which Results In Efflorescence</td>
</tr>
<tr>
<td>Environment Friendly</td>
<td>Fly Ash (a waste product during thermal power generation) is the MAJOR Raw material consisting 60 to 70% of the total weight and it reduces water consumption for curing</td>
<td>Brick Manufacturing which degrades and erodes agricultural land and no reduction in water consumption for curing</td>
</tr>
</tbody>
</table>

### COST ANALYSIS

**ANALYSIS**

**COMPARATIVE COST ANALYSIS REPORT ON OF BLOCK AND BRICK MASONARY:**

<table>
<thead>
<tr>
<th>Total Quantity of Work</th>
<th>7577.222cumec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortar thickness</td>
<td>10 mm</td>
</tr>
<tr>
<td>Block size</td>
<td>625X240X200mm</td>
</tr>
<tr>
<td>Brick size</td>
<td>220X205X65mm</td>
</tr>
<tr>
<td>1:4(cement:sand) Mortar is used</td>
<td></td>
</tr>
</tbody>
</table>

### BLOCK MASONRY

**NO. OF BLOCKS**

No. of Blocks are required in 1 cumec work (with mortar) =

\[
\text{volume of one block} = \frac{1}{1} = 0.635 \times 0.25 \times 0.21
\]

= 0.2996

= 30 Blocks

Including 13.33% wastage we need 34 blocks per 1 cumec

Total Number of blocks are required for total work = (No. of blocks per cumec) X (Quantity of total work)

= 34X7577.222

= 257625.548 Blocks

(Cost of 1 cumec = Rs 2075, including taxes = Rs 2705/cumec)

Total Cost = (Cost of 1 cumec) X (Total Quantity)

= 2705X7577.222

= Rs 20496385.51

Using blocks we are saving Rs 1,50,46,838.07 crores

### BRICK MASONRY

**NO. OF BRICKS**

No. of Bricks are required in 1 cumec work (with mortar) =

\[
\text{volume of one brick} = \frac{1}{0.230 \times 0.115 \times 0.075} = 504 \text{ Bricks}
\]

Including 16 to 17% wastage we require 600 bricks per 1 cumec

Total Number of bricks are required for total work = (No. of bricks per cumec) X (Quantity of total work)

= 600X7577.222

= 4546332 Bricks

(Cost of 1 brick = Rs 6, including taxes = Rs 7.818/brick)

Total Cost = (Cost of 1 brick) X (Total Quantity)

= 7.818X4546332

= Rs 35543223.58
**MORTAR CONSUMPTION**

1. Wet Mortar
   
   For 1 cumec block masonry, volume of blocks required (without mortar) = (No of Blocks per cumec)X(Volume of 1 block) = 30X(0.625X0.24X0.2) = 0.9 Cumec
   
   Wet Mortar is required for 1 cumec = 1- 0.9 =0.1 cumec
   
   (3% extra mortar is required for bonding and wastage)
   
   So, wet mortar’s volume required including 3% wastage = (1 cumec wet mortar volume)+(0.03X1 cumec wet mortar volume) = 0.1+(0.03X0.1) =0.103 cumec
   
   2. Dry Mortar
      
      In Dry Mortar 30% extra quantity is required for voids and cavities
      
      Dry Mortar’s Volume required in 1 cumec = wet mortar’s volume +(0.30X wet mortar’s volume) =0.103+(0.30X0.103) =0.1339 cumec
      
      Using Blocks Mortar Consumption is reduced upto = 0.2308 cumec

**MATERIAL CONSUMPTION**

Total Dry mortar volume = (Total volume of work)X(Dry mortar’s volume per cumec) = 7577.222X0.1339 =1014.59 cumec

1:4 C:S

Cement = total dry mortar’s volumeX1 Sum of ratio ____________

= 1014.59 X 1 5

= 202.918 cumec

Note: 1 Cement Bag volume is 0.035 cumec

No of Bags required = volume of total quantity of cement

Volume of 1 bag = 202.918 0.035

= 5797.65 Bags

Approx 5798 bags required

Sand = 1014.59X4 Sum of ratio ____________

= 811.672cumecX35.52 cuft 5

= 28830.589 cuft

= 28830.589 = 5

1 cumec = 35.52 cubic feet

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**COST ESTIMATION**

Cement

Rate of 1 bag = Rs 265

Rate including all taxes = Rs 345

Cost of cement = rate of 1 bag X total quantity = Rs 345 X 5798 bags =Rs 20,00,310 Lakh

Sand

Sand Cost = Rs 40 per cubic feet

Sor including taxes = Rs 52 per cuft

Sand cost = rate X total quantity = 40 X 5798 =231,920 Lakh

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*Note*
Total Cost For Block Masonry = Rs 3,02,20,286.14 Crore
(Using Blocks we are saving Rs 2,35,06,135.46 crore of total project cost)

Total Cost For Block Masonry = Rs 5,37,26,421.6 Crore

UPVC DOOR & WINDOW (EXTERNAL):

UPVC(unplasticized polyvinyl chloride) At Site we are using UPVC external doors & windows. Upvc doors & windows are the unplasticized polyvinyl chloride.Now a day’s UPVC windows are becoming more popularly used This is due to their good aesthetics, durability, noise proofness, low maintenance requirement, best air & water tightness, and their ability to provide excellent thermal insulation, thereby helping save air-conditioning power costs in homes, offices and commercial centers. UPVC Windows come with a very high-quality surface finish, soft-contoured profiles and a variety of styles to meet the needs of the most demanding architects, designers and users. The environmental benefit of using UPVC Windows instead of wood and metal windows is phenomenal. Due to their ability to conserve energy throughout their life-time (from raw-material stage to in-use stage), UPVC Windows are recognized as Green Windows thereby scoring over traditional wood and metal windows. UPVC Windows are the best fit for all weather conditions prevalent across India - from salty humid corrosive air of coastal areas to sub-zero temperatur es of Ladakh to heavy rains of Cherrapunji to the hot dust storms of Central India to the cyclonic gale winds of Orissa coast to the extremely hot deserts of Thar in Rajasthan.

Technical Details:- These details are related to the site material Which UPVC Doors and windows are required at site.
- UPVC profile colour is white.
- UPVC virgin.
- Saint Gobin glass - According to green building norms ST-450 in 6mm toughened glass at all floors.
- Wind load as per norms is 2120 Pascal.

UPVC VS WOOD

<table>
<thead>
<tr>
<th>EXPANSION &amp; CONTRACTION OF WINDOW PROFILES CAN LEAD TO PRODUCT DEFORMATION</th>
<th>UPVC WINDOWS</th>
<th>WOODEN WINDOWS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPVC windows &amp; doors is manufactured from tropical formulation which makes it durable with minimal expansion and contraction</td>
<td>✔ ✔ ✔</td>
<td>Wood has inherent property to breathe / absorb moisture / expand &amp; contract, eventually leading to distortion and gaps</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INSULATION FROM HEAT</th>
<th>UPVC WINDOWS</th>
<th>WOODEN WINDOWS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPVC windows &amp; doors provides superior insulation to your home from outside heat as UPVC is a poor conductor of heat</td>
<td>✔ ✔ ✔</td>
<td>Wood is a poor conductor of heat, however improper sealing &amp; bending can allow heat to pass</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOW MAINTENANCE</th>
<th>UPVC WINDOWS</th>
<th>WOODEN WINDOWS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPVC windows and doors require no painting, only routine cleaning</td>
<td>✔ ✔ ✔</td>
<td>Wooden windows need regular painting and polishing</td>
</tr>
</tbody>
</table>

| LOW EMBEDDED ENERGY | UPVC Windows and doors | Wooden windows and doors use |
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<table>
<thead>
<tr>
<th>Feature</th>
<th>UPVC Windows and doors</th>
<th>wooden windows and doors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TERMITE RESISTANCE</strong></td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Description</td>
<td>UPVC Windows and doors are not prone to termites</td>
<td>Wooden windows and doors are prone to termites</td>
</tr>
<tr>
<td><strong>RESISTANCE TO CORROSION</strong></td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Description</td>
<td>UPVC Windows &amp; doors do not rust or corrode due to inherent material characteristics</td>
<td>Wooden windows do not rust / corrode</td>
</tr>
<tr>
<td><strong>FADE RESISTANT/UV RESISTANT</strong></td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Description</td>
<td>UPVC Windows and doors are made of special UV resistant blend and therefore do not fade even after prolonged exposure to sun</td>
<td>Wooden windows and doors start fading very soon; require constant repolishing/finishing</td>
</tr>
<tr>
<td><strong>FIRE</strong></td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Description</td>
<td>UPVC windows &amp; doors are Self Extinguishing and do not propagate fire</td>
<td>Wooden windows can catch fire easily</td>
</tr>
<tr>
<td><strong>FIRE ESCAPE</strong></td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Description</td>
<td>UPVC windows &amp; doors can allow easy escape in case of fire; due to its lower softening temperature glass can be pushed out of the frame easily</td>
<td>Wood itself can catch fire very easily</td>
</tr>
<tr>
<td><strong>COST SAVING MATERIAL</strong></td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Description</td>
<td>UPVC Windows and Doors are cost saving upto 50 -60%</td>
<td>Wooden windows and Doors are costly</td>
</tr>
</tbody>
</table>

**COST ANALYSIS**
- **Total Flats** = 272 nos.
- **4 BHK Flats** = 42 nos.
- **3 BHK Flats** = 230 nos.
- There are 13-14 external door & windows in one Flat.
Cost Analysis of UPVC External Door and Windows:-
Upvc Rate = Rs 589.84 per sqft
Total Quantity =113087.51 sqft
Total cost = (total quantity)X(rate per sqft)
Total cost = (113087.51X(589.84)) = Rs 66,703,536.9 crores

Note:- 10% Installation charges including hardware.

Cost Analysis of Wooden(CP Teak 2nd class wood) external doors and windows:- Frame size = 150X 65mm
Rate of Frame (finished and polished)= Rs 255 per Rft
Rate of door(finished with 6mm toughened glass ) = Rs 1090 per sqft
Rate of shutter( finished with 6mm toughened glass)=Rs 1044 per sqft
Rate of glass(6mm toughened glass)= Rs 65 per sqft
Total quantity of frame= 89733.998 Rft
Cost of frame= 89733.998 X 255=Rs 2,28,82,169.49
Total quantity of door = 10998.52 Sqft
Cost of door= 10998.52X 1090 =Rs 1,19,88,386.8
Total quantity of shutter= 92779.202 Sqft
Cost of shutter = 92779.202 X 1044 = Rs 9,68,61,486.89
Total quantity of glass = 190.932 Sqft
Cost of glasss = 190.932X65 = Rs 12,410.58
TOTAL WOODEN COST = Rs 12,09,54,903.8

Note:- 10% installation charges excluding hardware.

Rft = running feet
1 meter = 3.281 feet
Sqft= square feet
1 metre square = 10.76 square feet

| Comparative Cost Analysis External (UPVC Door Window VS Wooden Door Window) |
|---|---|---|---|
| Flats | Quantity(Sq. feet) | UPVC Cost(Rs) | Wooden Cost(Rs) |
| 4 BHK X42 Flats | 19,929 | 11754921.15 | 21962965.67 |
| 3 BHK X 230 Flats | 93158.51 | 54948641.05 | 104134010.9 |
| Total Material Cost | | 66703562.2 | 126096976.6 |
| Total Manpoer Cost | | 594000 | 2992000 |
| Total Cost : | | 67297562.2 | 129088976.6 |
| Cost Difference between UPVC and Wooden Cost | | | Rs 61791414.4 |

CONCLUSION
Using blocks in masonry work we are saving approx 47 % cost in total project cost. And this material is also a earthquake resistant material. In light weight structure in earthquake zone, structural requirement is light weight material. Due to this reason we are also saving the extra steel cost. And it is also a time saving material in work.
Using UPVC door and windows ( External ) we are saving approx 52 % cost in total project cost. It provide faster rate of time in work. But wooden work is time and cost consuming. As we can say that using these two material in project work makes our project

Cost effective
Time saving
Quality Assured

REFERENCES
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5. Analysis of Rates For Delhi: (DAR – Vol 2), 2014 By CPWD (Government of India)