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Behavior of Masonry Walls with Respect to Seismic Stress, Analysis and Recommendation

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Abstract: ***Structures with masonry infill panels and reinforced concrete frame are widely used structural systems and by lack of knowledge considered secondary, masonry infill walls are considered until now as non-load-bearing elements, therefore the role of taking and transmitting vertical and horizontal loads (seismic) is ensured only by the reinforced concrete structure. However, experience from past earthquakes around the world has shown that this calculation approach is simplifying and approximate, because we have found during the analysis of earthquake damage that the neglect of masonry walls in calculations can decisively influence and even upset the response of structures to seismic forces. The tests carried out in our research and the numerical modelling carried out on several cases have shown that the effect of shear stress on gantry masonry structures can be taken into account by replacing in the numerical modelling the masonry with equivalent diagonals whose thickness will be calculated according to the physical and mechanical characteristics of the gantry and the masonry.***

Keywords: Structures, masonry, concrete, loads, mechanical characteristics

1. Introduction

The intensity of the seismic forces acting on a building during an earthquake is conditioned not only by the characteristics of the seismic movement, but also by the rigidity of the stressed structure.

The various cases of damage observed in the past have revealed the vulnerability of self-stable portal structures (posts- beams), these structures represent the largest percentages of the housing stock, their filling is ensured with hollow brick under form of panels.

Portal structures with masonry are considered to be very vulnerable to stresses.

Seismic. Most of the works made with this type of construction have undergone significant damage in affected areas.

However even if the taking into account of the presence of the filling turns out to be of economic interest, the safety practice wanted this contribution to be ignored in the calculations because of the absence of a practical method and a regulatory tool.
Studies by researchers and experts have revealed that these fillings are not always safe, they can however promote the rupture of certain frameworks, and even upset the behavior of structures.

Therefore, we are going to study in this present report the effect of the presence of filling on the response of the structure to the shearing force, to do this we carried out of the experimental tests on walls built with local materials.

2. Objective

The objective of the thesis is to complete and contribute to existing research and knowledge on the behavior of masonry walls with respect to the shearing force

3. Experimental Tests

a) Geometrical characteristics

- Wall width L = 2m
- Wall height h=1.56m.
- Length of the diagonal D = 2.54m
- thickness of the diagonal e= 0.2m
- inertia of the column I=32552cm4.
- Dimensions of the bricks used (30*10*20)
- The portal frame consists of two columns (20cm x 20cm), and a beam (20cm x 20cm).

b) Results of tests on materials

- Sand equivalent: ES > 85 % (very clean sand, no clay fines, risk of bringing a plasticity defect in the concrete, increasing the water dosage gives exceptional concretes of very high resistance)
- Modulus of fineness: 1.2< 2.2 (sand has a majority of fine and very fine elements, which (sand has a majority of fine and very fine elements, which requires an increase in the water dosage).

c) Result of the formulation of the concrete

- quantity of sand = 85kg/m3
- quantity of gravel = 190kg/m3
- quantity of cement=357kg/m3
- water=174l/m3.

d) Mechanical characteristics

- Young's modulus of the filling Er=16000 Mpa.
- Young's modulus of the post Ec= 7200 Mpa.
- Young's modulus of mortar 4000Mpa

- The poison coefficient is null
- The compressive strength of concrete is 25 Mpa, its tensile strength is 2.1 Mpa

4. Loading

The wall is subjected to a distributed vertical load of value N=90 KN/m and a seismic force (horizontal)V=195KN.

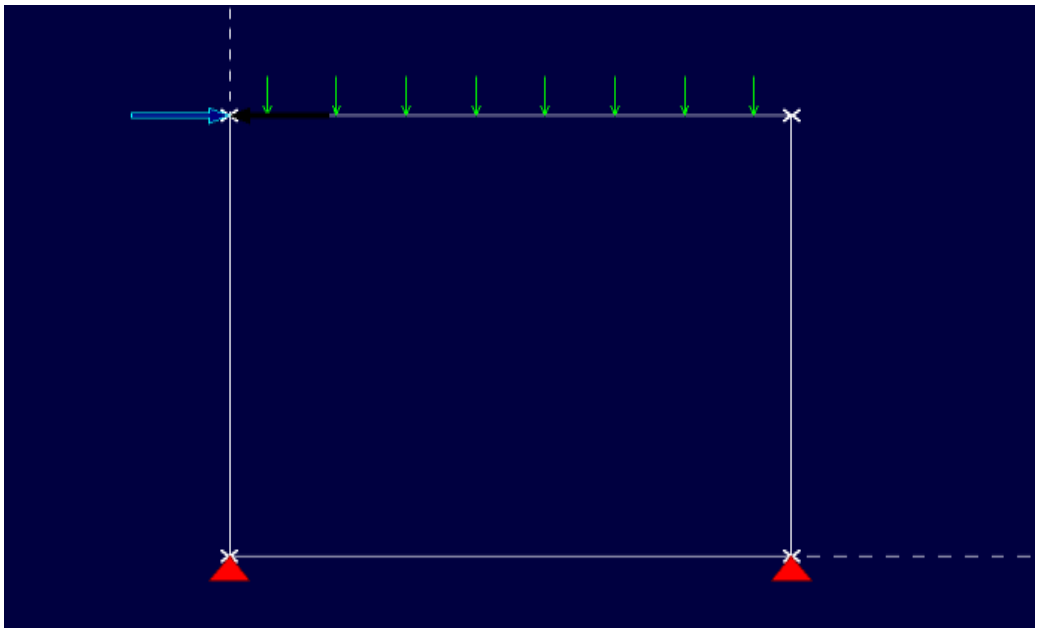

Figure 1: Loading mode

5. Test Result

For the comparison between the different models, we made a test on local materials, the results of this test are:

Figure 2: Built Wall

6. Analysis of Results

Explanations and Failure Mechanisms

- The diagonal cracking of the infill can be caused by a combined mechanism of failure: bending failure of one column and shear failure of the other.
- Cracking of the panel occurs in the direction of the compressed diagonals along the vertical joints of the mortar.
- The second and third cracks appear in the masonry panel and parallel to the diagonal in compression.
- The wall was built after the realization of the columns and beams, which makes the connection between the differentelements strong, so the joints are resistant and can influence the mode of failure.
- This mode of construction prevented the portal-fill detachment found by several researchers.
- As an indication, since the masonry walls are not considered as load-bearing elements, the phase of their

construction in Morocco occurs after that of the columns and beams which makes the connection between these different elements very weak.

Figure 3: Cracking at the joints

7. Force-displacement Curves and Comments

The above-mentioned cracks show that the behavior of the wall is marked by non-linearity. This non-linearity is illustrated by the shape of the wall force-displacement curve.

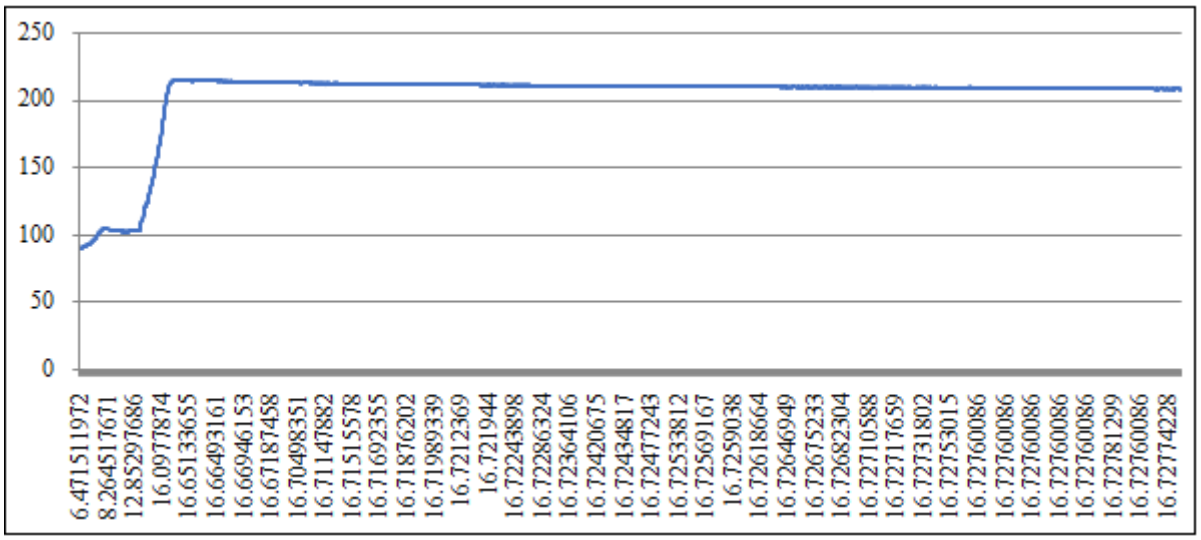

Figure 4: The effort (KN)-displacement (mm) curve of the filled frame

8. Analysis of the Curve

- During small deformations, the corresponding force-displacement curve can be assimilated to a straight line with an increasing slope. This increase in slope can be explained by an increase in the lateral stiffness of the frame(uncracked filling).This is an elastic behavior of the structure.
- Following an increase in lateral loading, the masonry of the infill begins to degrade, the deformations continue to increase and the stiffness to decrease slightly.

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