International Journal of Research in Engineering, Science and Management
Volume-1, Issue-9, September-2018
www.ijresm.com | ISSN (Online): 2581-5782

Comparative Study of AAC Blocks and Clay Brick and Costing

Utkarsh Jain[1], Muskan Jain[2], Smriti Mandaokar[3]
[1,3]*Student, Department of Architecture, SDPS Women's College, Indore, India*
[2]*Assistant Professor, Department of Architecture, SDPS Women's College, Indore, India*

***Abstract*—Brick is the most commonly used building material in construction. AAC blocks are new construction material which is very light in weight. Compare to same size of (200mm x 100mm x 100mm,its 3 times lighter than traditional brick (clay brick);it means it covers more area in same weight as clay brick gives in one bricks. In this paper; attempt has been made to replace the clay brick with light weight AAC blocks. The usage of AAC block reduces the cost of construction up-to 25%. The use of AAC block also reduces the requirement of materials such as cement and sand up-to 55%**

***Index Terms*— autoclaved aerated concrete (AAC), light weight, clay bricks, cost reduction, difference.**

I. Introduction

Bricks are one of the most important building materials in the India. In recent years, with expanding urbanization and increasing demand for construction materials, brick kilns have grown to meet the demand. It has directly or indirectly caused a series of environmental and health problems. At a global level, environmental pollution from brick-making operations contributes to the phenomena of global warming and climate change. Also, extreme weather may cause degradation of the brick surface due to frost damage. Global warming and Environmental pollution is now a global concern. Various types of blocks can be used as an alternative to the red bricks, to reduce Environmental pollution and Global warming. AAC blocks may be one of the solutions for brick replacement. Similar to foam concrete, Autoclaved Aerated Concrete (AAC) is one of the certified green building materials, which can be used for commercial, industrial and residential construction. It is porous, non-toxic, Perusable, renewable and recyclable.

AAC was developed in 1924 by a Swedish architect, who was looking for an alternate building material with properties similar to that of wood having good thermal insulation, solid structure and reaction. It is one kind of new type green warm preservation wall material formed easy to work with, but without the disadvantage of combustibility, decay and termite damage. As AAC Block uses fly ash, sand as main raw material, cement, lime as accessory materials, aluminum powder as forming agent, it refers to foaming through

Chemical through raw materials grinding, batching and mixing, pouring and foaming, quiet stop and cutting, autoclave curing processes. It has lightweight, high strength, good durability, heat preservation, sound insulation, fire proofing, impervious, good anchoring properties.

Significant research studies have been conducted on the development of new construction materials using different kinds of material. However, the application of these construction materials in real construction is limited. Therefore more research is needed to study the actual behavior or performance of new construction materials under field conditions to encourage their practical applications. Many research studies had been conducted utilizing various new construction materials. Most of these research works focused on the physical and mechanical properties of construction products. Some of those studies attempted to investigate the durability performance of several construction materials including AAC block like material. However, more research studies are needed to confirm the beneficial effects of new construction material. In this context, research work has been started to investigate Cost effectiveness by using AAC Blocks for building construction. This paper highlights different aspects of using AAC block masonry construction. Findings of comparative statistical analysis of cost effectiveness of using AAC block instead of traditional bricks are presented in this paper.

II. Objectives

- The objective of study is practical comparison between traditional clay bricks, and AAC blocks under seismic loading.
- To study the economical, constructional and structural difference between the structures using above two constructional materials.
- Through this study, we will accomplish the relationship between the two materials. Also due to two different materials there would be changes in loading, structure, construction cost, construction techniques; which would be observed through this project.

III. Materials and Methods

The materials used for the study are burnt clay bricks and

autoclaved aerated concrete blocks. The burnt clay bricks of size 200 x 100 x 100 mm are collected from locally available processing units of burnt clay bricks. AAC blocks are collected from the distributors of Aerocon blocks in Cochin. Aerocon is India's leading manufacturer of AAC blocks. These Aerocon has a long time association with Indian Green Building Council (IGBC) and consistently work together for the cause of sustainable construction. These blocks offer effective and practical solutions for the current building regulations and are manufactured using the latest technologies at India's most advanced AAC facilities located in Chennai and Surat . These blocks are manufactured by using fly ash, cement, lime and an aeration agent like aluminum powder. An AAC block of face size 600 x 200 mm is collected from GEETEE Traders, Aerocon supplier, Cochin. The thickness of the collected specimen is 100 mm. The density of blocks ranges from 600 to 800 kg/m3. The collected blocks are cut and conditioned before testing. The methodology adopted for the study is as follows: Literature survey of previous studies is conducted to derive the objectives and scope of work. Collection of AAC blocks are done on the basis of objectives. Cutting and conditioning of blocks into required sizes are done.

Comparative study of AAC blocks and burnt clay bricks are done.

Experimental studies:

Size of different brick taken in analysis:

Clay brick = 200mm x 100mm x 100mm

AAC block = 300mm x 200mm x 100mm

IV. Comparative Analysis

The comparative analysis is shown in Table-1.

V. Cost Analysis

The cost analysis is shown in Table-2

VI. Conclusion

However it is difficult to replace 7millenium old materials with new one. Also availability is still a challenge in India. AAC blocks are easily available in southern and western regions of country. AAC blocks are gaining popularity in northern region and demand in tier –II cities. Comparative Analysis indicates that in almost all the parameters, the AAC blocks have a superior edge over burnt clay bricks. The use of AAC blocks leads to savings in overall project cost; enables to speed up the construction process reduced environmental and social impact. Therefore we can conclude that use of ACC blocks over burnt clay bricks is recommended. It is advisable to developers, contractors, and individuals to encourage this product as its use is in national interest.

TABLE II
Cost Calculation for AAC Blocks and Clay Brick for 1 M^3 [1:4]

S. No.	Parameter	Clay Bricks	AAC Blocks
1.	Quantity Analysis	200mmx 100mm x 100mm	600mm x 200mm x 200mm
2.	No. of bricks / blocks	500 No.	37 No.
3.	Mortar Quantity	0.2766 M^3	0.1344 M^3
4.	No. of begs of cement	1.65 NO.	1 No.
5.	Quantity of Sand	0.221 M^3	0.1075 M^3
6.	Quantity of Water	31 Liters	16 Liters
7.	Rate Analysis	5252.00 Rs. per square meter (As per MP PWD SOR building work2014 clause no.6.3 page no.85)	5052.00 Rs. per square meter (As per MP PWD SOR building work 2014 clause no.6.27 page no.89)
Plaster Work			
1.	Volume of mortar for plaster	1.8M^3	1M^3
2.	The volume of mortar by 25% for wastage and frog filling	2.25 M^3	1.25 M^3
3.	Quantity of cement	0.45 M^3	0.25 M^3
4.	No. of begs of cement	13.5 NO	7.5NO.
5.	Quantity of Sand	1.8 M^3	1 M^3
6.	Quantity of Water	236.25 Liters	131.25 Liters
7.	Rate Analysis	171.00 Rs .per square meter,(As per MP PWD SOR building work 2014 clause no.13.6 page no.244)	91.10.00 Rs. per square meter (As per MESSOR building work 2010 item no.14001 page no.287)

TABLE I
COMPARATIVE ANALYSIS

S. No.	Parameter	Clay Bricks	AAC Blocks	Remarks
1.	Material composition	Silica (sand) + Alumina (clay) + Lime + Iron oxide + Magnesia In other words-Top Soil	Quartz sand + calcined gypsum + lime (mineral) and/or cement Aluminum powder + fly ash In Other Words-Cement +Fly Ash	The raw materials used for AAC Blocks production, have been found to be eco – friendly, as very little cement is used. The use of fly ash in this venture makes us to utilize a waste material from thermal plants. AAC blocks can use fly ash(70% of its weight), thus provides the most constructive solution to the nation's fly-ash utilization problem
2.	Size	225 mm x 100 mm x 65 mm / 230 mm x 75 mm x 115 mm	600 / 625 mm x 200 / 240 mm x100-300 mm	Bricks need more mortar since size is smaller. But Mortar requirement is lesser in AAC blocks due to Bigger size.
3.	Precision in Size	5 mm (+/-)	1.5 mm (+/-)	The AAC block is dimensionally more accurate as it is produced with wire cut technology in a certified factory.
4.	Compressive Strength	2.5-3 N/mm^2	3-4 N/mm^2 (IS 2185, Part-3)	AAC blocks has higher compressive strength i.e.it can withstand greater loads than bricks
5.	Dry Density	1800-2000 kg/ m^3	600-800 kg/m^3	Using AAC Blocks reduces the load on the foundation and other structural components in a structure due to its lower self-weight. 55%reduction in weight of walls. Up to 15% savings in cost of structure has been observed. Because of reduction in self-weight, AAC block Construction attracts, Less earthquake load.
6.	Fire Resistance (8″ wall)	Around 2 hours	Up to 7 hours.	AAC blocks have air voids and hence have better fire resisting property compared to red clay bricks. The melting point of AAC blocks are over 1600 Degree Celsius, more than twice the typical temperature in building fire 650 degree Celsius.
7.	Energy Saving	Low	Approx. 25% reduction in air conditioner load /25 – 30% less electricity consumption on HVAC	AAC blocks are resistant to thermal variations. It reduces the total load of refrigeration and air conditioning. Though initial installation cost may remain same but AAC blocks reduces operation and maintenance cost drastically.
8.	Reuse of waste product	None	Fly ash	AAC blocks use Bio product of power plants
9.	Efflorescence	Generally Present	Absent	AAC blocks don't have efflorescence, superior than Bricks
10.	Pigmentation	Mineral oxides in clay plus natural and synthesized miner a oxide pigments	Natural and synthesized mineral oxide pigments	-
11.	Thermal Conductivity	K value = 0.81 W/mk	K value = 0.16 W/mk	AAC Blocks with very low thermal conductivity keeps interior remain cool in summer and warm in winter and best for both internal and external construction
12.	Embodied Energy /Energy needed to produce the building material	High (900-1000 kWh/m^3)	Low. (50-100 kWh/m^3)	AAC Blocks consume approx. 70% less energy than Clay bricks. AAC block covers greater area for the same mass of brick used thus saves on transportation costs and conserves precious fuel.
13.	Environmental Impact	**Soil Consumption**		AAC block is 100% Green building material & is a walling material of a choice in LEED certified buildings. This helps in reducing carbon Footprint. In India itself AAC blocks has potential to avert 200mn tones of CO_2 emissions into environment – a saving of $20 billion every year.
		One clay brick consumes 3.2 kgs of top soil	No top soil consumed	
		One sq. ft. of carpet area with clay brick walling will consume 25.5 kgs of top soil	Uses fly ash which is a thermal power plant waste product & thus no consumption of top soil	
		Fuel Consumption		
		One sq. ft. of carpet area with clay bricks will consume 8 kgs of coal	One sq. ft. of carpet area with AAC blocks will consume 0.9677 kgs of coal	
		CO_2 Emission		
		One sq. ft. of carpet area will emit 17.6 kg of CO_2.	One sq. ft. of carpet area will emit 2.2 kg of CO_2	

TABLE I
COMPARATIVE ANALYSIS

S. No.	Parameter	Clay Bricks	AAC Blocks	Remarks
14.	Social Impact	**Labor**		AAC blocks are manufactured under organized sector, which contributes towards government taxes and has standardized factory facility.
		Unorganized sector (child labor rampant in unorganized sector)	Organized sector. Nation building through Corporate Governance, Statutory Labor and HR practices	
		Tax Contribution		
		Does not contribute to government exchequer (taxes)	Contributes to government taxes in form of Central Excise, VAT& Ontario.	
		Production Facility		
		Unhealthy working conditions due to toxic gases. Mostly involves manual processes	Standardized factory facility with automated processes.	
15.	Speed of construction	Comparatively lower	Very high due to bigger size, light weight. Can have a Tongue -Groove Profile, which results in faster construction, saving on Labor and jointing mortar due to elimination of vertical joints	The Productivity of the mason (with AAC blocks) increases up to 3 times, because of less number of joints
16.	Moisture Resistance	Average	Very Good	AAC Blocks do not have any "micro-pores" or continuous "capillaries" through which exterior surface water can be absorbed to interiors. It means longer life to the paints and interiors free from growth of any kind of fungus, providing healthier and long lasting interiors to the occupants. AAC Block's water barrier properties are further enhanced by adding silicon based additives.
17.	Water Absorption Coefficient in Kg/ m2 x h0.5	22 – 30 (suction through capillary action)	4 – 6 (no continuous pores and capillaries)	Use of AAC Blocks leads to Long life of paint and healthy interiors.
18.	Water absorption % by weight	High. 20% by volume	Very High. 45% by volume	The volume of AAC is 20% solid material and80% air. Due to the closed cell structure of AAC, the water absorption only takes place through the soli material. This solid is only 20% of the volume, which the water absorption of AAC strongly reduces.
19.	Noise Transmission / Sound Insulation	More than 50db for 230mm thick wall	40-45db for 200mm thick wall	The AAC Block has better sound insulation properties, due to its air voids presence. AAC blocks have an excellent Sound transmission Class (STC) rating of up to 45 db. Therefore it is an ideal material for wall construction in hotels, auditoriums, studios, hospitals etc.
20.	Ease of Use / Workability	Low	High Can be cut into require sizes. It can be sawn, drilled, nailed, grooved etc. Can be used to create arches, curves etc. Can have Hand Grips, which gives ease in lifting & placement.	AAC Blocks can be easily cut, drilled, nailed, milled and grooved to fit individual requirements. Available in custom sizes. Simplifies hydro-sanitary and electrical installations, such as pipes or ducts, which can be installed after the main construction is complete.
21.	Cost Benefit	None	Dead weight reduction leads reduction in consumption of steel and cement and lesser excavation for foundations.	AAC blocks reduce overall cost of construction
22.	Speed of manufacturing	Low	High	AAC Reduces construction time by 20%. Different sizes of blocks help reduce the number of joints in wall masonry. Lighter blocks make construction easier and faster. Easy to install. Sets and hardens quickly.
23.	Quality / Durability	Normally varies	Uniform and finished	AAC Blocks being produced in a factory with automated processes, so, they have uniform quality and hence are more durable.
24.	Water Usage during Manufacturing	High, needs curing before use	Low, needs only surface wetting before use	AAC saves water consumption.

TABLE I
COMPARATIVE ANALYSIS

S. No.	Parameter	Clay Bricks	AAC Blocks	Remarks
25.	Applicability	Load bearing & Non-load bearing	-Load Bearing masonry up to 2 to 3 story. -Partition walls in Load Bearing and Framed Structures. -Infill walls in Multistory Building Frames both internal and external Walls. -All Filling are as including in flat slabs and instead of brick bats in Weathering course, over roof.	Band width of applicability is higher in AAC Blocks, they are especially used in
26.	Earth quake resistant	Average. Conditional Conformance to seismic zones IV & V	Good. Generally, they have Conformance to requirement of seismic zone IV & V.	Earthquake forces on structure are proportional to the weight of the building, hence AAC blocks shows excellent resistant to earthquake forces. They absorb and transmit less seismic forces in event of any earthquake. The structure has millions of tiny cells which cushions buildings from major force, preventing progressive collapse. Regions of the seismic activities like exclusively use AAC blocks. It has been proven to withstand wind loads of category 5 tropical storms
27.	Mortar consumption per M3 with 1:6	1.40 bag of cement	0.5 bag of cement	AAC blocks are 7 times bigger than the size of the conventional bricks. Bigger size means less number of joints. Less joints results in lesser quantity of mortar for building. There is overall60% reduction in use of Mortar.
28.	Savings in Plaster	-	Overall 35% reduction in the cost of plastering.	AAC blocks have uniform shape and texture which gives even surface to the walls. The AAC Block, when built has both faces as fair faces unlike brick work, which has only one face as a fair face. Hence, the thickness of Plaster for AAC block is much less compared to conventional bricks
29.	Maintenance	High	Comparatively Lesser due to its superior properties	-AAC block reduces operating cost by 30% to40%. -Reduces overall construction cost by 2.5% as it requires less jointing and reduces need for cement and steel. -High-insulation blocks save up to 30% in energy costs. -Wall painting and plastering last longer as almost nil efflorescence affects AAC. This translates into lower maintenance costs.
30.	Wastage Due to Breakages	Approximate 10 to 12%	Minimal (1-2%)	If any breakage in the AAC blocks, it would be into two or three pieces which can be utilized in masonry as "brick bat".
31.	Pest & Termite Resistance	Low	High.AAC blocks are in organic, insect resistant and solid wall Construction material. Termites and ants do not eat or nest in AAC Blocks.	AAC Blocks do not allow spread of termites and growth of pests and hence provides longer life to expensive wooden interiors.
32.	Fume Resistance	Average	Good.	AAC Blocks are completely inorganic and hence do not generate any toxic fumes or poisonous gases harmful to the occupants. The air tight nature of blocks also prevents toxic fumes from spreading into other parts of building.

REFERENCES

[1] www.westerngranite.co.za
[2] www.constructionworld.in
[3] www.biltechindia.com
[4] the constructor.org/ ecofriendly building materials
[5] www.level.org.nz
[6] www.aac-india.com
[7] Government of Madhya Pradesh public work department SOR for building work in force of august'2014.
[8] Military Engineer Services Standard Schedule of Rates Parts – II 2010.