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Effect of reinforcement the mortar on adobe walls performance

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ABSTRACT: Present study investigates an experimental performance of mud brick wall under static lateral load. The size of bricks was about 22×22×7 cm3 (face × bed × end). For wall specimens, two types mortar was used: a) non-reinforced mortar, b) reinforcement mortar. For reinforcement mortar many types such as: metal mesh (mesh size: 0.5 and 0.75 inches), polymeric mesh (mesh size: 10 and 25 mm) and palm fiber considered was used. First mechanical properties of each types of mortar have been determined. Then the 12 wall with dimensions of 120 × 120 × 22 cm^3 are made with six different kinds of mortar. Walls are loaded under static lateral load in order to evaluate their cracks pattern, load capacities, deformability and energy absorption characteristics. Cracks in the specimens occurred between the first and the second row that caused the failure. The mortar was vulnerable part of conventional walls (unreinforced mortar). Ultimate strength of walls with mortar reinforced by polymer mesh (mesh size was 25 × 25 mm) increased the load and energy capacity to 83.04% and 158% respectively. The palm fibers increased the load carrying capacity about 82.14% and energy absorption capacity about 247%. Test result was shown that using palm fiber and polymer mesh with diameter of 25 mm in mortar can increase adobe wall performance.
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1- Introduction

The buildings constructed of mud bricks were the oldest buildings. One of the oldest buildings of this type, was constructed about 5800-6200 BC in the Dehloran valley [1].
For the past many years, earth brick has been used as a construction material. It is estimated that more than half the world population lives in earth constructions [2]. This is due to that it is a low-cost material available everywhere and it is recyclable, incombustible and provides good thermal insulation. Nowadays a revival of this type of construction can be observed all over the world, including in developed countries, due to energy and environmental benefits, coupled with a rising interest in architecture of this type of construction [2].

Many researches were conducted about improving the properties of clay brick to increase the strength and behavior of wall was done [3-6]. Using of horizontal and vertical bars in brick walls improving in lane and out of plane of adobe walls [7]. Mortar is one of the weaknesses of the masonry walls against lateral loads. In this study the behavior of wall with various mortars under lateral load was investigated.

2- Methodology

Samples with dimensions of 22×22×7 cm3 constructed by bricks with dimensions of 22×11 ×7 cm3.the bricks were made by clay, sand and gravel.For reinforcement of mortar following materials was used:

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- Polymer meshes with springs mesh size 10 mm;
- Polymer mesh springs mesh size , 25mm;
- Metal mesh with mesh size 1/2 inch;
- Metal mesh with mesh size 3/4 inch;
- Palm fibers with 1.5 % of the composition of the mortar.

Plans wall are shown in Figure 1.

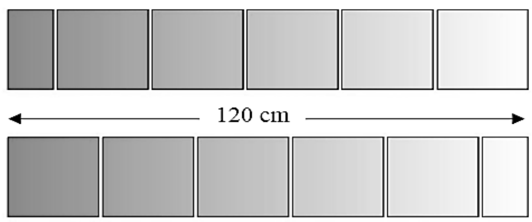

Figure 1: Plans wall

The dimensions of the walls are 120×120×7 cm^3. The wall is composed of two parts (block and mortar). In the control samples, walls made by reinforced clay (Palm fiber and straw) and conventional fibers. In the strengthened samples used of clay reinforced (by palm fiber and straw) and reinforced mortar. In Figure 2 the location of experimental equipments were shown..

Mortar is the weakest part of mud brick wall. Mortar acts very weak in tension. When the lateral load is applied to the lower load due to bending tensile stress occurs and When the lateral load applied to the top of wall, bending stress at the lower part of the wall caused tensile stress in the mortar.

Since the mortar is weak in tension, the wall failure occurs in this zone.
In Figure 3 the failure of walls are shown.

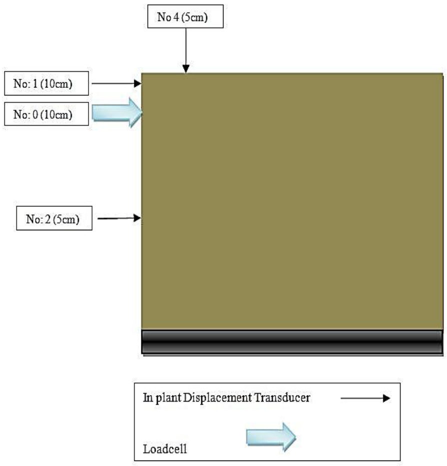

Figure 2: Lateral load test details

Figure 3: The failure of wall under lateral load

Load-displacement diagram of the walls is shown in Figure 4.

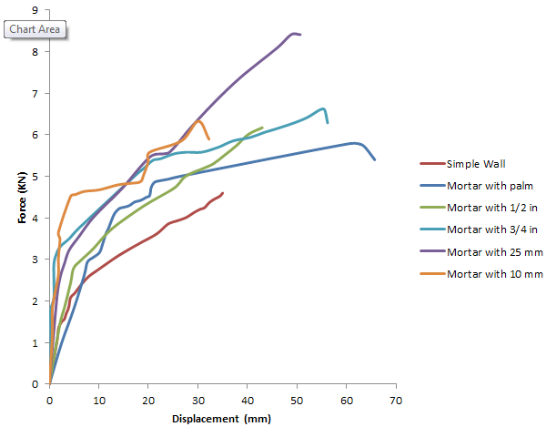

Figure 4: Load-displacement diagram of walls

According to Figure 4, it is observed that:
All the walls are initially show linear behavior and then behavior of walls changes to nonlinear. Failure of the whole sample of fissuring in the lower left corner of the loading, occurred between the first and second row.
The maximum lateral load was beard by speciments reinforced with polymer mesh size 25 mm..

3- Conclusions

Using plastic mesh with a diameter of 10 mm in the mortar walls, increased 37 percent in the final lateral load and a 39% increase in energy absorption.
Using plastic mesh with diameter of 25 mm in the mortar walls, increased 83 percent in the final lateral load, an increase of 44 percent in the final displacement and increase 158 percent in energy absorption.
Using steel mesh diameter springs 1/2 inch the mortar wall, increased 35 percent in the final lateral load, an increase of 15 percent in the final displacement and increase 65% in energy absorption.
Placing plastic mesh diameter 3/4 inch in the mortar wall, increased 43 percent in the final lateral load, increased 57 percent in the final displacement and 164 percent increase in energy absorption.
The use of palm fiber in the mortar walls, increased 25 percent in the final lateral load, up 82 percent in the final displacement and increase 247 percent in energy absorption.

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