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Earthquake residential design of G+5 residential building using STAAD pro in Earthquake Zone V.

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Abstract -Earthquake occurred in multistoried building shows that if the structures are not well designed and constructed with and adequate strength it leads to the complete collapse of the structures. To ensure safety against seismic forces of multi-storied building hence, there is need to study of seismic analysis to design earthquake resistance structures. In seismic analysis the response reduction was considered for two cases both Ordinary moments resisting frame and Special moment resisting frame. The main objective this

paper is to study the seismic analysis of structure for static and dynamic analysis in ordinary moment resisting frame and special moment resisting frame.

Equivalent static analysis and response analysis are the method used in structural seismic analysis. Construction building requires proper planning and management. Building are subject to various load such as deal load, live load, wind load.

load and seismic load. seismic load has extreme adverse effect on building so it is necessary to perform seismic aThis paper describe about the response of building when it is subjected to seismic load, this response can be shown by story drift and base shear. s e i s m i c analysis has been performed on (G+8) building which is located in zone 2 & 4 using STAAD Pro software. Analysis has been performed according to IS 1893 PART 1 (2002).

• 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 Them according to the necessities of the owners and prevailing the environmental conditions. But recent performance of earthquakes has 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. Moment Resisting Frame:

The frame whose member and joints resist the forces primarily caused by flexure is Moment resisting frame.

1.1 Ordinary Moment Resisting Frame: The moment resisting frame which are designed without any special attention towards ductile nature of the frame are called ordinary moment resisting frames.

1.2 Special Moment Resisting Frame: The moment resisting frame which are designed to have ductile nature are called as special moment resisting frames. The design is done according to the requirements specified in IS-13920. The earthquake resistant designs of structures are considering the following magnitudes of an earthquake.

2. Design Basis Earthquake (DBE):

The earthquake whose probability of occurrence is at least one during the structure design life is called design basis earthquake.

3. Maximum Considered Earthquake (MCE):

The earthquake whose expected intensity is maximum that can occur in a particular area or region is called maximum considered earthquake. The maximum values are considered as per code. The design approach recommended by IS: 1893-2002 is based on the following principles (clause 6.1).

- The structure should have the strength to withstand minor earthquakes less than DBE without any damage.
- The structure should be able to resist earthquakes equal to DBE without significant structural damage though some non-structural damage may occur.
- The structure should withstand an earthquake equal to MCE without collapse.

• RESEARCH REVIEW

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. Too long walls:

3. 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 they're 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.

• COMMON TYPES OF FAILURE

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

In this project, a seismic assessment of existing residential buildings for various seismic zones is carried out. Use STAAD.pro software in an analogous static analysis process. Structural proper- ties that are used for construction.

1) RCC FRAMED STRUCTURE'S STRUCTURAL PROPERTIES

- Number of Stories = G + 5
- Floor Height = 3.2 m
- Plinth level height = 0.8 m Column size = 0.3X0.5 m
- Area of steel for column = 1800 mm 2
- Beam size = 0.3X0.45 m
- Area of steel for beam = 1150 mm 2
- Thickness of slab = 0.125 m Wall thickness = 0.200 m
- 2
- Live load, including floor finish = 3.5kN /m (part-2) from IS:875
- Seismic Zones All five Indian s2eismic zones
- SBC of soil taken = 200 kN /m
- Grade of concrete = M30
- Young's modulus of concrete, E = 27.386 kN /m^2
- Poisson's ratio of concrete = 0.15
- co – efficient of thermal expansion of concrete = 170E-33
- co – efficient of thermal expansion of steel = 300E-33
- Grade of steel = Fe415

2) Method of analysis

The equivalent static lateral force method is a simplified method to substitute the behavior of dynamic loading of an expected earthquake by a static force distributed laterally on a structure for design purpose.

The arrangement of structural elements, including beams, col- urns, slabs, footings, etc., requires a building frame model. To reflect the structural features of a building's traditional frame and to show its actions under external loading. Via a full spectrum of local and global displacements, an empirical model must prefer- ably reflect the mass distribution, power, stiffness, and deformable- it. This chapter deals with the simulation of G + 5 floor design RC plane frames.

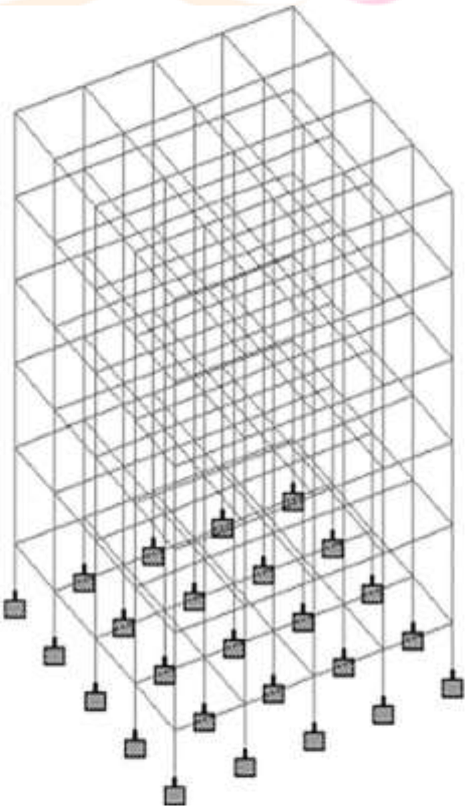
At four earthquake zones, RC plane frames of G + 5 storey build- ins were modelled and analyzed using STAAD.pro. Both compo- nets concerning the strength, mass of the frame & stiffness is described in numeral model.

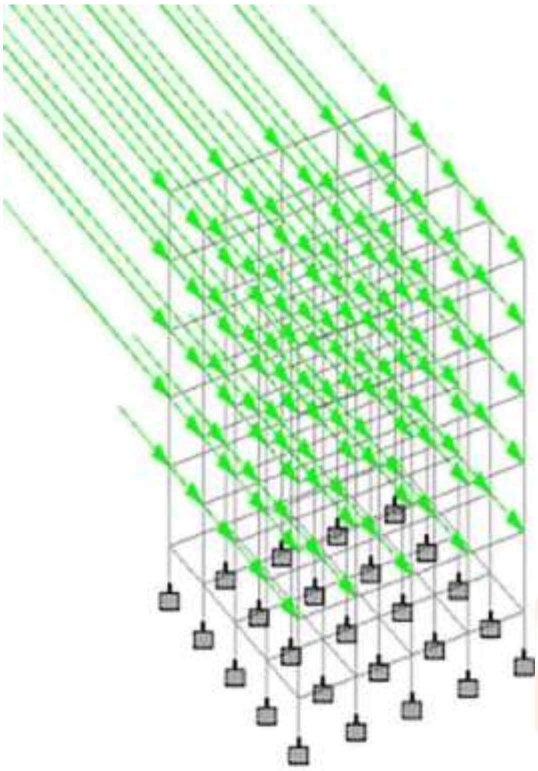
4. Earthquake load due to lateral load

4.1. *Structural elements*

The specifics of the modelling taken for different components of the RC frame are given below in this section.

1) Columns and Beams: The components of the structure mod- elled as beams and columns. The components reflect the members Energy, rigidity, & deformation measure. C/S mean- surements, reinforcement specifics & the form of material utilized are the properties to be allocated during the mod- elling of the beams and columns.
2) Beam-Column Joints: It is believed that the beam-column joints are rigid. By having closing offsets near joints, they were modelled. It is built to introduce the moments of bend- ing to the Starting of the beams & columns. To ensure inflex- ible relations for the beam & columns, an inflexible region factor as 1.0 is taken.





5. Results and discussion

5.1 Base shear calculation

In compliance with clause 7.5.3 of IS 1893:2002, Cumulative detailing of lateral force/seismic base shear (VB) measured. The foundation shear calculated as,

VB ¼ *Ah*W

Z I Sa

Ah ¼ ð)

2 *R g*

Here,

Ah = Design horizontal seismic co – efficient Z = Factor Region

I = Factor of Significance

R = Factor for Response Reduction

The values of Z, I, R are taken from IS 1893 (Part-1):2002 Sa/g

= coefficient of spectral acceleration. According to clause

6. 4.5 of the Code, it is determined that the specific time period Ta is given in seconds, as follows.

Resisting Frame without infill for a moment

Ta ¼ 0.075$h^{0.75}$

Resisting Frame for a Moment with brick infill panels.

When constructing a multi-story earthquake resistant structure, a shear wall that is part of the lateral force-resistant earthquake resistant building system is often taken into account. Lintel beams should ideally not be integrated into column I in RC frame build- ins to prevent short column impact. Mass, a material used, damp- ing ratio, ductility, and other variables depend on the structure intended for stability, strength, and serviceability

This paper's key goals are: -

- To research storey drift output under the four areas.
- To research the output under the four zones of storey displacement.
- To research the out – put under lateral loads of RC plane frames. To
- research the variations in the shear force and bending moment of the construction of RC planes in four zones.
- To research the behaviour of stability indices under four zones of different storey RC framed.

Storey drift calculation of zone-II.

Storey	DISP-X(mm)	DRIFT-X(mm)	DISP-Z(mm)	DRIFT-Z(mm)
1	7.26	2.69	10.78	3.89
2	5.99	2.43	9.17	3.61
3	4.17	2.06	6.57	3.10
4	2.16	1.86	3.47	3.03
5	0.29	0.29	0.44	0.42

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The arrangement of structural elements, including empirical model must prefer- ably reflect the mass distribution,

power, stiffness, and deformabil- ity. This chapter deals with the simulation of G + 5 floor design RC plane frames.

1.Modelling aspects

At four earthquake zones, RC plane frames of G + 5 storey build- ings were modelled and analyzed using STAAD.pro. Both compo- nents concerning the building frame model. To reflect the structural features of a building's traditional frame and to show its actions under external loading. Via a full spectrum of local and global displacements, an empirical model must prefer- ably reflect the mass distribution, power, stiffness strength, mass of the frame & stiffness is described in numeral model.

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Here,

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Ta ¼ 0.075$h^{0.75}$

Resisting Frame for a Moment with brick infill panels.

Table 3
Storey drift calculation of zone-III.

Storey	DISP-X(mm)	DRIFT-X(mm)	DISP-Z(mm)	DRIFT-Z(mm)
1	15.17	5.17	22.97	6.95
2	12.59	4.78	19.48	6.75
3	8.82	4.32	13.95	6.59
4	4.54	3.93	7.36	6.43
5	0.61	0.61	0.92	0.09

Table 4
Storey drift calculation of zone-IV.

Storey	DISP-X(mm)	DRIFT-X(mm)	DISP-Z(mm)	DRIFT-Z(mm)
1	16.72	5.33	25.33	7.91
2	13.88	4.97	21.49	7.42
3	9.72	4.77	15.38	7.27
4	5.01	4.33	8.11	7.09
5	0.67	0.67	1.02	1.02

Ta
0.075h/d
here

H = Building Frame Height D – Base measurements of the struc- ture in meters, besides lateral load path considered, at the plinth level.

5.4 drift calculation at storey

Maximum allowed drift= 0.004xhs (height of the storey).it side as the structure detailing is similar in both ways.

5.2. Earthquake analysis

Using STAAD.pro program, the space frame is modelled. In the table below the simple load cases are shown where the lateral orthogonal directions are X and Z (Table 4).

EXTP: X path EQ load with positive torsion EXTN: EQ load in X direction with negative torsion load

EZTP: Z-direction EQ load with positive torsion EQ load

EZTN: Z-direction EQ load with negative torsion load

For + X, -X, +Z and-Z directions, earthquake loads must be considered. In comparison, unintended eccentricity induces moments of clockwise or counter clockwise. Therefore, as provided in methodology, load combinations are 13 instances, not utilising - ve torsion with respect to the regularity of the structure (Table 5). Design data can be obtained from device output for the plan of different structural components. Significant plan forces will be tab- ulated and seen diagrammatically as required for selected beams. IS1893 (Prt 1): 2002 advises fifty percent of applied load is deliber- ated for seismic mass measurements in load combinations involv- ing Imposed Loads (IL). The writers are however, the relaxing of the applied load is nontraditional. Consequently, following exemplar assumes hundred percent placed loads in load amalgamation.

Analysis is carried out with the above load configurations and the effects of deflections in each floor and forces are obtained in separate components.

5.3. *Drift storey*

As per Clause no. 7.11.1 of IS 1893 (Part 1): 2002, subject as panned lateral force with a imperfect load component of One, the drift of the Storey in either Storey should not more than 0.004 mul- tiplier to the lateral length of Storey. The rearrangements of the mass centers of different stories are derived from frame study and are seen along with floor drift. The rearrangement results are similar in each side, as the structure detailing is similar in both ways.

will often occur that the storey drift condition is not fulfilled. How- ever, in accordance with Cls 7.11.1, IS: 1893 (Part 1): 2002; For the purposes of displacement criteria only, the use of seismic force derived from the measured specific time (T) of structure with absence of a lower bound seismic force specification cap is allow- able. Storey drifts can be tested in such situations by utilizing the comparatively lower seismic forces of magnitude derived out of a dynamic investigation.

5.4. *Outcomes*

The following results obtained by evaluating the frames in all the zones (II, III, IV, V).

5.4.1. *Zone-II*

The drift at storey would depend on the displacement. Storey drift taken into account the displacements in two ways, i.e., Direc- tions for X and Z. In general, displacement grows from the bottom to the top floor and floor drifts are also raised from the bottom to the top floors. The cumulative displacements in this earthquake region are 7.263 mm and 10.788 mm in the X & Z irections, in addition to that maximum storey drifts are 2.692 mm & 3,896 mm in the X & Z sequentially.

5.4.2. *Zone-III*

The cumulative displacements in this seismic region are 15.174 mm and 22.973 mm in the X&Z directions sequentially, & the maximum floor drifts are 5.175 mm and 6.955 mm in the X & Z directions sequentially.

5.4.3. *Zone-IV*

The cumulative displacements in this seismic region are 16.72 mm and 25.337 mm in the X & Z directions, and the maxi- mum storey drifts are 5.331 mm and 7.912 mm in the X & Z sequentially.

5.4.4. *Zone-V*

The cumulative displacements in this seismic region are 25.003 mm and 38.002 mm in the X & Z directions sequentially, and the maximum storey drifts are 7.903 mm and 11.848 mm in the X & Z directions sequentially.

Table 5
Storey drift calculation of zone-V.

Storey	DISP-X(mm)	DRIFT-X(mm)	DISP-Z(mm)	DRIFT-Z(mm)
1	25.00	7.90	38.00	11.84
2	20.80	7.62	32.22	11.48
3	14.59	7.14	23.05	10.90
4	7.50	6.49	12.15	10.62
5	1.01	1.01	1.52	1.52

Storey drift calculation of zone-II.

Storey	DISP-X(mm)	DRIFT-X(mm)	DISP-Z(mm)	DRIFT-Z(mm)
5	7.26	2.69	10.78	3.89
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