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Comparative Study between conventional Bricks and AAC Blocks

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ABSTRACT- In this project we do practical comparison between conventional bricks and AAC blocks. We conducted various tests on conventional bricks and AAC blocks for locating out the properties of both bricks. The time required for construction with conventional bricks is more as compare to AAC blocks. Also, the pricing calculation for multi storey building. We will solve this problem using AAC blocks in multi storey buildings. Because AAC blocks are lighter in weight as compared with conventional bricks. During this project we take compressive test, water absorption test, weight comparison, labour required and price required for both bricks.

KEYWORDS: Conventional Bricks, AAC blocks, Compressive Test, Water Absorption Test

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. According to the U.S. EPA "Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high performance building." The annual United Nations Forum for Climate Change summits being held for the last few years have reinforced the need of sustainable development. Sustainable development has been defined as achievement of social, economic and environmental goals without compromising with the needs of future generations. As civil engineers we can also contribute to this noble agenda by curbing the wastage of natural resources and energy during construction and minimizing carbon emissions at each stage of an infrastructure project. But this is not possible without arming the concerned people in the industry with sufficient knowledge and data to take well informed decisions. Over the last few decades the trend of 'Building Green' has taken the market by wave. This has led to a corresponding increase in the scope and size of the global green building material market which is expected to reach $234 billion by 2019. Green materials claim to be environment friendly, low carbon emitting, energy saving and resource economical. But the question that largely remains unanswered is whether the use of these materials is cost efficient in real economic terms or not. The stakeholders in the construction industry are divided on the answer owing to the lack of authentic academic research and data on the same, especially in India.In this project we do practical comparison between conventional bricks and AAC blocks. We conducted various tests on conventional bricks and AAC blocks for locating out the properties of both bricks. The time required for construction with conventional bricks is more as compare to AAC blocks. Also, the price for multi storey building is increased.

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II. LITERATURE REVIEW

[1] Comparative study between conventional bricks and AAC Blocks

Shreyasha S. Patil. Author, Anant P. Navale. Author, Vivek T. Babar. Author, Abhishek S. Shinde ,Pratik B. Chaugule (2020)- During this project we take compressive test, water absorption test, weight comparison, labour required and price required for both bricks. AAC blocks are more economical for multi storey building because they required less quantity of steel due to less weight. Due to AAC blocks the cost construction reduces by 20% as reduction of dead load of wall. The need of materials like sand and cement is also reduces by 50% by using AAC block. AAC blocks are 3 times lighter than conventional brick. AAC block cover more area in less weight of conventional bricks. AAC is manufactured from common natural raw materials, therefore it is efficient and eco-friendly. Therefore, we can use AAC block instead of traditional clay brick in multistorey buildings.

[2] Comparison of Autoclaved Aerated Concrete Blocks with Red Bricks

Prashant Gautam, Navdeep Saxena (2013)- The concept of "resources saved are resources generated" need to be stressed for efficient energy utilization. Residential buildings right from their stage of construction interact with environment and harm it. The construction materials used in buildings cause pollution during their manufacture. Sustainable development which means fulfilling the needs of present generation without overlooking the needs and aspirations of future generations, need to be stressed in today's world. In this paper we aim to show a comparative study between Red Bricks and AAC Blocks and their effects on the environment. Bricks are one of the traditional building material that are being used widely in construction industry and AAC Blocks are one of the newly adopted building material.

[3] Comparative analysis on aac, clc and flyash concrete blocks

Ashish Kurweti, Ruchi Chandrakar, Ahsan Rabbani (2017)- The main objective of this paper is to comparing the different types of light weight concrete according to their physical properties. Light weight concrete are widely used in all over the world, these types of concrete having densities ranges 450-1800 kg/m3 and are more sustainable than burnt brick clay or ordinary types of concrete. In this paper a deep discussion are carried out between the properties of AAC, CLC and fly ash. AAC(Autoclaved aerated concrete) is a light weight concrete material that was developed in many years ago, the main constituents used in making of this type of concrete is cement grade53 , gypsum, class C lime (hydrated lime), aluminum powder(.05-.25% by wt of cement) , fine aggregate or fly ash (class F) combining with definite proportions. CLC (Cellular light weight concrete) is another light weight concrete material which are widely used in making infrastructure and high rise building, the main ingredients of making CLC is cement(OPC grade 53), Fly ash (class F),sand (passing 2mm sieve) , foaming agent(either protein based or synthetic based). Fly ash is also taken in this paper as a light weight concrete because it replaces partially fine aggregate and fully coarse aggregate the raw materials of this type of concrete is cement (grade53/grade43), Fly ash (class F),sand (passing 2mm sieve). On keeping density as a constant parameter their load carrying capacity in compression, thermal insulation and water absorption are to be tabulated and then conclusions are made by their best performance.

[4] Comparative Study of AAC Blocks and Clay Brick and Costing

Utkarsh Jain, Muskan Jain, Smriti Mandaokar (2018)- 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%.

[5] Comparative Analysis of AAC Blocks and Red Clay Brick

Kalyana Chakravarthy P. R., Pradeep Kumar K (2019)- In the construction industry AAC blocks are beingused. The main aim of this paper is to compare AAC concrete blocks with red clay bricks which are the most commonly used building material. It is analyzed in terms of cost, performance, advantages etc. Hence in the comparison, we were able to find many clear conclusions. AAC block brings development through price lessening as more savings would be seen in per unit rate of AAC blocks and also very less usage of plastering and mortar while doing brickwork, as compared to red clay bricks This can be applied in the architectural and structural components of the building. Conclusion says that AAC blocks are good for high raise constructions than red clay bricks because of the reduction in consumption of steel reinforcements. Hence cost, quality, labor and time has been compared and suggestion from this paper is to use AAC blocks for construction.

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III. PROPOSED METHODOLOGY

VARIOUS STEPS INVOLVED IN THIS METHODOLOGY

Step 1: Sample collection

- We collected three conventional bricks of size 0.19*0.09*0.09m.
- Also three samples of AAC blocks of sizes 0.6*0.19*0.15m were collected.

[Fig.4.3: Collection three conventional bricks of size 0.19*0.09*0.09m]

[Fig.4.4: AAC blocks of sizes 0.6*0.19*0.15m]

Raw Materials Used in the Manufacture of AAC Blocks-

1. Cement: Portland cement is generally preferred over other types of cements.
2. Water: Potable water should be used which must conform with the general requirements of the concrete.
3. Fly Ash: It is usually a by-product of thermal power plants and is an important raw material in the manufacture of AAC Blocks.
4. Quick Lime: Lime powder required for AAC production is obtained either by crushing limestone to fine powder at AAC factory or by directly purchasing it in powder form from a vendor.
5. Gypsum: Gypsum is easily available in the market and is used in powder form. It is stored in silos.
6. Aluminium Powder

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Step 2: To carry out various tests on both bricks

1. Water absorption test: The bricks when immersed in water for 24 hours should not absorb water by more than-

- **20% in case of 1st class bricks**
- **22% in case of 2nd class brick**
- **25% in case of 3rd class bricks**

In this test bricks are weighed in dry condition and let them immersed in fresh water for 24 hours. After 24 hours of immersion those are taken out from water and wipe out with cloth. Then brick is weighed in wet condition. The difference between weights is the water absorbed by brick. The percentage of water absorption is then calculated. The less water absorbed by brick the greater its quality. Good quality brick doesn't absorb more than 20% water of its own weight.

Procedure:

1. Put the brick in oven at temperature 105ºC-115ºC.
2. Cool the brick to normal room temperature and take its weight (w1).
3. Sink completely dried brick in water at temperature of 27ºC for 24 hrs.
4. Remove the brick from water and put it in gunny bag then take weight of brick as (w2).
5. A brick with water absorption of < 7% provide better resistance to damage by freezing.

[Fig.4.5: Conduct water absorption test on AAC Blocks]

2. Compressive strength test: The bricks should process minimum compressive strength of:

- **1st class- 10 N/mm^2**
- **2nd class- 7.5 N/mm^2**
- **3rd class- 3.5 N/mm^2**

This test is done to know the compressive strength of brick. It is also called crushing strength of brick. Generally 5 specimens of bricks are taken to laboratory for testing and tested one by one. In this test a brick specimen is put on crushing machine and applied pressure till it breaks. The ultimate pressure at which brick is crushed is taken into account. All five brick specimens are tested one by one and average result is taken as brick's compressive/crushing strength.

Procedure:

1. Place the brick in compression testing machine (CTM) in such way that the load shall be applied to the opposite side of the brick.
2. Align the brick centrally on the base plate of the machine.
3. Rotate the movable portion gently by hand so that it touches top surface of the brick.
4. Apply the load gradually which should be without shock and continuously at the rate of 140kg/cm^2.
5. Record the maximum load and note any unusual features in the type of the failure.

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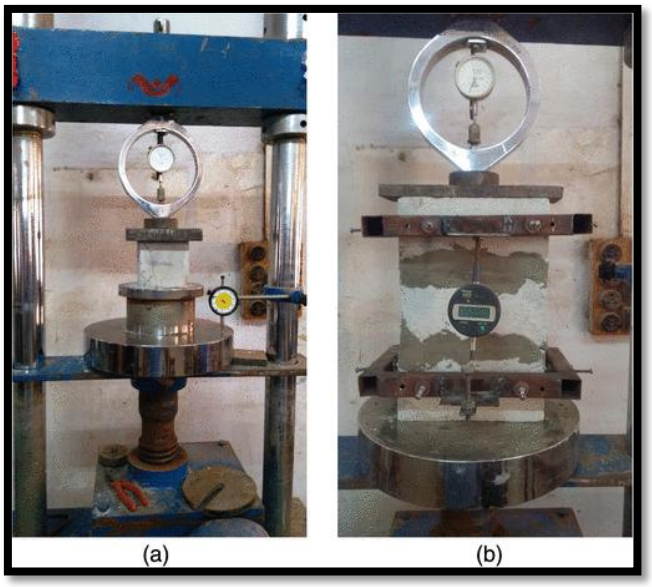

[Fig.4.6: Conduct compressive test on AAC Blocks]

Step 3: Weight comparison

[Fig.4.7: Weight measurement of AAC Blocks]

[Fig.4.8: Weight measurement of conventional bricks]

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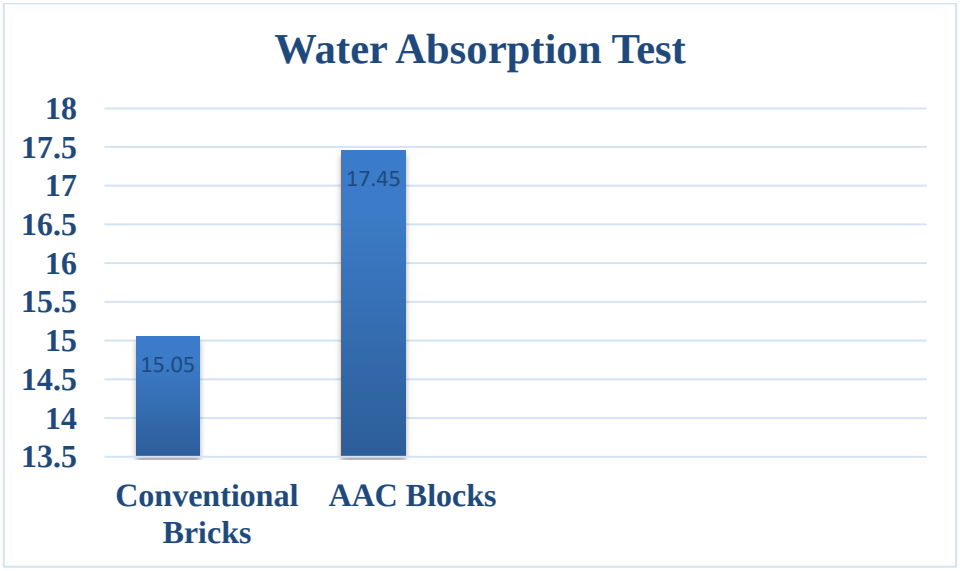
IV. RESULTS

WATER ABSORPTION TEST

A conventional soaking-in-water test may be done to evaluate the porosity of bricks and blocks, which can then be used as an indicator of the potential for issues like as salt attack and efflorescence to occur due to the penetration of salts and other materials into the units as shown in Figure 5.1.

% age water absorption= (Wet weight-oven dried weight/Oven dry weight) x 100

- Water Absorption Test of Bricks as Per IS 3495 (Part 2) 1992.
- Water Absorption of AAC as Per IS 2185 (Part 1)-1979.

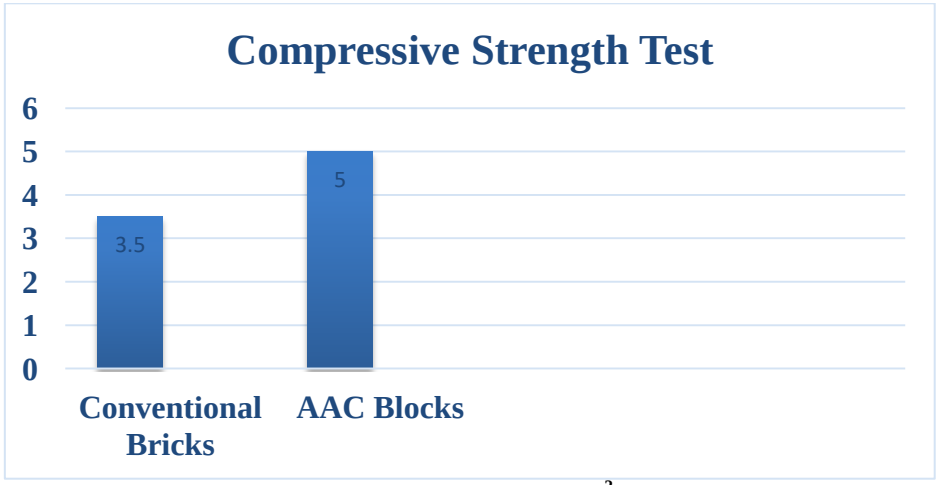


[Fig.5.1: Water absorption in % comparison]

COMPRESSIVE STRENGTH TEST

Autoclaved aerated concrete (AAC) blocks have good compressive strength as shown in Figure 5.2. The compressive quality ranges from 35 to 50 kg per square metre (according to IS: 2185). Previous research has demonstrated that AAC blockwork may be used to safely elevate loadbearing structures up to three storeys high.

Compressive Strength= Ultimate Compressive load/Contact area



[Fig.5.2: Compressive Strength N/mm^2 Comparison]

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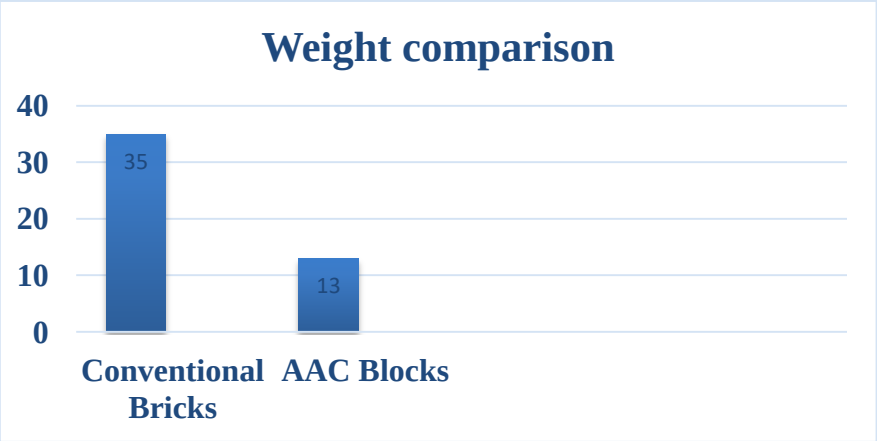
WEIGHT COMPARISON

The average weight of AAC block is 13 kg and the average weight of burnt clay bricks is 2.8 kg. To construct similar sized construction as a sample, 10 conventional bricks are required. The total weight of conventional bricks constructed similar to size of AAC block is 35.260 kg. It means the conventional brick construction similar to AAC block is 2.712 times heavier than AAC block as shown in Figure 5.3. So, comparison to size AAC Block is lighter than conventional brick.



[Fig.5.3: Weight in Kg comparison]

COST COMPARISON

For the cost analysis purpose, a room of size 3m x 3m x 3m has been considered. The size of both the materials i.e., clay bricks and AAC blocks have been taken as per IS codes. To keep the calculations simpler, reduction of openings has not been considered.

Cost Analysis for Room Size 3m x 3m x 3m:

AAC Block masonry = 4 x [3 x .02 x 3] = 7.2 cumec

Brick masonry = 4 x [3 x .02 x 3] = 7.2 cumec

FOR AAC: -

Dimension = *500 x 200 x 250*

Assume = *10 mm thick mortar*

Number of blocks in cum = $\frac{1}{.51 \times .21 \times .26} = 35.91$

Let us assume 5% waste = *1.7955*

Total no of block required = *35.91+1.7955 = 37.70 = say 38 no.*

Rate of one block = *80 Rs*

Amount of 38 blocks = *38 x 80 = 3080 Rs.*

Quantity of cement & sand in 10 mm thick cement mortar (1:4): -

Volume of mortar = $1 - (38 \times 0.5 \times 0.25 \times 0.20) = 0.05\ m^3$

Add of 40% for dry volume = $0.05 \times .40 = 0.02\ m^3$

Total volume of mortar = $.05 + .02 = .07\ m^3$

No. of cement bag = $\frac{.07}{1+4} = 0.014\ m^3$

No. of cement bag = $\frac{.014}{.035} = 0.40 = say\ 1\ bag$

Amount of cement = *360 Rs.*

⇨ *Sand in* m^3 = $\frac{.07}{1+4} x\ 4 = 0.056\ m^3$

Amount of sand = *.056 x 1500 = 84 Rs.*

Total material cost = *3080 + 360 + 84 = 3524 Rs.*

Add 5% transportation cost = *3524 x 0.05 = 176.20 Rs.*

Safety 1% = *3524x 0.01 = 35.24 Rs.*

Subtotal = *3524 + 176.20 + 35.24 = 3735.44 Rs.*

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Labour required:
1 Mistri = 700 Rs. /Day
2 mazdoor = 2 x 450 Rs. /Day
Subtotal = 3735.44 + 700 + 900 = 5336 Rs.
Add 15% OH & Profit = 5336 x 0.15 = 800.40 Rs.

Rate per cumec for AAC Block masonry = 5336 + 800.40 = 6137 Rs.

FOR CONVENTIONAL BRICKS:

Size of brick = 190 x 90 x 90mm
Number of bricks in one Cumec = 500 no.
Rate of one brick = 6.50 Rs.

Quantity of cement & sand in 10mm thick cement mortar (1:4): -

Volume of mortar	= 1 – (500 x .19 x .09 x .09) = 0.2305 m^3
Add 40% of dry volume	= 0 .2305 x 0.4 = 0.0922 m^3
Total vol. of mortar	= 0.2305 + 0.0922 = 0.3227 m^3
⇨ No. of cement bag	= $\frac{0.3227}{(1+4)}$ = 0.06454 m^3
⇨ No. of bag	= 1.844 = say 2 bags
Amount of cement	= 2 x 360 = 720 Rs.
Sand in m^3	= $\frac{0.3227}{(1+4)}$ x 4 = 0.2582 m^3
Amount of cement	= 0.2582 x 1500 = 387.30 Rs.
Total material cost	= 500 x 6.50 + 720 + 387.30 = 4024.60 Rs.
Add 5 % transportation cost	= 201.23 Rs,
Safety 1%	= 40.246 Rs.
Subtotal	= 4266.07 Rs.
Labour required	
1 Mistri	= 700 Rs. /day
2 mazdoor	= 2 x 450 Rs. /day
Subtotal	= 4266.07 + 700 + 900 = 5866.07 Rs.
Add 15% OH & Profit	= 879.91 Rs.
Rate per cumec for bricks	***= 5866.07 + 879.91 = 6745.98 = say 6746 Rs.***

Name of item	Rate per Cumec masonry (Rs.)	Total Cost (Rs.)
AAC block masonry (7.2 cumec)	6137	44186.40
Brick masonry (7.2 cumec)	6746	48571.20

V. CONCLUSION

- The use of AAC block reduces the overall cost of project.
- Speed up the construction process as installation of AAC blocks is easier vis-a-vis clay bricks.
- It helps in reducing dead load of structure and hence can be used as replacement of conventional clay bricks as an infill material in high seismic zones.

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- AAC is efficient and eco-friendly. Since AAC blocks use readily available raw materials in the manufacturing process, have excellent durability, are energy efficient, and cost-effective, therefore AAC can be referred as a sustainable building material.

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