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A Contextual Analysis of the Advantages by Using Lightweight Concrete Blocks as Substitution of Bricks

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Abstract - *Conventionally the buildings are made with Burnt Clay Bricks which are associated with several disadvantages as Clay bricks are small in size though are heavy in weight and require a lot of concrete as masonry materials in joining each brick and plastering them from both the faces to fill the unevenness of the wall surface and to provide better finish. & Clay brick's soundproof and thermal insulation effect is poor. Lightweight blocks reduced mortar consumption, offering a unique combination of high durability, strength and faster speed of work compared to brick masonry. Lightweight blocks are 10 times the size of clay bricks, with their demand increasing rapidly due to their overall low cost, light weight, almost 70% less than clay bricks and sound and thermal insulation properties. The primary goal of this examination is to study about the effect of Lightweight concrete blocks on building structure with specific stress on spearing in general cost and weight of the structure. Lightweight blocks were created reasonable as indicated by IS specification. To examine the effect of light weight blocks on building a theoretical genuine 100 ft2 wall of 4" and 9" walling area of a loft of the multistory story building was chosen as a contextual investigation and first broke down utilizing mud blocks in various perspectives quantity estimation, reinforcement figuring, measure of blocks assurance in the structure's wall. At that point the sample building was analyzed by utilizing Lightweight concrete blocks of 80% substitution 14.8% lessening in the overall building, weight has been watching when the contribution of block masonry load in overall building was 45% it was seen in the wake of performing examinations on various kinds of structure that light weight blocks indicate responsible outcome in elevated structure overwhelm in the block masonry.*

***Key Words*: Aerated Concrete, Clay Bricks, Concrete Bricks, Foamed Concrete, Lightweight Blocks**

1. INTRODUCTION

Nature takes 500 years to change over one inch of hard surface into the top soil. Furthermore, we evacuate this best soil inside couple of minutes and influence earth blocks to out of it; uncovering the desolate land again coming about into ecological risks like deforestation, surface water overflow and loss of the cultivable land. The open ovens of block heating additionally prompt high air contamination. Traditionally the buildings are made in Burnt Clay Bricks resulting in being design as heavier structure that is mostly unnecessary and costly. One of its reasons is that the Clay bricks are 70% heavier than Lightweight blocks which increases the dead load of the structure and the risk associated with the concrete structure. It has been found that the considerable amount of dead weight which is contributed by the non-structural elements (such as non-load bearing walls) can be reduced if lighter options are utilized. For building there are many lightweight options available that can be used as replacement of the clay bricks or used with the concrete by partial or full replacement to reduce the weight of clay bricks by keeping the desired strength. Lightweight blocks are created from the regular materials, for example lime, sand, cement and water, and a little measure of rising agent are utilized to deliver light weight pieces .Considering these focal points, and Lightweight blocks were utilized to see most extreme conceivable dead load decrease in the building.

2. METHODOLOGY

Methodology of the study includes:

1. The production of the Lightweight blocks
2. Building analysis
   a). Traditional building analysis
   b). Lightweight building

3. TYPES OF LIGHTWEIGHT CONCRETE BLOCKS AND PRODUCTION

The Lightweight concrete blocks can be divided into three main types according to the method of production. They are autoclaved aerated concrete (AAC), foamed concrete (CLC) and non-autoclaved aerated concrete (NAAC)).

The method for making of Lightweight blocks was derived from the literature review and the field survey which consists of material estimation, sieving, mixing, moulding and curing for the purpose of making Lightweight blocks.

3.1. Autoclaved Aerated Concrete (AAC)

The AAC is produced by adding in a predetermined amount of aluminum powder and other additives into slurry of ground high silica sand, cement or lime and water and autoclaved curing is done. The AAC began approximately 100 years ago. Invented in 1923 by Swedish architect and inventor Dr. Johan Axel Eriksson and has been around for over 90 years with being extensively in developed European countries, USA, Japan & China. Discovered a mixture of cement, lime, water and sand that was expanded by the adding aluminum powder to generate hydrogen gas in the cement slurry.

AAC Block

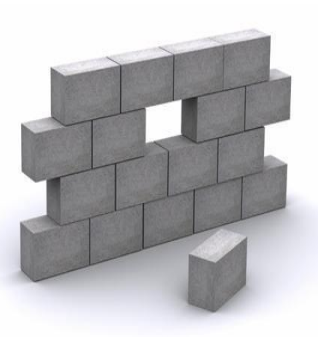
3.2. Cellular Lightweight Concrete (CLC)

Foamed concrete is produced by injecting preformed stable foam or by adding a special air entraining admixture known as a foaming agent into a base mix of cement paste or mortar (cement + water or cement + sand + water). The foamed concrete was produced in Europe more than 60 years prior and has from that point forward been on the International market for over 20 years. Foamed concrete have high flowability, low self-weight, least utilization of aggregate, controlled low quality, and great thermal insulation properties. The density of foamed concrete has wide range (1600 to 400 kg/m^3), with fitting control in the measurements of the foam, can be gotten for application to structural, partition, insulation, and filling grades.

Foaming agent

Foam formation

Cellular structure



CLC Blocks

3.3 Non autoclaved aerated concrete (NAAC)

NAAC is the concrete which is light in weight that is used as an alternative construction material in modern world. It is a green building material, possess excellent thermal insulating properties, good sound absorber and can also be used as a decorative material.

The NAAC is produced by adding in a predetermined amount of aluminum powder and other additives into slurry of ground high silica sand, cement or lime and water & then the concrete is cured in water this is called as non-autoclaved concrete or water cured concrete. Different dosages of aluminum powder (0%, 0.04%, 0.08%, 0.12% and 0.16%) taken by using weight of dry material to design aerated concrete blocks of 600mm × 200mm × 100mm sizes.

Table -1. Comparison of various bricks and blocks (AAC blocks vs CLC blocks vs red clay bricks)

S.No	Parameter	AAC Blocks	Red Clay Bricks	CLC Blocks
1	Raw Materials	Cement, fly ash, water and Air entraining agents	Locally avaiable clay	Cement, lime, specially grinded sand,foam
2	Size	400-600mm X 200mm X 150mm – 300mm	225mm X 75mm X 100/150mm	400-600 x 200 x 100/150/200 mm

3	Compressive Strength (As per IS codes)	3-4 N/mm2	3.5 N/mm2	2 -2.5 kg/cm2
4	Dry Density (As per IS codes)	550-650 kg/m3 It sone-third of the weight of clay brick which makes it easy to lift and transport	1800 kg/m3	800 kg/m3
5	Cost Benefit	For high rise buildings there will be reduction of Dead weight which leads to saving in Concrete and steel quantities.	As easily available in local market hence it is beneficiary for low rise structure.	For high rise buildings there will be reduction of Dead weight which leads to saving in Concrete and steel quantities.
6	Fire Resistance (8″ Wall)	Upto 4 Hours	Around 2 Hours	Around 4 Hours
7	Quality of End Product	Factory made product. So the quality of end product is consistent and good	Locally made product. Quality depends on various parameters like quality of raw materials used, process of manufacture etc.,	The quality of the end product depends on the foam used and degree of quality control
8	Sound Insulation	Better Sound absoprtion/insulation as compared to bricks	Normal	Better Sound absoprtion/insulation as compared to bricks
9	Environmental Friendliness	In AAC Block there is no top soil utilization and it transmits low Carbon dioxide as contrast with bricks while fabricating	One sq ft of cover territory with bricks walling will devour 25.5 kg of soil (approx). It really harms condition	In CLC Block there is no soil utilization and it produces low Carbon dioxide as contrast with Brickss while fabricating.
10	Internal and External Plaster	As these blocks have dimensional precision, the inner and extenal mortar thickness can be lessened	Requires thick mortar surface as there are varieties in the measurements	As these blocks have dimensional precision, the inner and extenal mortar thickness can be lessened
11	Cost of Construction	1 Cum costs – Rs. 4200/-	1 Cum costs – Rs. 2440/-	1 Cum costs – Rs. 4000/-
12	Joining Process	Substance mortars can be utilized for joining the block. This diminishes the material utilization of concrete and furthermore abstains from curing process	Traditional mortar needs to be used and the brick work should be cured at least for 7 days before plastering	Substance mortars can be utilized for joining the block. This diminishes the material utilization of concrete and furthermore abstains from curing process
13	Thermal Insulator	AAC Blocks are great thermal insulator if cooling is a noteworthy part of any building month to month costs it will spare cost for whole lifetime	It have low thermal insulation as compare to AAC and CLC Block	CLC Blocks are great thermal insulator if cooling is a noteworthy part of any building month to month costs it will spare cost for whole lifetime
14	Water Absorption	Absorb 12- 15% by total volume of AAC blocks	Absorb 17 -20% by total volume of red clay brick	Absorb 12-15% of water by total volume of Block
15	Range of Application	They are suitable for Non load bearing or RCC structure in partition wall	They are useful in both load bearing and non load baring structure	They are suitable for Non load bearing or RCC structure in partition wall

5. INVESTIGATION

To investigate the effect of light weight blocks on building a hypnotical real life 100 ft2 wall of 4" and 9" walling area of an apartment of multistory stories building was selected as a case study and first analyses using clay bricks in different aspects quantity estimation.

Table 2. Cost comparison of brick masonry vs. AAC Blocks Masonry for 4" wall

Cost comparision of brick masonry vs. AAC Blocks Masonry						
Walling area	100 ft2 wall (thickness 4")					
Red Brick	227mm x 109mm x 70mm					
AAC Blocks	625mm x 240mm x 100mm					
Particulars	**Material**	**Rate/Unit**	**Red Brick (4 inch)**		**AAC Blocks (4 inch)**	
			Quantity	**Amount**	**Quantity**	**Amount**
Bricks/Blocks	**Bricks/Blocks(A)**	6.5	500	**3500**	56	**2604**
Mortar	Cement Bags	280	2.25	630	1	280
	Coarse Sand (cft)	100	10	1000	4	400
	Mortar Cost (B)			**1630**		**680**
Plaster	Cement Bags	280	6	1680	3	840
	Coarse Sand (cft)	100	16	1600	7	700
	2 side @ 18-22	**Plaster cost (C)**		**3280**	2 sides @ 8-10mm	**1540**
Total walling cost (A+B+C)				**8410**		**4824**
Rate per sq. ft.				**84.1**		**48.24**

Table-3. Cost comparison of brick masonry vs. AAC Blocks Masonry for 9" wall

Cost comparision of brick masonry vs. AAC Blocks Masonry						
Walling area	100 ft2 wall (thickness 6")					
Red Brick	227mm x 109mm x 70mm					
AAC Blocks	625mm x 240mm x 100mm					
Particulars	**Material**	**Rate/Unit**	**Red Brick (9 inch)**		**AAC Blocks (9 inch)**	
			Quantity	**Amount**	**Quantity**	**Amount**
Bricks/Blocks	**Bricks/Blocks(A)**	6.5	1000	**6500**	56	**5208**
Mortar	Cement Bags	280	5.5	1540	1.5	420
	Coarse Sand (cft)	100	22	2200	6	600
	Mortar Cost (B)			**3740**		**1020**
Plaster	Cement Bags	280	6	1680	3	840
	Coarse Sand (cft)	100	16	1600	7	700
	2 side @ 18-22	**Plaster cost (C)**		**3280**	2 sides @ 8-10mm	**1540**
Total walling cost (A+B+C)				**13520**		**7768**
Rate per sq. ft.				**135.2**		**77.7**

Table-4. Cost comparison of brick masonry vs. AAC Blocks Masonry for 4" wall

Cost Calculation for 100 Sq. Ft Wall			
Clay Bricks (4" Thick wall)	**230x110x75mm**	**CLC Bricks (4" Thick wall)**	**600x200x100mm**
No. of Bricks 550 @ Rs.6.50/pic	3575	No. of Bricks 68 @ Rs.35/pic	2380
Mortar @ 1:6	1100	Mortar	365
Plastering @ 1:2 (Both Side)	1140	Plastering @ 1:2 (both sides)	1140
Labour (Construction and Two Coats Plastering)	1800	Labour (Construction and Single Coat Plastering)	1200
Total Cost	**7615**	**Total Cost**	**5085**

Table-5. Cost comparison of brick masonry vs. AAC Blocks Masonry for 9" wall

Cost Calculation for 100 Sq. Ft Wall			
Clay Bricks (9" Thick wall)	**230x110x75mm**	**CLC Bricks (9" Thick wall)**	**600x200x100mm**
No. of Bricks 1100 @ Rs.6.50/pic	7150	No. of Bricks 68 @ Rs.70/pic	4760
Mortar @ 1:6	2100	Mortar	365
Plastering @ 1:2 (Both Side)	1140	Plastering @ 1:2 (both sides)	1140
Labor (Construction and Two Coats Plastering)	2000	Labor (Construction and Single Coat Plastering)	1200
Total Cost	**12390**	**Total Cost**	**7465**

Table-6. Overall look on the total saving of cost, labor and materials

Parameter for 1 cu mtr wall	Bricks wall	CLC Blocks	CLC Percentage Advantage
No. of Units 1 cu. Mtr	565 pcs.	41.66 Pcs	94%
Weight of Wall	2000 kgs	750 kgs	85%
Mortar for masonry	0.58 ccu. Mtr	0.148 cu. Mtr	74%
Labour Skilled	1.98 Masons	0.51 Masons	74%
Unskilled	3.68 Coolie	1.66 Coolie	55%

6.MASONRY OF BLOCKS & BRICKS

Masonry is commonly used for walls and buildings. Brick and concrete are the most broadly recognized sorts of masonry being used in industrial countries and might be either weight-bearing or a facade. Concrete blocks, mostly those with hollow cores, offer different potential effects in masonry construction. They also give extraordinary compressive strength, and are most suitable to structures with light transverse loading when the cores stay blank. Filling a few or the majority of the cores with concrete or cement with steel fortification offers significantly more tensile and lateral strength to structures.

Ease of joining of blocks, plastering not required to cover the faces of blocks, less concrete and time is used in comparison of clay bricks due to its uniform surface.

Block mason plastering not required

Brick mason plastering required

7. CONCLUSION

1. As we known that in this building masonry wall contributes around 45% load of the building so if the weight of the block decreases then total load of the building can be decreases.

2. Blocks are 1/3 weight of bricks and 1/5 weight of concrete and are in easily handed sizes. It reduces dead load of the structure, consequently consumption and investment in steel saving up to 15% and concrete.

3. Blocks give superior thermal & acoustic insulation because of low air infiltration. Moreover, lesser joints and better compacted (thin) joining mortar add to the thermal & acoustic insulation. This leads to well insulated interiors, keeping out warm air in summers and cold in winters. Blocks reduce energy cost by up to 30%.

4. Speedy construction due to its big size light weight and ease to cut in any size or shape.

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