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A Comparative Study regarding Effect of Wall Span on Seismic Performance of Masonry Building

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Abstract:
Masonry can be defined as a structural assemblage of masonry units (such as stones, bricks and blocks) with a binding material which is mortar. A vertical two-dimensional structure of such an assemblage is known as masonry wall. Walls of a masonry building and the building itself should be stable, strong and durable to withstand a combination of design loads. In India, currently IS-1905 (1998) is the code of practice for "Structural Use of Un-reinforced Masonry". Reference Hand book on Masonry Design & Construction is published by Bureau of Indian Standards in the form of SP-20 (S&T, 1991) is referred for the purpose. The IS code for Structural Use of Reinforced Masonry is under preparation.
The present paper is a a step to analyze the seismic effect of wall length on seismic performance ,with other factors being constant. The method for design is divided in to several steps to provide a solid feeling and confidence that masonry buildings can also be designed as engineered construction. A study was carried out to compare the effect of wall length/span on seismic performance of masonry subjected to in plane and out of plane earthquake forces. Study can be useful for optimization of the sizes of enclosed spaces for effective performance of masonry buildings in earthquake affected areas.

Introduction

Masonry buildings are widely used for housing construction not only in India but in many other countries of the world. There are several advantages of masonry construction over both types of construction i.e reinforced concrete and steel. These advantages are thermal comfort, sound control, possibility of easy rennovation after construction , less formwork, easy and inexpensive repair, use of locally available materials, need of less skilled man power, less engineering intervention etc. However, there are some disadvantages as well, particularly, when it is built in seismic zones. The seismic resistance feature of masonry construction is relatively low in comparison to engineered constructions. Many developed nations have imposed certain restrictions on the use of unreinforced masonry constructions. In developing nations, unreinforced masonry construction is still being used frequently. In India, masonry constructions are generally made by using locally available materials like stone, brick, timber, mud etc. and are constructed in a traditional manner \ with or without the earthquake resistant features mentioned in IS: 4326 and 13927. This type of construction is treated as non-engineered construction and most of the casualties are due to collapse/severe damages of these constructions in earthquakes. After gaining knowledge of earthquake engineering since the last thirty five years, neither a proper method has been developed for the seismic analysis and design of masonry buildings nor the topic is fairly given attention by engineers in spite of the fact that about 90% population of India lives in masonry buildings. The present paper is a step to study the effect of wall length on seismic performance of masonry buildings. The procedure of design includes several distinctive steps in order to create a solid feeling and confidence that masonry buildings can also be designed as engineered construction. Optimization of wall length in masonry building to get maximum seismic performance can help to reduce damages/collapse of walls due to earthquake.

EXPERIMENTAL PROGRAMME

A three storey building with brick masonry walls is considered for design. Buildings consisting of different wall lengths were analyzed keeping the wall height of each floor constant as 3.00 meter.

METHODOLOGY:

Preliminary Data of geometry of the typical structure.(G+2) storey building with different wall length as 3.5, 4.5 and 5.00 m. were considered

- Assuming location of structure in zone II .
- Assuming floor loads as per IS code .
- Assuming walls made of brick masonry using bricks of class designation 5.
- Dead Load Calculation.
- Live load calculation.
- Earthquake load calculation.
- Seismic Analysis of structure
- Calculations for in plane forces on walls
- Calculations for forces causing out of plane bending.

PROCEDURE FOR LATERAL LOAD ANALYSIS OF MASONRY BUILDINGS

To analyze the effect of wall length on performance of masonry buildings, procedure is divided into several distinctive steps. These various steps may not be so clearly separated but this step-by-step procedure was adopted in order to analyze it systematically. Masonry building subjected to a lateral load , its resisting mechanism and effect of length of wall carrying gravity loads, also its action as shear walls to resist lateral load was analyzed. The structural walls parallel to lateral forces and subjected to in-plane forces (shear) and bending forces are called *shear walls.* The walls perpendicular to seismic force and subjected to forces causing out-of-plane bending, are called *flexural walls.* Following were the major steps for the lateral load analysis of masonry buildings:

Step 1 : Calculation of lateral load based on ISI 1893 (Part 1) : 2002
Step 2: Calculation of lateral forces on the basis of flexibility of diaphragms
Step 3: Determination of rigidity of shear wall by considering the openings
Step 4: Calculation of direct shear forces and torsional shear forces in shear walls
Step 5: Calculation of increase in axial load in piers due to overturning
Step 6: Check the stability of flexural wall for out-of-plane forces

CONCLUSION:

In comparative study it was found that out-of-plane bending tends to be governed by wall span (*L*) being other factors like site sub-soil class, hazard factor (*Z*) and the number of levels constant. An increase in wall span reduces the total design capacity. This finding is based on the failure criterion of cracking at the extreme tension fiber in bending. In-plane shear in the short direction was not critical for the range of parameters investigated. It was concluded that the wall length in masonry buildings should be kept around 3 to 3.5 m. Increase in wall length may affect the seismic performance adversely.

References:

[1] Standards Australia (2005), AS 1170.4: Earthquake actions in Australia (Ballot draft), Standards Australia, Sydney, April 2005.

[2] Standards Australia (2001), AS 3700-2001: Masonry structures (including proposed Amendment 3), Standards Australia, Sydney, 2001.

[3] Standards Australia (2002), AS/NZS 1170.1: Structural design actions -Permanent, imposed and other actions, Standards Australia, Sydney,2002.

[4] Page, A. W. (1995), "Unreinforced Masonry Structures - An Australian Overview". Proceedings of the Pacific Conference on

Earthquake Engineering, Parkville, Victoria, Australia, November 1995, pp. 1-16.

[5] Priestley, M. J. N. (1985), "Seismic Behaviour of Unreinforced Masonry Walls". Bulletin of the New Zealand National Society for Earthquake Engineering, Vol.18, No.2, June 1985, pp. 191-205.

[6] IS: 1905- 1987, *"Indian Standard Code of Practice for Structural Use of Unreinforced Masonry"*, Bureau of Indian Standards, New Delhi, India, 3rd Edition, 1987.

[7] SP 20 (S & T), 1991 "*Hand book on Masonry Design and Construction*" (First revision), Bureau of Indian Standards, New Delhi 110002

[8] IS-4326-1993 "*Indian Standard Earthquake Resistant Design and Construction of Buildings – Code of Practice"*, Bureau of Indian Standards, (Reaffirmed 1998), Edition9.2 (2002-2004), New Delhi 110002

[9] Dayaratnam P, "*Brick and Reinforced Brick Structures*", Oxford IBH Publishing Co. Pvt. Ltd., New Delhi, India, 1987.

[10] Venkataramareddy B V, Jagadish K S and Yogananda M R, "*Specification for the use of Stabilized Mud Blocks for building construction (draft code of practice)*", Proceedings of National Seminar on Application of SMB in Housing and Building, Bangalore, Nov.1988, Vol.2, pp 19-22

[11] Venkataramareddy B V and Jagadish K S, "*Properties of soil-cement block masonry*", Masonry International, Vol.3, No.2, 1989, pp 80-84.