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Study of Failure Pattern on Load Bearing Wall

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Abstract — The paper deal with study of models of load bearing wall structure. This Masonry load bearing wall subjected to vertical concentric and eccentric loading may led to collapse through instability. In this paper the failure pattern of masonry load bearing wall of different sizes were investigated via testing shaking table test , compressive strength . The result shows that the bearing wall cannot carry heavy loads but by increasing thickness their is possibility of less damage in the structure.

***Keywords*— Compressive, Shaking Table, Bearing Wall**

I. Introduction

A load bearing structure is a building structure in which the load is moved vertically downward through the structure's walls. The weight is transferred from the roof to the walls, which in turn are transferred to the foundation. Only constructions with up to two floors should use a load-bearing building structure. A load-bearing wall, also known as a bearing wall, is an active structural element of a building that carries the weight of the elements above it to a foundation structure below it. Load-bearing walls were among the first types of construction. A load-bearing wall is a wall that is built to support the above slab or other building elements in a structure while also supporting the weight of the structure.

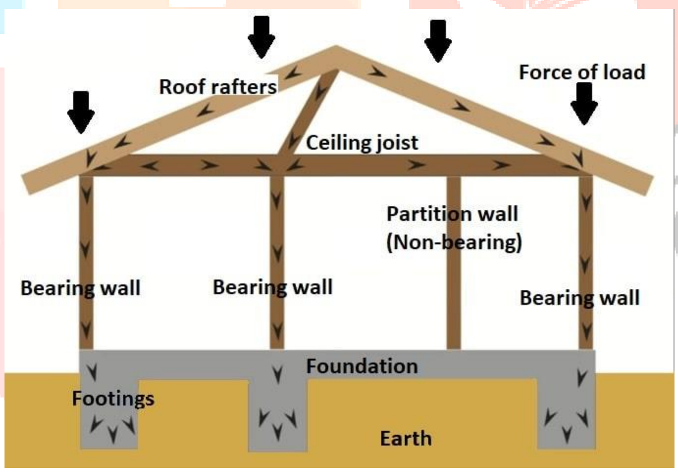

Fig 1: Load bearing walls

A. *MAIN FEATURES OF LOAD BEARING WALL:*

- This wall is a structural element that bears the weight of a house from the roof and upper floors.
- These walls transfer loads all the way to the foundation or other suitable frame members.
- The structural members such as beams, slabs, and walls on the upper floors can support these members.
- A load-bearing wall is one that is designed to carry the vertical load directly above the beam.
- On each floor, these walls are typically over one another and can be used as an exterior or interior wall.

B. *TYPES OF LOAD BEARING WALL:*

1. Precast Concrete Wall
2. Retaining Wall
3. Masonry Wall
4. Pre Panelized Load Bearing Metal Stud Wall
5. Engineering Brick Wall
6. Stone Wall.

Fig 2: Types of load bearing wall

SHAKE TABLE

A shake table mimics the ground motions that occur during an earthquake. They are typically used to test structural models, scaled slopes, or building components to failure.
One of the most widely used techniques for assessing the seismic performance of structures made of various materials is the shaking table test. It is commonly used to assess the linear/nonlinear and elastic/inelastic dynamic response of structures.

Fig 3: Shake table

II. Literature survey

Kirtschig and Anstotz (1991) studied about the influence of slenderness ratio and load eccentricity on the load bearing capacity of masonry is treated differently in each country's regulations. The primary goal of the experimental tests developed by Kirtschig and Anstotz (1991) was to validate this overestimation by comparing load bearing capacity values to theoretically derived results.
The main factor limiting the strength of brick masonry imposed by **Watstein and Allen (1970)** is the relatively low tensile bond strengths developed between the masonry units and conventional Portland cement mortars. According to the authors, the mechanism of failure due to geometric instability of the masonry works suggests that increasing the bond tensile strength of the masonry will significantly affect not only its transverse strength but also its compressive and shearing strengths.
Hasan and Hendry (1976) investigated the effect of slenderness ratio and eccentricity on the compressive strength of a wall (1976). The primary objective of this research was to determine whether or not the reduction factors prescribed in various codes are conservative. A third-scale model was tested with axial and eccentric loading as well as different end conditions. Figure 7 depicts the rotation measurement arrangement. The outcomes were compared to a variety of national codes. Twenty-five specimens were tested for slenderness ratios of 6, 12, 18, and 25 with various end conditions (flat ended, reinforced concrete slab, and hinged) and load eccentricities of 0, t/6, and t/3.
Decorative tiles and mouldings made of polymeric foams are becoming more popular in buildings, according to **S.Doroudianii and H. Omidian** presented that products and their use in buildings raise health, safety, and environmental concerns. In this paper, we present the study's findings and discuss the issues surrounding decorative mouldings made of expanded polystyrene (EPS). Physical damage to building structures, potential harm to residents, and health hazards were identified as major concerns in this regard.
Chandra Kumar (2012) followed and studied the pre-engineered steel building system construction has significant advantages over single-story buildings, providing a practical and efficient alternative to conventional structures, with the system representing a single central model across multiple disciplines. Large steel structures are being constructed, but they are only single-story buildings for industrial use. Secondary structural members span the distance between the primary building frames of metal building systems.

Shing et al. (1989) conducted an experimental analysis using a combination of vertical and horizontal elements to increase the flexural capacity of walls.

Khattab and Drysdale (1993) discovered that horizontal and vertical reinforcement can only withstand shear stress.

Bartlett (1965) demonstrated that a good solution for controlling tensile cracks is to use horizontal or vertical reinforcement in the masonry wall. Priestley and Bridgeman (1974) also demonstrated that horizontal reinforcement is less efficient than vertical reinforcement in resisting shear loading (Shear by dowel action is transferred to vertical steel, while shear by tension is transferred to horizontal steel)**.**

Voon and Ingham (2006) confirmed from vertical and horizontal reinforcement of masonry walls that shear strength of masonry increases with pre compression loading and amount of shear reinforcement used in-plane cyclic tests and decreases inversely with length to breath wall aspect ratio, confined that post crack behaviour walls on shear dominated improved shear reinforcement in disturbed on uniformly manner.

Gouveia and Lourenço (2007) conducted cyclic tests on sandwiched from four edge sides of the reinforced concrete confinement under vertical constant precompression level and the bed joint reinforcement addition on the masonry walls and the confined concluded that there is a significant advantage.

III. Material

Material are used for making masonry brick wall are :-

- Cement : We used Ordinary Portland Cement (OPC) of 43 Grade

Fig 4: Ordinary Portland Cement

- Sand (Fine Aggregates) : Sand is a granular substance made up of finely divided rock and mineral particles. Sand is classified into four types based on its origin: pit sand, river sand, sea sand, and manufactured sand. Medium Sand was used (2.0 mm to 4.75mm)
- Coarse Aggregate: Coarse aggregates are irregular broken stone or naturally occurring rounded gravel that is used in the production of concrete. Coarse aggregates are typically obtained through blasting in stone quarries or by breaking them down by hand or with crushers. For the Beam, Column, and Slab, we used 10-20mm gravel.
- Coarse aggregates are irregular broken stone or naturally occurring rounded gravel that is used in the production of concrete. Coarse aggregates are typically obtained through blasting in stone quarries or by breaking them down by hand or with crushers.
- For the Beam, Column, and Slab, we used gravel with a size of 10-20 mm.
- A brick is a type of block that is used to build walls, pavements, and other masonry elements. The term brick refers to a block made of dried clay.
- We made use of common burnt clay bricks (1st) which is 190mm X 90mm X 90mm
  Reinforcement Steel: Reinforcement steel is a steel bar or a work of steel wires used as a tension device in reinforced concrete and reinforced masonry structures to fortify and help the solid under strain. Stirrups and ties are made of 8mm steel bar, while beams and columns are made of 10mm steel bar.

IV. Casting & Preparation of load bearing wall

- Cast-in-place concrete, also known as "site-cast" or "poured-in-place" concrete, is poured and cured on-site in the finished position of the concrete. This type of moulds can be ideal for certain applications. We are centring beam, column and slab in 10mm dia steel bar and beam and column stirrup and ties are 8mm dia.Slab : 1m X 0.36m X 0.1m; Beam : 1m X 0.23m X 0.23m; Column : 0.23m X 0.23m X 0.45m; Cover for beam and column – 25mm; Distance of Stirrups and Ties c/c are 150mm

Fig 5: Shuttering

Fig 6: Casting

V. Result and Discussions

Table 1 : Compressive strength of wall

Specimens	Thickness (mm)	Length (mm)	Height (mm)	Weight per unit volume (KN/m^3)	Compressive strength (MPa)
LBW1	115	1000	460	19	36.2
LBW2	230	1000	460	19	46.8
LBW3	300	1000	460	19	54.8

Table 2 : Shake table test

Specimens	Time (Sec)	Failure Pattern
LBW1	10	Diagonal cracks
	15	Diagonal cracks
	20	Vertical cracks
LBW2	10	Diagonal cracks
	15	Diagonal cracks
	20	Diagonal cracks
LBW3	10	Vertical cracks
	15	Diagonal cracks
	20	Diagonal cracks

VI. Conclusion

- Compressive strength of LBW1 is 36.2 MPa which is very less then Compressive strength of LBW3 i.e. 54.8 MPa due to the thickness of wall.
- Vertical cracks are seen by shaking table test in LBW1 after 20 seconds wheeas in LBW3 case, vertical cracks are seen in earlier stage after 10 sec.
- This concluded that LBW3 due to its 300 mm thickness of wall is much effective then LBW1 & LBW2.

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