Experimental Analysis of the Mechanical Performance of Aac Block

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Abstract: Fly ash blocks made of autoclaved aerated concrete (AAC) are lightweight and employed quickly in high-rise structures. One of the sustainable materials is the AAC Block, which is made from fly ash from industrial waste. AAC block masonry in fills contributes to a structure's low weight, thermal conductivity, and speed of construction. To increase the effectiveness of the AAC block masonry, material-level research is required. The literatures lack an awareness of the material level of behaviour of AAC block construction. This article describes an experimental investigation that was conducted to better understand the compressive stress-strain behaviour of AAC Block masonry and its constituent parts. Compression testing is a method used to assess the response of AAC block masonry to both strong and weak mortar.
Keywords: Compressive strength, masonry prisms, and AAC block

Introduction: The behaviour of masonry infills and their impact on structural performance have varied greatly throughout India as a result of recent advancements in the materials used to build them. The infill walls used in building construction are only built for aesthetic reasons. The infill's are regarded as non-structural components and are not taken into consideration while designing the structure's seismic response. Infill walls often take up a significant amount of space in RC frames. In the current study, infill is made of block masonry made of autoclaved aerated concrete. these have extra benefits that make them more comfortable for the inhabitants and are superior to red clay bricks that have been burned. Therefore, AAC infills are employed as the best substitute for clay brick infill's in the majority of modern constructions. Air pollution is produced when clay brick kilns are heated; instead, the autoclave is used in the manufacturing of AAC. Additionally, one of the primary raw materials utilised in the production of AAC is fly ash. AAC is a sustainable building material as a result. Compared to other construction materials, these blocks' low weight minimises the dead load on the structures. Compared to traditional clay bricks, construction with these blocks is quicker and more affordable. Infill made of AAC blocks have an impact on the stiffness and performance overall. As a result, the behaviour of AAC masonry infill as well as its prepack and post-peak behaviour must be examined.

1. Introduction

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2. Experimental Program

Based on the numerous test processes utilised in the laboratory, the characterisation of the materials used in the masonry is described in this experimental programme. Standard codal references are used to describe the casting and testing process. The testing equipment is discussed, and the results of the experiments are compiled. AAC Brick, Mortar, and Masonry.

3. The setup for mortar cubes

Ordinary Portland Cement (OPC) of Grade 53 is used to make the mortar specimens in two strengths: M1 (1:2) and M2 (1:5), which are for strong and weak mortar, respectively. In compliance with IS 4031 PART 7 clause 5.3, the mortar specimens are made using the 50mm cube moulds [5]. The compressive strength of mortar cubes is calculated using an edge length of 50 mm. The W/C ratio was established at 0.5 for mortar ratios M1 and M2. Ten cubes are constructed for each ratio in order to determine the tensile strength of the mortar. According to Article 9.1, cubes need to be dried for 28 days by immersing them in clean water. After curing and before testing, gypsum is applied to the top and bottom surfaces of the mortar cubes to smooth out any uneven surfaces and guarantee that the weight is distributed equally when the mortar cube is tested. After drying and before testing, gypsum is applied to the top and bottom surfaces of the mortar cubes to balance out any uneven surfaces.

Fig.1 Cube of mortars **Fig.2 Gypsum to cube**

4. AAC specimen preparation

Autoclaved aerated concrete blocks come in three distinct sizes for construction: The dimensions are 100x200x600mm, 150x200x600mm, and 200x200x600mm. A 150x200x600m. A cube with rotating blades is cut to a 150mm edge length to provide the test specimen in compliance with IS 6441 (PART 5) 1972 [6] clause 2.1. With reference to clause 2.2, three cubes are selected from a single AAC block: one from each of the upper third, middle, and bottom quarters. Before testing, gypsum is applied to the top and bottom surfaces of AAC cubes to balance out any uneven surfaces and provide a uniform weight distribution.

Fig.3 Gypsum applied in both surfaces

5. Masonry preparation prisms

The AAC blocks are cut into 200x100x70 mm pieces, which are the same size as a clay brick, in order to construct the masonry prism. One brick for every width brick and five bricks for every height brick were used in the construction of the AAC brick masonry prisms, which were built using two cement sand proportions, or strong and weak mortars. The mortar thickness of a brickwork prism is 10 mm. To maintain a constant thickness of 10 mm, a wooden frame measuring 200 mm in length and 70 mm in width is designed to be utilised comfortably when producing a brick prism. A minimum height of 40 cm and a height to thickness (h/t) or aspect ratio between 2 and 5 are specified in Appendix B of IS 1905 [3]. The aspect ratio is kept at 3.9 in the current study, and IS 1905 [3] table 12 provides a correction factor for translating prism strength to brickwork. Gypsum was also applied to the top and bottom surfaces of the brick prism. During testing, two pieces of plywood are placed in between the top and bottom bricks. There are six masonry prisms in each cube of weak and strong mortar. The curing period is 28 days when using sealed gunny bags. The AAC bricks were coated with gypsum and masonry prism on both their top and bottom surfaces.

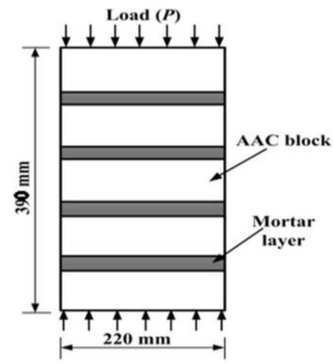

Fig.4 Masonry prism **Fig.5 AAC masonry Prism**

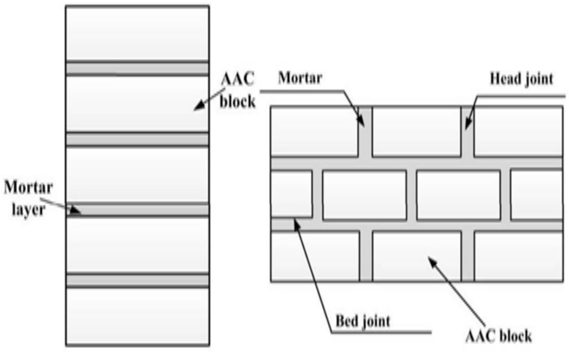

Fig.6 AAC masonry compression test schematic illustration

6. Compression tests conducted

Using a computerised hydraulic compression testing machine (CTM), the compressive strength of weak and strong mortar cubes as well as the AAC block is evaluated. CTM has the ability to automatically record load and displacement data in order to produce a graphical depiction of the specimen load response. It may also hold onto every result. The sensitivity of CTM is 0.8%.

The compressive response of AAC Masonry prisms is evaluated on a four-post loading frame using a hydraulic jack equipped with a displacement control and a 1000 kN load cell. Both the test results and the processes are shown.

Fig.7 AAC Block's Compressive Strength Test

To assess the compressive strength of AAC blocks, the specimen's edge length should be 150 mm. As to the 1972 IS 6441 (PART 5) documents. Testing of AAC blocks is done at UTM. The standard AAC block graph appears following the evaluation of six samples.

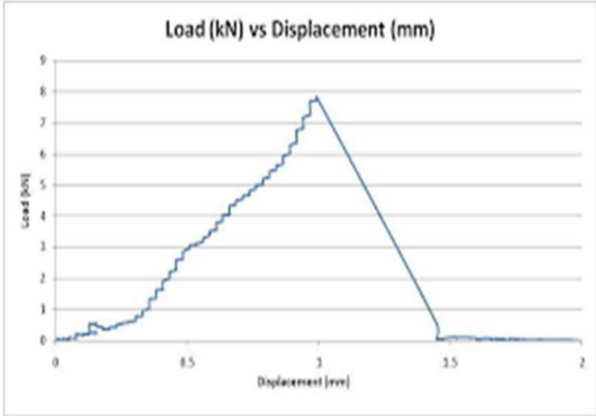

Fig.8 AAC Block Load vs. Displacement

Table 1 AAC cube outcomes

Samples	Load (kN)	Strength (MPa)
Sample 1	58.2	2.4
Sample 2	96.2	4.4
Sample 3	102.5	4.8
Sample4	93.2	4.6

7. Mortar cubes compressive strength test

In the current investigation, a 50mm cube is tested to assess mortar's compressive strength in line with IS 4031 PART 7 [5]. It is calculated the strength of strong and weak mortar cubes. The load response of weak and powerful mortar cubes is shown in Figure 10, and the results are summarised in Table 2.

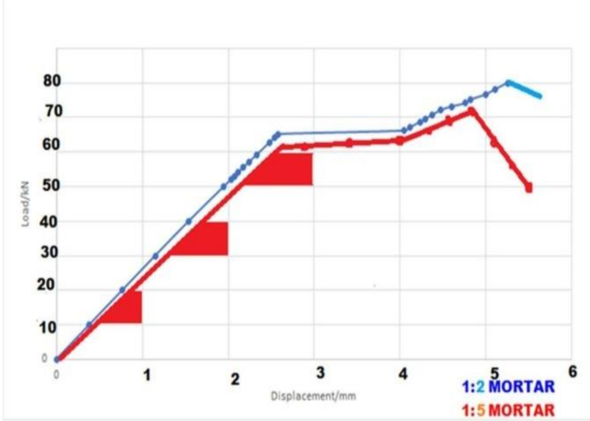

Fig.9 Mortar cube typical load response (1:2) and (1:5) by volume

Table 2 The Results for mortar cubes of 1:2

	Mortar Cube 1:2	
Sample	**Compressive load (kN)**	**Compressive strength (MPa)**
Sample 1	52.99	20.95
Sample 2	53.22	20.44
Sample3	48	18.9
Avg	51.40	20.09

Table 2.1 The Results for mortar cubes of 1:5

	Mortar cubes 1:5	
Sample	**Compressive load (kN)**	**Compressive strength (MPa)**
Sample 1	29.34	11.98
Sample 2	20.99	7.99
Sample3	27.99	10.85
Avg	26.10	10.27

8. Masonry prism compression test

Masonry prisms are produced and displacement measurements are made using AAC bricks and mortar ratios of 1:5 and 1:2. Controlled Utilising a hydraulic jack and a 1000kN load cell installed on a four-post loading frame, compression testing was carried out.Five millimetre strain gauges and two LVDTs with a combined maximum displacement of 100 mm are used as measurement instruments.

Fig.10 Configuration in the loading frame

9. Results

AAC MASONRY PRISM COMPRESSION TEST

An AAC masonry prism is assessed in a loading frame with continuous displacement following a 28-day curing period. For 1:5 Masonry Prism, a crack may be seen at 210 kN; however, for strong mortar 1:2, a crack can be seen at 270 kN. Masonry Lens. An early masonry prism fracture was caused by poor mortar. The typical stress-strain response of the masonry prism with strong and weak mortar strengths is shown in Figure 12. Table 3 summarises the compression test strengths of masonry prisms made of strong and weak mortar. The specimen with the highest strength is not taken into consideration while averaging in order to prevent testing mistakes. After the correction factor is applied to the masonry prism, Table 4 displays the strengths of the masonry. Although there isn't a significant difference in the two prisms' strengths, the failure in 1:5 has revealedone.

Table 3 AAC masonry prism strength and Young Modulus

	Masonry 1:3	
Sample	**Prism Strength (MPa)**	**Young'sModulus E (MPa)**
Sample 1	11.9	962
Sample 2	12.4	11.3

Sample3	9.7	9.4
Avg	11.3	10.5

Table 3.1 AAC masonry prism strength and Young Modulus

	Masonry 1:6	
Sample	**Prism Strength (MPa)**	**Young's Modulus E (MPa)**
Sample 1	10.9	199
Sample 2	11.3	910
Sample3	9.45	621
Avg	10.55	576.6

Table 4 The table of Masonry Strengths was created by adding an adjustment factor for a prism

S.no	**strength of Prism (MPa)**	**IS 1905 correctio n values**	**Strength Of Masonry (MPa)**	**E (MPa)**
1	10.55	0.942	10.34	576.6
2	11.394	0.942	10.87	949.8

MASONRY FAILURE:

The specimen collapsed as a result of a fracture in both masonry prisms that began at the mortar junction and travelled through the brick. Spalling caused the 1:5 masonry prism to collapse. The breakdown of the masonry prism 1:5 observed was caused by a fracture that went through the brick and formed a single, massive crack. in Fig. 13. the 1:2 masonry prism fails because only one fracture develops. Because the distance between the nonlinearity points and the ultimate load is so small in 1:2 the fracture spreads exceedingly fast, and the specimen exhibited brittle failure.

(a) (b)

Fig.11 (a) 1:6 masonry specimenswith numerous cracks and (b) Failure resulted from a single crack in 1:3) masonry specimens.

CONCLUSION:

•According to compression test findings, AAC brick has a strength of 4.2 MPa, which is lower than that of normal clay bricks stated in IS1905.

•When compared to comparable brick unit materials, the observed elastic modulus of 340 MPa suggests a very soft material.

•The mortar strengths for 1:2 and 1:5 are 20.09 MPa and 10.27 MPa, respectively, when compared to the strength of AAC brick.

•For a 1:2 masonry prism, the elastic modulus is 949.83 MPa and the compressive strength is 11.394 MPa. The elastic modulus is 576.6 MPa and the compressive strength is 10.55 MPa for a 1:5. Although the mortar strengths and elastic modulus differ, they are almost equal.

•The Stress-Strain response for masonry prisms built of 1:2 and 1:5 AAC blocks revealed nearly earlier nonlinearity in the latter than the former.

•Multiple cracking and AAC brick spalling are detected in the 1:5 masonry prism failure pattern, but just one crack is seen in the 1:2 masonry prism.

•The mortar joint and the AAC brick are both where the masonry prism 1:5 fails.

•The fracture propagation in the 1:2 masonry prism is fairly quick, indicating brittle collapse.

Numerous cracking and spalling have been seen in a 1:5 masonry prism up until the ultimate load, indicating some lagging between the ultimate load and the breaking load.

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