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Experimental evaluation of masonry building walls behavior made of AAC block and shear strength of it mortar

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ABSTRACT

The using of Autoclaved Aerated Concrete (AAC) blocks is increasing day by day due to the some advantage such as lightweight, low thermal conductivity and fire resistance. In this paper performance of Autoclaved Aerated Concrete walls was studied. At first the compressive and shear strength of mortar and blocks was tested and then three walls with dimensions 120 × 120 ×25 cm were studied under diagonal loading. The failure mode occurred at AAC block because sliding has not occurred between the mortar and the blocks.

KEYWORDS

AAC, Diagonal Tension Tests, The Shear Strength of Mortar, Masonry Building AAC.

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1- INTRODUCTION

Lightweight construction material reduces the seismic load of a building and also saving energy which one of the issues that is very important. Lightweight materials have less thermal conductivity and lower thermal conductivity coefficients. Due to this advantage it is necessary to evaluate the structural performance for low rise structures, and used as infill walls. The density of this type of concrete is about 400 to 800 kg / m3 (one-third to one-sixth of conventional concrete). Due to the limited number of articles and research about structural behavior of Autoclaved Aerated Concrete walls [1] it is needed to more experimental study to understand of AAC walls performance. ASTM [2, 3] was given only density and compressive strength Autoclaved Aerated Concrete blocks.

2- METHODOLOGY

2-1- Compressive strength test of blocks

Three specimens were selected based on ASTM [2]. The average compressive strength of 10 × 10 × 10 cm3 cube specimen was almost equal 3.2 MPa. Average compressive strength of 15 × 15 × 15 cm3 cube specimens was 2.33 MPa, due to test result blocks are classified in class of AAC-G2 [2].

2-2- Compressive and Shear strength of mortar

Due to porosity structure that high water absorption of blocks, conventional mortar (sand and cement) could not be used easily in bed joints of blocks thus it was needed the mortar make with prefect bonding between blocks. It is necessary to tested compressive strength of mortar according to ASTM C109 [4] and according to ACI 530 [5] and then compressive strength of mortar obtains 12 MPa. To test the shear strength of mortar with thin bed mortars has done with using three blocks and desired mortar (adhesive) and placing it under load. [1,6]. Blocks compression strength was 3.2MPa and shear strength was respectively 0.75 MPa .

2-3- Diagonal loading test of wall

To perform this experiment determined by a wall with dimensions of 1.20 × 1.20 × 0.25 m^3 that applying load along the diameter of element [7]. In Figure1 the setup of the tests according to ASTM E519 [7] was given. Three walls that tested have 25cm thickness so that their size equal with reality. Blocks used in the construction of walls have dimensions 60cm × 25cm × 20cm. the thickness of mortar is two to three millimeters and filled all of vertical and horizontal mortar bed.

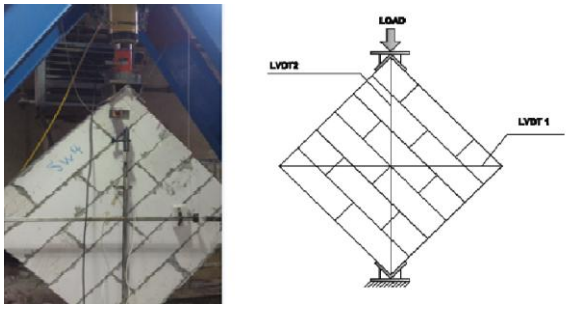

Figure1. Diagonal Tension Test of walls

The relation between compressive and shear strength of AAC block can be given in Equation (1) [1,6]. ($F_{vAAC}=0.15F_{AAC}$ *(1)*) F_{AAC} was the compressive strength of AAC F_{vAAC} would the shear strength of walls according to equation (1).

The walls shear strength that made of autoclaved aerated concrete equal to 0.15 times of its compressive strength and in this research is about 0.48 MPa. This value is lower than the shear strength of mortar. For obtaining the tensile strength of the wall used from equation (2). ($Ft=0.45F_v/A$ *(2)*) Where Fv is the failure load of the wall and A is the cross section area of wall [8].

Diagonal tensile test results are shown in Table1:

Table1. Results of the diagonal tensile test of three walls (average (avg))

f_t (Mpa)	tensile stiffness k_t (kN/mm)	compress stiffness k_C (kN/mm)	Shear module G (MPa)	*load (Max)* F_v (kN)	NO.
0.424	1249.66	119.96	428.91	139.3	avg

Static calculations and analysis of forces in wall showed good agreement with experimental results and equation. According to calculations of ACI523 [6] relationships obtained shear strength of walls of the

block is 0.48 Mpa that less than the shear strength of the tested mortar.

In this study, it was taken shear strength of any walls that made of different blocks and stone and concrete blocks with other mortars that compared with this research blocks and mortar according to the ASTM E519[7]. In Table 2 has been shown shear strength of the walls made of blocks and stone and autoclaved aerated concrete blocks with other mortars compared with blocks and mortar of this research is based on ASTM E519[7].

Table2. The shear strength of some masonry building walls according to ASTM E519 shear strength equation.

shear strength (MPa)	Tomazovich experiments with AAC Yetong block (1/3scale) [8]	AAC blocks wall with special mortar in this research	Walls made of stone [9]	Hollow block walls filled with grout [10]	Hollow block walls filled with mortar [11]	Hollow block walls filled with mortar and horizontal reinforced [11]	Hollow block walls filled with mortar and vertical reinforced [11]
average	0.389	0.666	0.061	0.596	0.42	0.71	1.09

3- RESULTS

-Tested mortar shear strength was obtained about 0.06 specified compressive strength of mortar. And the average shear strength of the mortar in state without mortar on surface is 0.742 MPa and with surfaces mortar is 0.933 MPa. This means that when the specimen surface is made of it adhesive in mortar bed indicate 25% increase in resistance.

- In tested Autoclaved Aerated Concrete blocks compressive strength of cubic specimens with dimensions 10 × 10 × 10 cm, 1.37 times the compressive strength of cubic specimens with the dimensions 15 × 15 × 15cm.

- According to the shear strength of the mortar in tests has more resistant than obtained shear strength from walls made of AAC blocks with 3.2MPa compressive strength (test specimen) thus wall behavior is controlled by the force and loading along diameter caused the failure modes of diagonal tension and pressure the toe. According to the resulting load-displacement diagram clear that failure of walls was brittle and limits of its ductility was less.

- Autoclaved Aerated Concrete walls with special mortar compared with walls made from other blocks according to weight loss and good adhesion formation has better shear strength in mortar beds.

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