

# Seismic Analysis and Design of G+9 RCC Residential Building in STAAD.PRO for Zone II Region

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**ABSTRACT:** Today, tall structures have turned out to be overall engineering wonder. From past earthquakes, it is demonstrated that a significant number of structure are absolutely/somewhat harmed because of earthquake and now-a-days it has turned out to be important to decide seismic reactions over such structures. Structural analysis is a branch which includes in the assurance of structures with a specific end goal to foresee the reactions of genuine structures, for example, structures, spans, trusses and so on. Basic outlining requires basic investigation and seismic examination of any structure before development. All together satisfy the prerequisite of this expanded populace in the constrained territory; the stature of building has turned out to be medium to tall structure. In this way, to guarantee wellbeing against seismic powers of multi-storied working, there is need of seismic examination study and planning quake protection structures. Amid earthquake, disappointment of structure begins from the purposes of a shortcoming. By and large, shortcoming happens because of geometry, mass brokenness and solidness of structure. That is the reason; structures fizzle amid earthquakes generally, because of vertical abnormality. The principle target this thesis is to think about the seismic investigation of structure for static and dynamic examination in standard minute opposing casing. We have thought about the private building, a G+9 storied structure for the seismic investigation and it is situated in Zone II district in India. The base necessities relating to the basic security of structures are being secured by the method for setting out the base plan loads which must be accepted for dead loads, forced burdens, and other outside loadings. Total structure was analysed by computer with using STAAD.PRO software.

**KEYWORDS:** Earthquake-resistance Building, G+9 Storied-structure, Seismic Analysis, Structure Analysis, Staad.pro.

## I. INTRODUCTION

Earthquake has turned into a danger to human progress from the day of its reality, wrecking human lives, property and the man-made structures. Mass of a building being intended to controls seismic outline, notwithstanding building firmness, as earthquake initiates latency compel that winds up corresponding to the building's mass. Outlining structures ought to act flexibly amid the seismic shaking without harm may render the undertaking monetarily unreasonable? This paper is presented to improve the efficiency of real time earthquake risk mitigation methods and its capability of protecting structures, infrastructures and people, to investigate a multistorey RCC building (G +9 Story) for Zone 2, to look at seismic conduct of multistorey RCC building for specific shaking power regarding reactions, to contemplate the impacts of various Seismic zones on execution of multi-story working as far as seismic, to know the connection between various techniques for seismic investigation and their seismic reactions, to accomplish functional learning on basic investigation, seismic examination, outlining and specifying of auxiliary segments utilizing standards of Earthquake Resistant Design.

### 1.1. MOMENT RESISTING FRAMES

The structure whose members and joints resist the forces principally caused by flexure is Moment Resisting Structure.

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- 1.1.1. Ordinary Moment Resisting Frame (OMRF):** The moment resisting frame which are designed withno uncommon consideration towards malleable nature of the frame are called ordinary moment resisting frames.
- 1.1.2. Special Moment Resisting Frame (SMRF):** The moment resisting structure which are intended to have malleable 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 accompanying magnitudes of a earthquake.
- 1.2. Design Basis Earthquake (DBE):** The earthquake whose likelihood of event is no less than one during the structure design life is called design basis earthquake.
- 1.3. Maximum Considered Earthquake (MCE):**The earthquake whose expected intensity is most extreme that can occur in a specific zone or region is called maximum considered earthquake. The maximum values are considered according to code. The design approach recommended by IS: 1893-2002 is depends on the accompanying standards (clause 6.1)
- The structure ought to have the quality to withstand minor earthquakes less than DBE without any damage.
  - The structure should have the capacity to oppose quakes equivalent to DBE without significant structural damage though some non-structural damage may occur.
  - The structure should withstand an earthquake equivalent to MCE without fall.

## II. LITERATURE SURVEY

**Sayed O. et al. (2017) [1]**, concentrated his examination on the impact of infill and mass inconsistency on various floor in RC structures. The outcomes were presumed that the block infill upgrades the seismic execution of the RC structures what's more, poor seismic reactions were appeared by the mass sporadic building, thusly it ought to be maintained a strategic distance from in the seismic defenceless districts.

**Khan et al.(2016) [2]**, featured the impact of mass inconsistency on various floor in RCC structures with as Reaction Spectrum investigation utilizing STAAD-Pro V8i programming. In the undertaking work seismic investigation of RCC structures with mass abnormality at various floor levels were done. Models are contrasted and each other for reaction regarding float and redirection.

**Reddy A. et al. (2015) [3]**, directed diagnostic examination for customary and sporadic structures to break down reaction of structures in seismic zone V.15 story building is considered and ETABS programming is utilized to show also, recreate building reaction. Examination is performed for static and dynamic techniques for investigation. Paper finished up conduct of unpredictable structures when contrasted with general structure.

**Mukundan H. et al. (2015) [4]**, discovered shear divider arrangement in building has been successful and efficient. A 10 story working in Zone IV is tried to diminish the impact of seismic tremor utilizing fortified solid shear dividers in the building. The outcomes are introduced subsequent to breaking down model utilizing ETABS programming and RSA strategy is utilized. Scientists additionally examined outcomes fluctuating thickness of shear dividers. It is presumed that shear dividers are more impervious to parallel loads in customary/Irregular structure and for more secure plan, the thickness of the shear divider ought to go between 150mm to 400mm.

**Mayuri D. Bhagwat et al.(2014) [5]**, G+12 multi-storeyed RCC building considering Koyna and Bhuj tremor is completed by utilizing time history examination and reaction range investigation. Seismic reactions of such building are nearly considered and displayed with the assistance of ETABS programming. Two time accounts (i.e. Koyna and Bhuj) have been utilized to create distinctive satisfactory criteria (base shear, story uprooting, story floats).

**T.Mahdi et al. (2012) [6]**, contemplated seismic conduct of three solid moderate minute opposing space outlines with unsymmetrical arrangement in five, seven and ten stories. In every one of these three cases, design arrangements of the structure contained re-entrant corners. Nonlinear static and direct unique systems had been utilized to dissect these structures. To quantify the precision of these two techniques, the non-straight powerful investigation had been utilized. In spite of the fact that the contrasts between the consequences of these two techniques with the nonlinear dynamic system were very wide, the direct powerful examination indicated marginally preferable outcomes over nonlinear static investigation.

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**Williams Ryan J. et al. (2009) [7]**, considered the financial advantage of a given retrofit method utilizing the system subtle elements. A parametric investigation was directed to decide how certain parameters influence the attainability of a seismic retrofit. A contextual investigation was performed for the illustration structures in Memphis and San Francisco utilizing an unassuming retrofit methodology. The consequences of the parametric investigation and contextual investigation advocate that, for most circumstances, a seismic retrofit of a current building is more fiscally practical in San Francisco than in Memphis.

### III. METHODOLOGY

If the structure not properly designed and constructed with required quality they may cause large destruction of structures due to earthquakes. Response spectrum analysis is a helpful procedure for seismic examination of structure when the structure indicates linear response.

- Extensive literature survey by referring books, specialized papers did to comprehend essential idea of subject.
- Selection of an appropriate plan of G+9, story building.
- Computation of loads and selection of preliminary cross-sections of different structural members.
- Geometrical modelling/demonstration and structural analysis of building for various loading conditions as per IS Codal provisions.
- Interpretation of results incorporate base shear, story float and story diversion.
- In the present work it is proposed to complete seismic investigation of multi-story RCC structures utilizing Response Spectrum Analysis method considering mass irregularity with the help of STAAD PRO software.

### IV. ANALYSIS AND DESIGN OF BUILDING

S. No.	Description of Structure	Values	S. No.	Description of Structure	Values
1	Material	Concrete (M25) and Reinforcement (FE415)	7	Floor Height	3 m
2	No. of Storeys	G+9 (10 storey's)	8	Seismic zone	Zone 2 (Table 2, IS 1893 (Part I): 2002)
3	Size of Beam	600 x 300 mm	9	Dead Load	Member Load: (-14KN/m) Floor Load: 0.4KN/mm <sup>2</sup>
4	Size of Column	300 x 600 mm	10	Live Load	3 KN/m <sup>2</sup>

Table 1. Building Data for Analysis

**Step – 1:** Creation of nodal points. In view of the columns situating of plan we entered the node points into the STAAD file.

**Step – 2:** Assigning the property of beams and columns. Fix the dimension and apply to direction in X, Y or Z.

**Step – 3:** Assign the support which is fixed and then go to seismic definitions (IS1893 Part 1:2002) and punch the value we had taken out above in particular section respectively in +X, -X, +Z, -Z directions.

**Step – 4:** Apply types of weight ie, self-weight, floor weight etc. Take the value we have taken out by calculation done above. Figure 2 & 3 shows the structure after live load and dead load is applied.

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**Step – 5:** Adding all the load mixes. After that, the load combinations are given with suitable factor of safety as per IS 875 Part 5.

**Step – 6:** Then, analysis after the completion of all the above advances we have played out the examination and checked for errors using run analysis command.

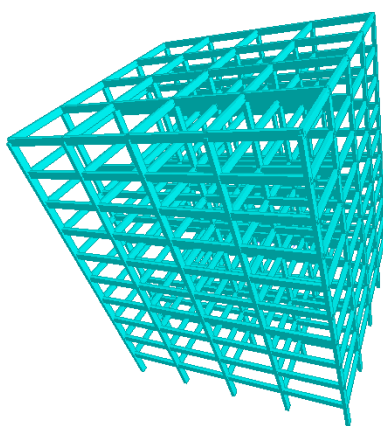


Fig. 1. 3D View of Structure

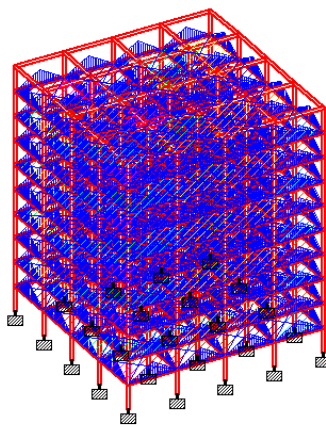


Fig. 2. When Live Load is applied

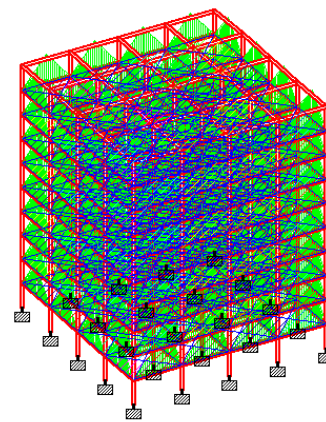


Fig. 3. When Dead Load is applied

## V. RESULT

	Node	L/C	Horizontal X mm	Vertical Y mm	Horizontal Z mm	Resultant Mm	Rotational		
							rX rad	rY rad	rZ rad
Max X	162	1 EQX	89.113	1.372	0	89.123	0	0	0
Min X	166	3 D.L	-0.088	-6.014	0	6.015	0	0	0.001
Max Y	162	1 EQX	89.113	1.372	0	89.123	0	0	0
Min Y	164	3 D.L	0	-10.195	0	10.195	0	0	0
Max Z	54	2 EQZ	0	1.306	48.766	48.783	0	0	0
Min Z	274	3 D.L	0	-6.383	-0.133	6.385	0	0	0
Max Rx	19	2 EQZ	0	0.776	16.362	16.381	0.002	0	0
Min rX	274	5 R.L.	0	-0.816	-0.059	0.818	0	0	0
Max rY	107	1 EQX	87.24	1.343	0.009	87.251	0	0	0
Min rY	217	1 EQX	87.24	1.343	-0.009	87.251	0	0	0
Max rZ	161	3 D.L	-0.013	-5.972	0	5.972	0	0	0.001
Min rZ	127	1 EQX	32.113	0.822	0	32.124	0	0	-0.002
Max Rst	162	1 EQX	89.113	1.372	0	89.123	0	0	0

Table 2. Nodal Displacement

Nodal displacements are referred in above table in X, Y and Z directions; by underlying arrangement in the aggregate Lagrangian definition in horizontal and vertical directions and to the last met setup in the refreshed Lagrangian plan. This exploration likewise proposes a relative nodal migration technique to address to the position and introduction for a node in framed structures. Since the proposed techniques measures the relative nodal relocations in respect to its adjoining nodal reference outline, they are still little for a framed structure experiencing huge damage for the little size components. As a result, component details created under the little distortion suspicion are as yet substantial for structures experiencing vast disfigurements, which altogether disentangle the conditions of harmony. A basic

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framework is spoken to by a diagram to deliberately build up the overseeing conditions of harmony for general frameworks. Two computational successions are characterized in the table above. One is the forward way grouping that is utilized to regain the Cartesian nodal removals from relative nodal uprooting and navigates a chart from the node hub towards the terminal hubs. The other is the regressive way succession that is utilized to recuperate the nodal powers in the relative facilitate framework from the known nodal controls in evidently the mastermind structure and crosses from the terminal hub towards the base hubs.

## VI. CONCLUSION

The research paper enables to consolidate the knowledge of analysis and design of structure during seismic effects. Since, the project building is located at Delhi (Zone 2) region, we have given more emphasis on earthquake load rather than others. The building is more practically analysed over Staad.Pro software which is nowadays a helpful tool in the analysis of frame for various loading condition. In the paper, design and detailing of all required element of building were calculated manually and values were kept in required field in the software.

Detailed structural design of building is important aspect of construction procedure. Practically an engineer employed must have knowledge on designs, construction procedures, site study etc. The project work was only related with the practical application of the studied courses in the field. Finally, I hope that efforts and coordination for the project work will prove much useful in our career and project will be helpful in providing information on the earthquake resistant design and its safe practice.

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