ENHANCEMENT OF LATERAL LOAD RESISTANCE OF HOUSES CONSTRUCTED WITH LOADBEARING MASONRY

by

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THESIS SUBMITTED TO THE DEPARTMENT OF CIVIL ENGINEERING IN FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN ENGINEERING

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Abstract

Masonry buildings are one of the most widely used building materials in the world. In case of masonry buildings, similar to the compressive strength, the flexural strength also plays a major role under the extreme forces of nature like earthquakes, cyclones, tsunami and floods. However, there are only limited amount of studies carried out in Sri Lanka regarding the flexural strengths of masonry. The field surveys carried out in many parts of the Sri Lanka after natural disasters like Tsunami of 2004, severe floods in 2006 and earth tremors in 2007 have shown that the lack of awareness of people on disaster preparedness is the main reason for the loss of lives and damage to the built environments and properties. Therefore, the main aim of this research was to develop suitable set of guidelines for masonry structures to enhance their disaster resistant properties in a cost effective manner.

Properties of burnt clay bricks such as strength and the quality of manufacturing can affect the bond strength of masonry to a great extent. Sand type could have a significant influence on bond strength. The results from couplet and triplet tests showed that the mortar with higher coarse-sand percentage could give higher bond strength values. Pre-compression added on a masonry wall can enhance the lateral load resistance of a masonry wall. In case of a two storied or multi storied buildings, this pre-compression can be exerted by using floor slabs. However, for a single storey houses, this is not possible with floor slabs. Therefore, the use of tie beams was identified as a possible way to enhance the lateral stability of a masonry wall. It is shown that the panels tested with low pre-compression cam be used to determine the flexural strength of masonry. A series of experiments was carried out to find out the effect of tie beam in masonry buildings and it was shown that tie beams call enhance the lateral load resistance by about 30%. Computer modeling with SAP 2000 and a theoretical model were used to verify the results achieved from laboratory .experiments. Application of return walls also shows an enhancement in lateral load resistance and it can be used as lateral load enhancement technique for masonry construction, especially with tie beams.

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DECLARATION

I, Konthesingha Muhandiramlage Chaminda Konthesingha, hereby declare the content of this thesis is the output of original research work carried out over a period of 12 months at the Department of Civil Engineering, University of Moratuwa. Whenever others' work is included in this thesis, it is appropriately acknowledged as a reference.

Research Student: K.M.C. Konthesingha
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ABSTRACT

Masonry buildings are one of the most widely used building materials in the world. In case of masonry buildings, similar to the compressive strength, the flexural strength also plays a major role under the extreme forces of nature like earthquakes, cyclones, tsunami and floods. However, there are only limited amount of studies carried out in Sri Lanka regarding the flexural strengths of masonry. The field surveys carried out in many parts of the Sri Lanka after natural disasters like Tsunami of 2004, severe floods in 2006 and earth tremors in 2007 have shown that the lack of awareness of people on disaster preparedness is the main reason for the loss of lives and damage to the built environments and properties. Therefore, the main aim of this research was to develop suitable set of guidelines for masonry structures to enhance their disaster resistant properties in a cost effective manner.

Properties of burnt clay bricks such as strength and the quality of manufacturing can affect the bond strength of masonry to a great extent. Sand type could have a significant influence on bond strength. The results from couplet and triplet tests showed that the mortar with higher coarse-sand percentage could give higher bond strength values. Pre-compression added on a masonry wall can enhance the lateral load resistance of a masonry wall. In case of a two storied or multi storied buildings, this pre-compression can be exerted by using floor slabs. However, for a single storey houses, this is not possible with floor slabs. Therefore, the use of tie beams was identified as a possible way to enhance the lateral stability of a masonry wall. It is shown that the panels tested with low pre-compression cam be used to determine the flexural strength of masonry. A series of experiments was carried out to find out the effect of tie beam in masonry buildings and it was shown that tie beams can enhance the lateral load resistance by about 30%. Computer modeling with SAP 2000 and a theoretical model were used to verify the results achieved from laboratory experiments. Application of return walls also shows an enhancement in lateral load resistance and it can be used as lateral load enhancement technique for masonry construction, especially with tie beams.

Key words: *Natural disasters, flexural strengths, tensile bond strength, shear bond strength*

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