Comparative Priliminary 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 can we 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(AUTOCLAVED 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:-

Manuscript received April 27, 2017
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Comparison Between AAC Block And Brick		
Parameter	**AAC Block**	**Clay Bricks**
Size	Length X Height X Thickness 625mm X 250mm X 200 Mm	Length X Height X Thickness 220mm X 105mm X 65mm
Precision In Size	Variation 1.5 Mm (+ / -)	Variation 5 Mm (+ / -)
Compressive Strength	35 - 40 Kg / Cm2	25-30 Kg / Cm2
Dry Density	550 - 650 Kg / M3 (Over Dry)	1950 Kg / M3
Wet Density	Approx. 800 - 850 Kg.	Approx. 2400 Kg.
Fire Resistance	5 To 6 Hour	2 Hour
Sound Reduction Index (DB)	45 For 200 Mm Thick Wall	50 For 230 Mm Thick Wall
Thermal Conductivity	Approx. 0.16 -- 0.17	Approx. 0.81
Adaption To Various Surface Finishes	All Kind Of Finish Like In Brick Work Is Possible	Same
Mortar Consumption	0.1339 Per M3 With 1:4 / 0.765 Bag Of Cement	0.3647 Per M3 With 1:4 / 2.084 Bag Of Cement
Construction Time	2.66 M3 work per day 50 % Time Saving.	2 M3 With Brick Others As Conventional
Energy Saving	32 % (App.) Air-Condition Load Both Both Heating And Cooling Will Come Down	No Saving
Cost Benefit Factor	Depending Upon Project, Dead Load Reduce Then Saving In Structural steel Cost using light weight block.	No Saving
Contribution To Carpet Area	2 - 3 %	No Saving
Chemical Composition	Sand Used App.60 % Which Reacts With (Lime & Cement) To Form AAC Which Is An Inert Material	Soil Is Used Which Contains Many Inorganic Impurities Like Sulphates Etc. Which Results In Efflorescence

Environment Friendly	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	Brick Manufacturing which degrades and erodes agricultural land and no reduction in water consumption for curing

COST ANALYSIS
ANALYSIS

COMPARATIVE COST ANALYSIS REPORT ON OF BLOCK AND BRICK MASONARY:-
Total Quantity of Work = 7577.222cumec
Mortar thickness = 10 mm
Block size= 625X240X200mm
Brick size = 220X205X65mm
1:4(cement:sand) Mortar is used

BLOCK MASONRY	BRICK MASONRY
*BLOCK CONSUMPTION No. of Blocks are required in 1 cumec work (with mortar) = 1cumec $= 1 \frac{\text{volume of one block}}{0.635X0.25X0.21}$ = 29.996 = 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 = Rs2705/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 CONSUMPTION No. of Bricks are required in 1 cumec work (with mortar) = 1cumec $= 1 \frac{\text{volume of one brick}}{0.230X0.115X0.075}$ = 504 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 = Rs7.818/brick) Total Cost = (Cost of 1 brick)X(Total Quantity) = 7.818X4546332 =Rs 35543223.58
Total Quantity of Work = 7577.222cumec	
BLOCK MASONRY	BRICK MASONRY

*MORTAR CONSUMPTION
1). Wet Mortar
For 1 cumec block masonary,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 / 5
= 811.672cumecX35.52 cuft
(1 cumec = 35.52 cubic feet)
= 28830.589 cuft

*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 X5798 bags
=Rs 20,00,310 Lakh
Sand
Sand Cost = Rs 40 per cubic feet
After including taxes = Rs 52 per cuft

*MORTAR CONSUMPTION
1). Wet Mortar
For 1 cumec brick masonary,volume of bricks required (without mortar)
= (No of Bricks per cumec)X(Volume of 1 brick)
= 504X(0.22X0.105X0.065)
= 0.756 Cumec
Wet Mortar is required for 1 cumec
= 1- 0.756
=0.244 cumec
(15% extra mortar is required for frog filling, bonding and wastage)

So,wet mortar's volume required including 15 % wastage
= (1 cumec wet mortar volume)+(0.03X1 cumec wet mortar volume)
= 0.244+(0.15X0.244)
=0.2806 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)
=0.2806+(0.30X0.2806)
=0.3647 cumec

* MATERIAL CONSUMPTION

Total Dry mortar volume = (Total volume of work)X(Dry mortar's volume per cumec)
= 7577.222X0. 3647
=2763.41 cumec
1:4
C:S
Cement =
total dry mortar's volumeX1 / Sum of ratio
= 2763. 41 X 1 / 5
= 552.682 cumec
Note : 1 Cement Bag volume is 0.035 cumec

No of Bags required =
volume of total quantity of cement / Volume of 1 bag

= 552.682 / 0.035
= 15790.914 Bags
Approx 15791 bags required

Sand = 2763.41 X4 / 5
= 2210.728 cumec X35.52 cuft
(1 cumec = 35.52 cubic feet)
= 78525.058 cuft

*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 15791 bags
=Rs 54,47,895 Lakh
Sand
Sand Cost = Rs 40 per cubic feet
After including taxes = Rs 52 per cuft
Sand cost = rate X total quantity

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 temperatures 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

	UPVC WINDOWS	WOODEN WINDOWS
EXPANSION & CONTRACTION OF WINDOW PROFILES CAN LEAD TO PRODUCT DEFORMATION	✔✔✔ UPVC windows& doors is manufactured from tropical formulation which makes it durable with minimal expansion and contraction	✖ Wood has inherent property to breathe / absorb moisture / expand & contract, eventually leading to distortion and gaps
INSULATION FROM HEAT	✔✔✔ UPVC windows& doors provides superior insulation to your home from outside heat as UPVC is a poor conductor of heat	✔✔ Wood is a poor conductor of heat, however improper sealing & bending can allow heat to pass
LOW MAINTENANCE	✔✔✔ UPVC windows and doors require no painting, only routine cleaning	✖ Wooden windows need regular painting and polishing
LOW EMBEDDED ENERGY	✔✔✔ UPVC Windows and doors	✔✔✔ Wooden windows and doors use

	are environment friendly as they require very less energy to convert from raw material to finished good.	tropical hardwoods.
TERMITE RESISTANCE	✔✔✔ UPVC Windows and doors are not prone to termites	✖ Wooden windows and doors are prone to termites
RESISTANCE TO CORROSION	✔✔✔ UPVC Windows& doors do not rust or corrode due to inherent material characteristics	✔✔✔ Wooden windows do not rust / corrode
FADE RESISTANT/UV RESISTANT	✔✔✔ UPVC Windows and doors are made of special UV resistant blend and therefore do not fade even after prolonged exposure to sun	✖ Wooden windows and doors start fading very soon ; require constant repolishing/finishing
FIRE	✔✔✔ UPVC windows & doors are Self Extinguishing and do not propagate fire	✖ Wooden windows can catch fire easily
FIRE ESCAPE	✔✔✔ UPVC windows & doors can allow easy escape in case of fire; due to its lower softening temperature glass can be pushed out of the frame easily	✖ Wood itself can catch fire very easily
COST SAVING MATERIAL	UPVC Windows and Doors are cost saving upto 50 -60%	Wooden windows and Doors are costly

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= (113087.51)X(589.84) = Rs 6,67,03,536.9 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 weigth 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

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