Structural Mechanics

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Retrofitting of unburned clay blocks (wattle) buildings damaged by earthquakes

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Summary

The paper deals with the experimental investigations on shaking table of a full-scale model of an adobe-wall building.

After tests performed on the model built according to traditional practice, the severely damaged building has been strengthened by tie-roads and reinforced jacketing and subject to strong shaking again.

The results are presented and the efficiency of strengthening is discussed [1].

KEYWORDS: retrofitting, seismic range, maximum basic acceleration, unburned clay blocks, earthquakes

1. INTRODUCTION

The main objective of the study was checking the efficiency of a retrofitting method of the structures made of unburned clay blocks masonry, with clay mortar, strongly damaged by the surface earthquakes.

This research was imposed by the necessity of fast bringing into operation of the locative fond seriously damaged by the seismic events that took place in 1991 in Romania.

2. PROPOSED SOLUTION

In order to accomplish this objective, an experimental structure at natural scale was designed, representing a building with two rooms: one having 3.90x4.80 m and another 2.70x4.80 m. The structure was conceived and tested in seismic range up to the precollapse stage, on the 140tf oscillating platform belonging to the National Institute for Building Research - Branch Iasi (photo 1).

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Photo 1. Damaged structure

For retrofitting the damaged structure a simple and efficient solution was designed, consisting in the introduction at the upper side of the masonry wall, on both directions (transversal and longitudinal), of horizontal metallic backstays, less prestressed having Φ 12÷14 mm diameter, fixed at the ends with double boltnut and muff. At the same time, on both faces of the damaged diaphragms a plastering was applied, composed by mortar M 25, with 3-4 cm thickness, on a metallic mesh having the square eyes with the side 5 cm, mesh conceived by wires with Φ 2,5÷3 mm thickness.

The metallic meshes were fixed at 1 cm from the face of the walls by means of metallic anchors that traverse the diaphragms, 50 cm distance some from the others having o quasi - uniform distribution on the surface of the wall. At the intersection of the diaphragms, the welded or linked metallic meshes were joined by their overlap on 3÷4 eyes distance (15÷20 cm), and at the level of the foundation the meshes were connected on the same distance (3÷4 eyes) in the concrete basement.

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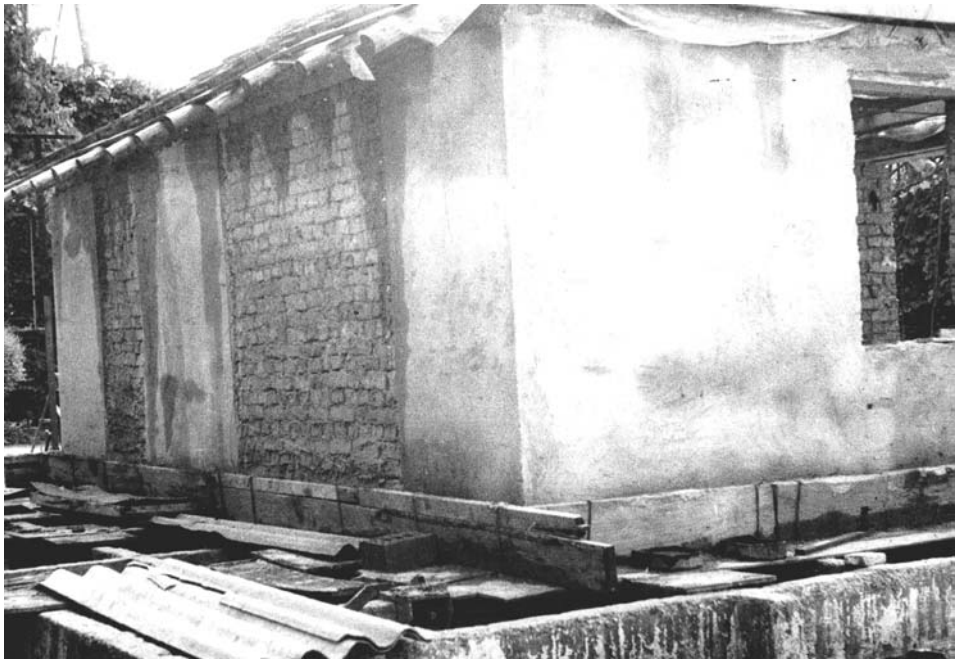

Photo 2. Retrofitted structure

3. RESULTS OF THE EXPERIMENT

Testing the structure, in the initial stage (initial) and retrofitted, in seismic range took place using the seisms with progressive intensities and variable frequencies specifically for the surface and real earthquakes from the Banat zone – Timisoara – Romania.

The maximum parameters for the **initial structure** are:

- The maximum basic acceleration: $a_0 = 2,95$ m/s^2.

- The amplitude of the horizontal displacement, at the level (+ 2,60 m) : D_{max} = + 55 mm

- Dynamic amplification coefficient decreses from $\beta = 1.65$ to $\beta = 0,8$, for the increases of the acceleration from the $a_0 = 0,59$ m/s^2 to $a_0 = 2,95$ m/s^2.

- The oscillation fundamental period in the transversal direction (the direction of the seismic action) was increased from $T_i = 0,250$ s in initial phase to the T_f = 0,285 s in the yield phase.

- Viscous damping %, ν was increased from the (3÷3.55)% to (5÷5.91)%.

The maximum parameters for the **consolidated structure** are:

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- The maximum basic acceleration: $a_0 = 5,7 m/s^2$.

- The amplitude of the horizontal displacement, at the level + 2,60 m; D_{max} = +5,5 mm

- Dynamic amplification coefficient decreases from $\beta = 1.42 (a_0 = 0, 78 m/s^2)$ to $\beta = 0,795$ ($a_0 = 5,74 m/s^2$).

- The oscillation fundamental period in the transversal direction (the direction of the seismic action) was increased from $T_i = 0,133$ s in initial phase to the $T_f = 0,192$ s in the yield phase.

- Viscous damping %, ν was increased from the (5÷5,80)% to (8÷8,44)%.

3. CONCLUSIONS

The wattle masonry's compound with the retrofitting plastering was good up to the limitation of the re-collapsed structure.

On the experimental data basis corroborated with theoretical investigations it can be affirmed that the retrofitting solution proposed presents a practical guide used at individual household level.

References

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