# STUDY OF SEISMIC ANALYSIS OF MULTI-STOREY BUILDING

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***ABSTRACT:*** **The effect of Seismic waves on multistory building is studied for different masonry building designed as per IS code 13920. The maximum story taken should be G+5, G+7 and upto 9$^{th}$ floor is tested. In this paper we also studied the various seismic zones in India and their seismic risk as per Indian codes. Therefore, this paper deals with the analysis of numerous damages faced by multistory building due to seismic waves and also provide the assessment of nature and extent of problem and facilitates various measures that can be implemented by the engineers and builders to transform the killing homes into safety homes.**

***Keywords*****: Failure, Base shear coefficient, Fundamental period, Storey displacement.**

## 1.0 INTRODUCTION

The traditionally built buildings and other structures of India includes small structures which are constructed in bricks, mud, stone or combination of these. The masonry structures which are brittle are proved to be the most susceptible to strong seismic forces. This building construction system generally built by local masons, without the direction of any professional experts is known as non-engineered construction. These usually built structures have underwent extensive destruction during earthquakes.

The main reason of their failure may be recognized to the negligible tensile strength of materials which are used in their heavy mass. In most of the cases there is generally a lack of ductile and strong connections between roof components, foundation system and masonry walls in masonry construction. More than 85 percent of Indian population chooses to live in such houses because the masonry construction are elastic enough to accommodate them according to the necessities of the owners and prevailing the environmental conditions. But recent performance of earthquakes have explained that seismic efficiency of this kind of constructions is very low and traditionally built houses collapse at a large scale is the single biggest factor contributing to the weighty losses and large number of casualties which happens during earthquakes, for example Bhuj Earthquake which occur in 2001. So it is very much important to progress the seismic behavior of these traditionally build constructions by introducing number of earthquake resistant measures and features.

## 1.1 SEISMIC PERFORMANCE OF MASONARY BUILDINGS

Study of some of the past earthquakes in the recent years (Gujrat 2001), Chamoli (Uttaranchal 1999), Jabalpur-1997, Latur-1993 have clearly stated that the seismic response of all traditionally built structures is very low and poor. The main cause of this large scale destruction is the improper seismic design of these traditionally constructions.

Some of the most important factors which contributes towards poor seismic efficiency of masonry buildings are explained below:

**1. Large size of openings**: The size of windows and doors openings must be remain small so that there is increase in resistance of wall towards seismic shocks.

**2. Failure of connection between walls:** All the walls which have the weakest link in the masonry buildings should be tied together like box to get good seismic performance.

**3. Too long walls:** The height to thickness and length to thickness ratio of walls are must be according to the definite seismic design codes.

**4. Absence of proper bonding between perpendicular walls in the junction:** in order to get proper bonding there should be good interlocking between the brick courses at the corner and junctions would be ensured.

**5. Irregular or asymmetric plans of masonry buildings:** the buildings which are rectangle in shape suffer less damage in earthquakes as compared to irregular structures. Irregular buildings are those buildings which lacks symmetry and are discontinuous in geometry and mass. It also be noted that focus of great number of mass at a one place attracts large number of torsional and horizontal forces during vibration of grounds i.e ground shaking. So whenever we have to design a building then adopt suitable structural configuration with complete distribution of mass.

6. **Poor tensile strength and porosity of bricks:** the seismic performance of masonry walls depends on the relative strength between mortar and bricks. As we all know that both concrete and masonry can carry all compressive loads safely but their both behavior in tension is very poor. Therefore proper grades and standard recommended bricks should be used in construction of masonry structures situated in the specified seismic zone as per Indian standards.

7. **Large number construction of non-structural components:** Structures like gables, parapets, projections, unanchored walls etc are the incorrectly tied non-structural components in earthquake is the one of the major cause of injuries and lives. This loss can be lessened by constructing lesser number of these elements and by giving proper design specification.

### 1.2 COMMON TYPES OF FAILURE:

The most common types or modes of failure of masonry structures subjected to seismic action are as under:

1. Non-structural components failure
2. Diaphragm failure
3. In-plane failure
4. Out of plane failure
5. Connection failure

### 1.3 LITERATURE REVIEW

As the world moves towards the fulfilment of Performance Based Engineering studies in SEISMIC DESIGN OF CIVIL ENGINEERING STRUCTURES. Structural Design of buildings for seismic loads is primarily concerned with structural safety with ground motions but serviceability and potential for economic loss are also of concern. Seismic loading requires an understanding of the structural performance under various factors such as elastic deformations, floating columns, spectrum analysis and static analysis , many more.

I. This paper investigates the seismic effect of coupled shear wall using probability and random vibration concept with respect to response spectrum in order to calculate the mean and the standard deviation of the peak response for coupled shear wall system subjected to earthquake .

II. The results from inelastic dynamic analysis gives the joint deformation which may have vital effect on maximum storey drift ,different joint studies may affect the elastic deformation demands imposed on columns and beams is explained.

III. The proposed Model Optimization for seismic analysis of tunnels based on response displacement method proposed seismic analysis carried out in transverse and longitudinal direction of a shield tunnel located in Shanghai through the response displacement method.in turn the analytical results when compared with traditional computational model shows not only inner force responses but also provides indexes of segment stress, bending capacity, joint deformation which therefore enhances the usability and safety of the tunnel during and after the earthquake.

IV. This paper deals with the exactness and accuracy of Time History Analysis compare to the commonly adopted equivalent static analysis and response spectrum analysis.

V. The proposed comparative seismic response of multistory building with and without floating column investigated the response spectrum carried out for G+5 stories and G+7 stories with and without floating columns where structures are considered to be placed in earthquake zone-III on a medium soil type-II.

VI. This paper explains the multistory building with ground floor are inherent vulnerable to collapse due to seismic load and these buildings are still widespread in developed nations.

VII. This paper analyze number of aspects related to seismic hazards which are formely ignored and how to put the lower limit of seismic probability for which explicit seismic design is worth being caused out.

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### 1.4 FINDINGS

In recent times most of the peoples of India are starting give preference to the reinforced buildings made of concrete due to huge number of ‘’ known engineered traditionally built ‘’ human made structures showing very bad performance during last earthquakes as one in ( 2001 bhuj).

Destruction from these earthquakes has mainly cause due to insufficient resistance in the design and construction of earthquake resistant buildings, that are progressed by thumb rules. The overall work should not be on masons and bar vendors and most of the role of structural engineer and geo technical engineer should be understood for the safety of building. Quality in masonry or RCC buildings and their detailing must be understood by structural engineer. As the reinforce concrete structures display the tile behavior when earthquake occurs. As we all know that ductility is the main requirement as it gives much of time to the peoples to move out from the building before it completely collapse.

Some of the main causes for the damage of reinforce buildings due to earthquake as follows:

(i) Poor quality of the materials used in construction.
(ii) Lack of suitable treatment for known structural components like staircase, parapets, walls etc.
(iii) Lack of better design during lateral load planning system like joints, shear walls and infill walls and action of frames during horizontal movements.
(iv) Improper detailing of beams in reinforcement, beams, columns from ductility.
(v) Response of foundation and soil ‘’ soil foundation interaction’’.
(vi) Faulty construction practices.
(vii) Inadequate directions in vertical and horizontal structural members like spacing, size and location in buildings.
(viii) Effect of pounding i.e. adjacent building collision.
(ix) Provision of infill walls for large size open storeys.

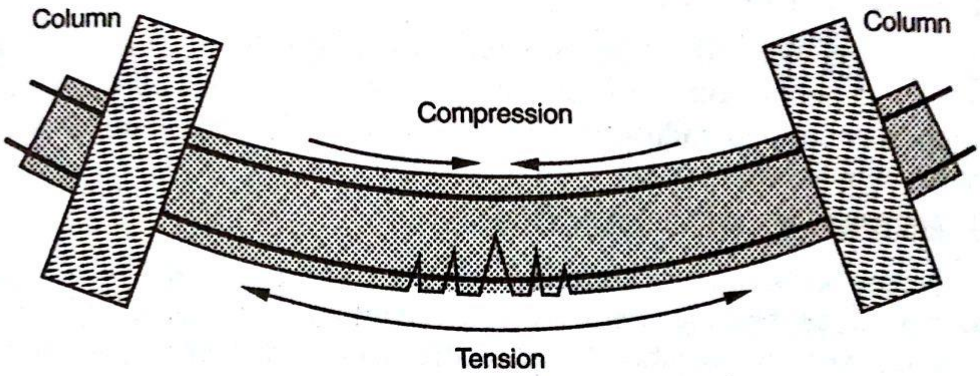


Fig. Flexural failure

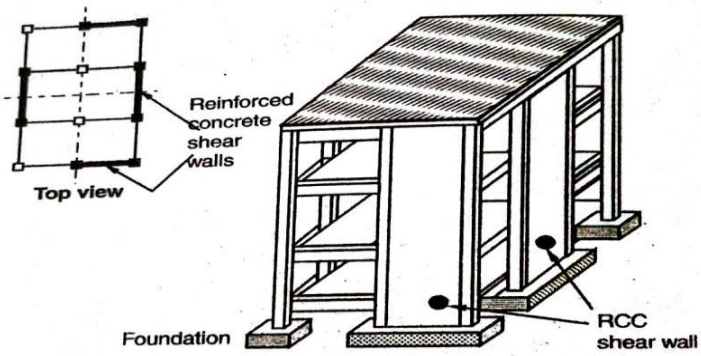


Fig. Damage of asymmetric shear walls

**1.5 Storey Displacement**

Result shows the various storey displacement at different storey level.

This table shows the position of storey level with and without floating column as when we are take storey 1 then the position of any floor without floating column displacement value is 0.003 whereas in position of displacement in ground floor is 0.026 and position at first floor is 0.091 and also the result for the other floors are also shown below.

| **Storey Level No.** | **Position (without floating column)** | **Position (with floating column at ground floor)** | **Position (with floating column at first floor)** |
|---|---|---|---|
| 1 | 0.003 | 0.026 | 0.091 |
| 2 | 0.003 | 0.103 | 2.182 |
| 3 | 0.001 | 0.111 | 7.825 |
| 4 | 0.010 | 1.666 | 13.382 |

| | | | |
|---|---|---|---|
| 5 | 0.020 | 2.002 | 18.898 |
| 6 | 0.023 | 2.878 | 24.363 |
| 7 | 0.027 | 3.690 | 29.787 |
| 8 | 0.030 | 4.450 | 35.182 |
| 9 | 0.033 | 5.157 | 40.672 |

**1.6 Fundamental Periods and Base Shear Coefficient:**

This table shows the variation of fundamental period with base shear coefficient as the case of 6 storey the value of fundamental period is 1.153 and the base shear coefficient for this 0.037 and the other results are shown.

| **Building Type** | **Fundamental Period** | **Base Shear Coefficient** |
|---|---|---|
| 3 storey | 0.793 | 0.056 |
| 6 storey | 1.153 | 0.037 |
| 9 storey | 1.483 | 0.028 |

**1.7 CONCLUSION**

The conclusion drawn from the study of seismic analysis of multistory building that the reason of failure behind the multistory buildings are lack of structural integrity, improper construction practice, heavy mass and low strength of mortar etc. the most commonly used technique of ascertaining ductile and strong connections between horizontal diaphragm and walls is to give seismic lands at plinth level, roof and lintels. So, to overcome the failure of multistory building, there is a need to follow up the proper guidelines provided by the Indian Standards, codes etc.

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