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M.TECH (STR.)

On Topic

"FLOATING COLUMN FOR EARTHQUAKE ANALYSIS OF MULTISTOREY BUILDING"

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CERTIFICATE

This is to declare that the major project entitled "**FLOATING COLUMN FOR EARTHQUAKE ANALYSIS OF MULTISTOREY BUILDING"** is a bonafide record of work done by me for partially fulfillment of requirement for the degree of M**.**E**.**, Civil Engineering (Structural Engineering) from GALGOTIAS UNIVERSITY.

This project has been carried out under the supervision of **DR. SUSHIL KUMAR SINGH**, Department of Civil Engineering, GALGOTIAS UNIVERSITY, (U.P)
I have not submitted the matter embodied in this report to any other University or Institution for the award of any Degree or Diploma.

Name: **ANURAG KUMA PRASAD**

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Certificate:-

This is to certify that the above statement laid by the candidate is correct to best of our knowledge.

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DEDICATION

"To all those who love me and those that I love."

ACKNOWLEDGEMENT

It is a great pleasure to have the opportunity to extent my heartfelt gratitude to everybody who helped me throughout the course of this project.

It is distinct pleasure to express my deep sense of gratitude and indebtedness to my learned supervisor **S. K. SINGH** for his invaluable guidance, encouragement and patient reviews. His continuous inspiration has made me complete this major project. He kept on boosting me time and again for putting an extra ounce of effort to realize his work.

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NOMENCLATURE

Ah	Design horizontal seismic coefficient
T	Time period
Z	Zone factor
Vb	Base shear
L	Length of G+6 building
H	Height of G+6 building
W	Width of G+6 building
T	Thickness of G+6 building
SMRF	Special RC moment resisting frame
Wi	Weight of the particular floor or roof
Qi	Story shear
R	Response reduction factor
I	Importance factor
D	The total base distance from the earthquake direction

ABSTRACT

Structural engineering is part of civil engineering it deals with the analysis and design of structures that support or resist loads. Floating column is a vertical member which does not transfer load directly to the foundation. It acts as a point load on the beam. It is a kind of typical feature in modern multi-storey buildings. These constructions are highly undesirable in buildings built in seismically active places. The term floating column is likewise a vertical element which results at its decrease level rests on a beam which is a horizontal member. Closely spaced columns based on the layout of upper floors are not desirable in the lower floors. So to avoid that problem floating column concept has come into existence. Now a day's lots of multistory buildings are constructed with floating column for purpose of getting more space at parking areas for movement.

Nowadays in most of the commercial as well as residential buildings lowers floors contains banquet halls, showrooms, conference rooms, large parking space etc. All these amenities requires huge uninterrupted space unlike closely spaced columns on upper floors, hence the concept of floating column came into existence. This paper aims towards the review of studies carried out on Seismic Analysis of the building with Floating column by This project deals with the study of architectural drawing and the framing drawing of the building having floating columns. The load distribution of the floating columns and the various effects due to it is also being studied. The importance and effects due to the line of action of force are also studied. In this we are dealing with the study of seismic analysis of multistoried building with floating columns. The equivalent static analysis is carried out on the entire project using the software Staad Pro V8i SS6.

CHAPTER 1

1.1 INTRODUCTION

In recent times, multi-storey buildings in urban cities are required to have column free space due to shortage of space, Population and also for aesthetic and functional requirements. For this, buildings are provided with floating columns at one or more storey. These floating columns are highly disadvantageous in a building built in seismically active areas. The earthquake forces that are developed at different floor levels in a building need to be carried down along the height to the ground by the shortest path. Modern construction technology in which prime concern is given for architectural and other needs, shaping most of the multistoried buildings having open ground storey as an obligatory feature to afford parking area, reception lobbies and for other architectural needs. This open ground storey concept leads to interruption of columns namely floating columns, which makes the building lateral irresistible. This concept of floating column is mainly driven from the architectural needs to bring out aesthetic view to building, and also to overcome FSI (Floor Space Index) restrictions. In order to study the earthquake effects on the buildings we have to know about the base shear of the building which depends on loads of the building. As we know that strength of the building totally depends on how the loads are distributed in each floor. The overall Base shear of the building depends on seismic coefficient, Time period and load distribution over the height of the building. The behavior of the building also depends on geometry and location of the building. As the Base shear is taken from the mass of each floor, these loads should be taken in a short path from top to the foundation of the building. From these floating columns the load path may get disturbed which results for increased levels of Displacements, Storey Shears, Time period and moments in columns.

1.2 FLOATING COLUMN

The floating column is a vertical member which rest on a beam and doesn't have a foundation. The floating column act as a point load on the beam and this beam transfers the load to the columns below it. But such column cannot be implemented easily to construct practically since the true columns below the termination level are not constructed with care and hence finally cause to failure.

1.3 RESEARCH QUESTIONS

The problems that lead this work are:

1. What will be the impact of floating column?
2. Whether it is economical or not?
3. Determine the storey drift, lateral displacement and storey shears of building?
4. What will be the result by doing analysis of multistory building with floating column using Staad Pro V8i SS6.

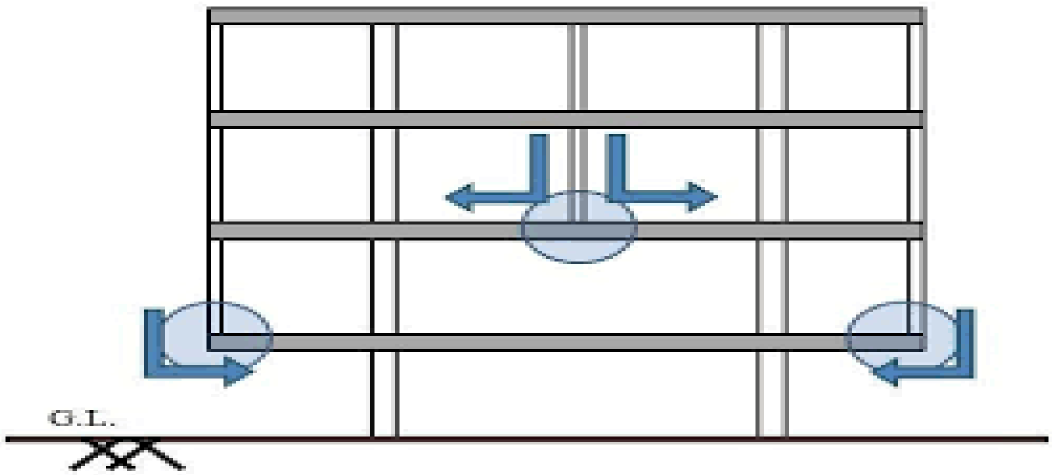


Fig 1-Floating column

1.4 OBJECTIVE

The objective of present work is to study the seismic study on strengthening of floating column of multistory building. The objective of the present work is to compare the response and behaviour of multi-storey RC frame structure with and without floating column under seismic/earthquake excitation. To complete this seismic study Staad Pro V8i SS6 software is handled.

The major objectives of the work are listed below:

1. The present study is done by using Staad pro v8i. The analysis is carried out by nonlinear Dynamic method in accordance with IS-1893-2002 (part-1), to study the performance levels and performance points of the building.
2. G+6 Building with floating column is to be analyze by using Static analysis.
3. Comparisons of results for Storey Drift, Displacement, Base shear, Frequency and time period. Percentage difference between the results of building with floating column and building without floating column.
4. Commercial study of the aspects of floating column building.

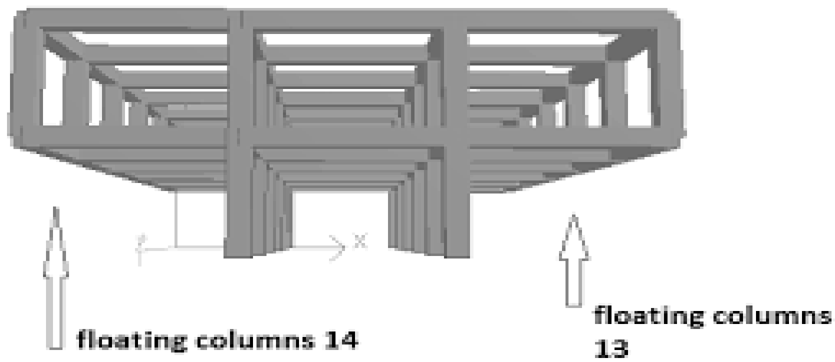


Fig 2-Floating column sample model

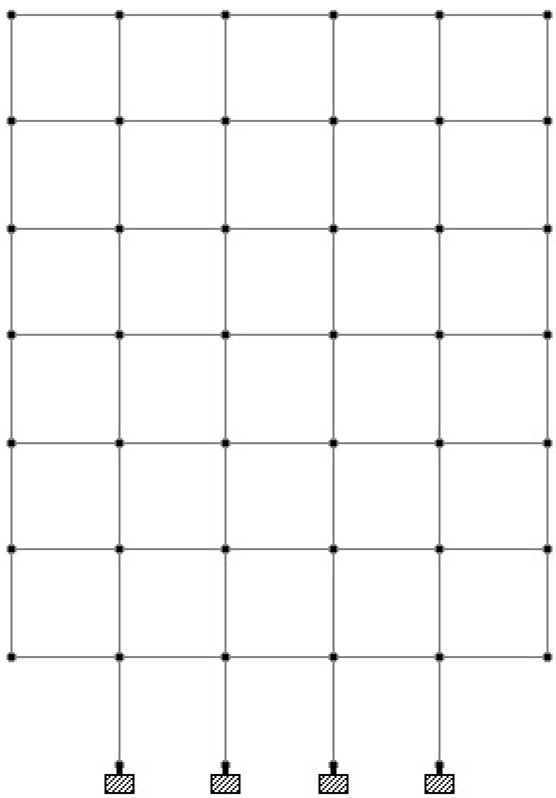


Fig 3-multistory building with Floating column

1.5 RESEARCH SCOPE AND LIMITATIONS

In this study the research scope and limitations are presented as under:

1. The work is limited to the data available in Criteria for Earthquake Resistant design of structures, Part1: General provisions and buildings, IS1893:2002, IS 875 (Part-I) Bureau of Indian Standards (1987) code *{Guidelines for the Design of Loads (Other than Earthquake) for Buildings and Structures: Dead Loads-Unit Weights of Building Materials}* IS 875 (Part-II) Bureau of Indian Standards (1987) Code of Practice for Design Loads For Buildings Structures: *Imposed Loads (Second Revision).*

2. Due to varying Indian climate conditions and vary earthquake conditions the building material properties gets affected. To overcome this problem it is needed to analyze the floating column for earthquake analysis of multistory building.

3. STAAD PRO V8I software is used for analysis purpose.

1.6 ORGANIZATION OF THESIS

In accordance with the Master Program, the present thesis is organized into five chapters, which are as follows:

Chapter 1 Introduction: This chapter consists of general background, research questions, objectives and scope of the study.

Chapter 2 Literature Review: This chapter describes about the characteristic of floating column, design of multi storey building with floating column. It includes the various factors affecting the building. A brief introduction and structure of STAAD PRO is also discussed.

Chapter 3 Methodology of the Study: This chapter presents the descriptions of the approaches being taken to achieve the objectives.

Chapter 4 STAAD PRO Data Analysis: This chapter contains the data analyzed by STAAD PRO V8i SS6 regarding the objectives of thesis. The analyzed data includes 1st order static analysis, p-delta analysis, pushover analysis or a buckling analysis and geometric non-linear analysis. Different forms of dynamic analysis from modal extraction to time history and response spectrum analysis can also be done using this program. You can utilize this program for any kind of structure design and analysis.

Chapter 5 Results, Conclusions and Recommendations: This chapter contains the conclusions that can be drawn from the analysis. Finding, results and recommendation for further work are included in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 BACKGROUND

Nowadays multi-storey buildings constructed for the purpose of residential, commercial, industrial etc., with an open ground storey has become a common feature. For the sake of parking, the ground storey is kept free without any constructions, except for the columns which transfer the building weight to the ground. For a hotel or commercial building, where the lower floors contain banquet halls, conference rooms, lobbies, show rooms or parking areas, large interrupted space is required for the movement of people or vehicles. The columns which are closely spaced in the upper floors are not advisable in the lower floors. So to avoid this problem, floating column concept has come into existence.

2.2 STRUCTURAL MODELS

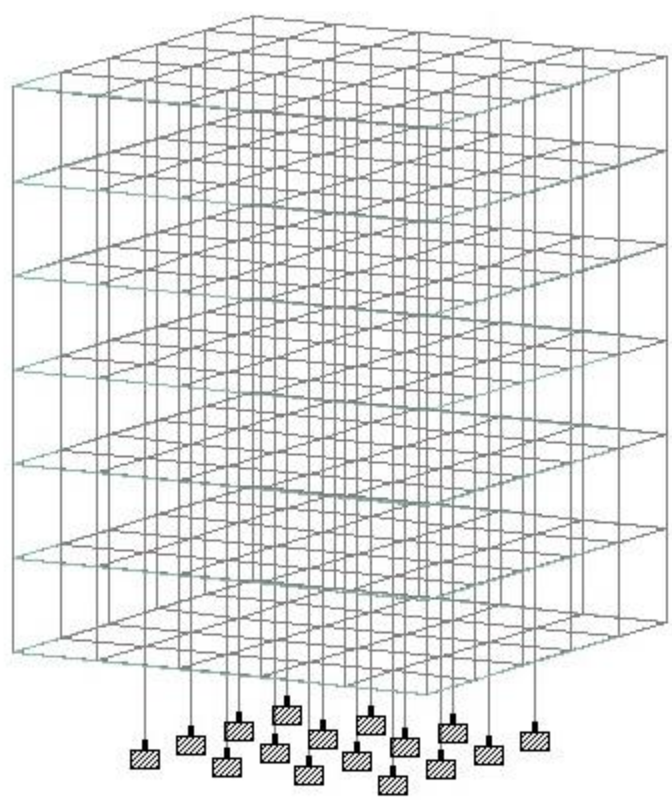


Fig 4-multistory building with Floating column using staad pro

2.3 LITERATURE SERVEY

Srikanth M.K [1] **[2014]** He observed that, the displacement of the building increases from lower zones to higher zones, because the magnitude of intensity will be more for higher zones, similarly for drift, because it is correlated with the displacement. Storey shear will be more for lower floors, then the higher floors due to the reduction in weight when we go from bottom to top floors. And with this if we reduce the stiffness of upper floors automatically there will be a reduction in weight on those floors so in the top floors the storey shear will be less compared to bottom stories .Whether the floating columns on ground floor or in eight floors the displacement values increases when a floating column is provided in edge and middle than the outer face of the frame. The multi-storey building with complexities will undergo large displacement then the model having only floating column. In all models the displacement values are less for lower zones and it goes on increases for higher zone.

Sukumar Bahera [2] [2012]
In this paper involve stiffness balance of first storey and the storey above are studied to reduce irregularity occurs due to presence floating column. To study response of structures under different earthquake excitation having different frequency content keeping the PGA and time duration factor constant they develop FEM codes for 2D frames with and without floating column. The behavior of building frame with and without floating column is studied under static load, free vibration and forced vibration condition. The finite element code has been developed in MATLAB platform. The time history of floor displacement, inter storey drift, base shear, overturning moment are computed for both the frames with and without floating column. The dynamic analysis of frame is studied by varying the column dimension. It is concluded that with increase in ground floor column the maximum displacement, inter storey drift values are reducing. The base shear and overturning moment vary with the change in column dimension.

A.p.mundada,S.G.Sawadakar [3] [2014]
In this paper study is done for architectural drawing and the framing drawing of the building having floating columns. For comparision G+7 existing residential building with and without floating column are taken for carry out entire project work. by using STAAD ProV8i 3D 3 model are created .equivalent static analysis of these model are done by using STAAD Pro V8i .Different parameters such as axial load ,moment distribution, importance of line of action of force and seismic factors are studied for models. This will help them to find the various analytical properties of the structure and also have a very systematic and economical design for the structure.

Hardik Bhensdadia,Siddarth shah [4] [2014]
In this study an attempt is made to reveal the effects of floating column & soft story in different earthquake zones by seismic analysis. For this purpose Push over analysis is adopted because this analysis will yield performance level of building for design capacity (displacement) carried out up to failure, it helps determination of collapse load and ductility capacity of the structure. To achieve this objective, three RC bare frame structures with G+4,G+9, G+15 stories respectively will be analyzed and compared the base force and displacement of RCC bar frame structure with G+4, G+9, G+15 stories indifferent earthquake zones like Rajkot, Jamnagar and Bhuj using SAP 2000 14 analysis package.

Susanta Banerjee,Sanjay kumar patra [5] [2014] This paper presents the effect of stiffness of infill wall to the damage occurred in floating column building when ground shakes. Modeling and analysis are carried out by non linear analysis program IDARC- 2D. Damage occurred in beams, columns, storey are studied by formulating modified Park &Ang model to evaluate damage indices. Overall structural damage indices in buildings due to shaking of ground are also obtained. Dynamic response parameters i.e. lateral floor displacement, storey drift, time period, base shear of buildings are obtained and results are compared with the ordinary moment resisting frame buildings. Formation of cracks, yield, plastic hinge, are also observed during analysis. From this it is concluded that lateral floor displacement, storey drift of floating column building with infill wall are reduced than floating column building without infill wall. Also it is concluded that fundamental time period, lateral floor displacement of floating column building are higher than ordinary moment resisting frame.

Sreekanth Gandla Nanabala1, Pradeep kumar [6] [2015] In this paper find whether structure is safe or unsafe with floating column when built in seismically active areas and also find floating column building is economical or uneconomical. For that purpose analysis of G+5 storey normal building and floating column building are done for external lateral forces. This analysis done by using sap2000.external lateral load are calculated manually. Using equivalent static method foranalysiscreated2D3model,model1,model2,model3.model1 is a normal building with same dimension of beam and column.model2 is floating column building without changing dimensions.model3 is floating column building with changing dimension of beam and column. And compare the both building based on displacement due to lateral load in terms of model1,model2,model3 also based on stiffness, and based on time history analysis. To check economy of both building compares steel and concrete quantity in terms of model, model2, model3.

Prerna Nautiyal,Saleem Aktar and Geeta Batham [7] [2015] In this paper investigate the effect of a floating column under earthquake excitation for various soil conditions and as there is no provision or magnification factor specified in I.S. Code, hence the determination of such factors for safe and economical design of a building having floating column. Linear Dynamic Analysis is done for 2D multi storey frame with and without floating column. For that purpose created the model G+4 and G+6 building having changing the position of floating column. after that response spectrum analysis is done for both building. Dynamic response parameters such as base shear and moment for hard and medium soil condition are obtained for both building models.

Gangadari Vishal Kumar [8] November [2016]

This study highlights the importance of explicitly recognizing the presence of the floating column in the analysis of building. Alternate measures, involving stiffness balance of the first storey and the storey above, are proposed to reduce the irregularity introduced by the floating columns. FEM codes are developed for 2D multi storey frames with and without floating column to study the responses of the structure under different earthquake excitation having different frequency content keeping the PGA and time duration factor constant. The time history of floor displacement, inter storey drift, base shear, overturning moment are computed for both the frames with and without floating column.

Ms.Waykule [9], January [2017]

Floating columns are a typical feature in the modern multi-storey construction in urban India and are highly undesirable in buildings built in seismically active areas. In this paper static analysis is done for a multi-storey building with and without floating columns. Different cases of the building are studied by varying the location of floating columns floor wise. The structural response of the building models with respect to, Base shear, and Storey displacements is investigated. The analysis is carried out using software sap2000v17.

Karishma I.patel [10], November [2017]

In this paper study of multistory buildings are constructed with floating column for purpose of getting more space at parking areas for movement. But same case highly damaged during highly seismic zone as compared to normal building in earthquake. And this paper also studies the seismic behavior of multistory building with and without floating column considered. And find whether the structure is safe or unsafe with floating column when built in seismically active areas.

Mohammed Mustafa [11], December [2017]

This paper aims towards the review of studies carried out on Seismic Analysis of the building with Floating column by various authors in the past. The analysis is done on building models having different numbers of storey of RCC with simple and complex floor plan with floating columns. Finite element base software namely ETABS, Staad pro v8i are used for the analysis which can easily determine the parameter such as lateral forces, bending moment, shear force, axial force, storey shear, storey drift, base shear. Time history method or response spectrum method is used for the dynamic analysis for simple and complex building configuration.

Kishalay Maitra [12], 2 April [2018]

In the modern multi-story construction, floating column is an unavoidable feature of buildings. Such features are highly undesirable in building built in seismic prone areas. This study highlights the performance of floating column building and compared with normal building under seismic load. In this study, static and dynamic analyses using response spectrum method have been carried out for multi-story building with and without floating column.

Shivani Tyagi [13], may [2018]
Structural planning and design is an art and science of designing with economy and elegance and durable structures. In present scenario buildings with floating column is a typical feature in the modern multistory construction in urban India. Such features are highly undesirable in building built in seismically active areas. Tremendous increase in the use floating column can be seen these days cause of spacious and aesthetic appearance but that could not be achieved on the risk of failure of building. This study highlights the importance of explicitly recognizing the presence of the floating column in the analysis of building. The study is carried out to analyze the building with floating columns and to find out its comparison with the building without floating column in terms of storey drift, base shear and time period frequency using designing software.

T.Raja Sekhar [14],[2018]
He studied the behaviour of multi-storey building with and without floating column is studied under different earthquake excitation. The compatible time history and earthquake data has been considered. The PGA of both the earthquake has been scaled to 0.2g and duration of excitation is kept same. A finite element model has been developed to study the dynamic behaviour of multi story.

Fig 5-site sample of multistory building

2.4 ANALYTICAL DESIGN IS 1893:2002, Bureau of Indian Standards, New Delhi FOR FLOATING COLUMN

The research scheme "floating column for earthquake analysis of multistory building" presents an analytical approach for building design in India which is followed by IS 1893:2002.

1. Applicable for new small type of building.
2. Not applicable for large constructions.
3. Typical multistory building

The characteristics (intensity, duration, frequency content, etc) of seismic ground vibrations expected at any site depend on magnitude of earthquake, its focal depth, epicentral distance, characteristics of the path through which the seismic waves travel, and soil strata on which the structure is founded. The random earthquake ground motions, which cause the structure to oscillate, can be resolved in any three mutually perpendicular directions. The predominant direction of ground vibration is usually horizontal.

Effects of earthquake-induced vertical shaking can be significant for overall stability analysis of structures, especially in structures

(a) With large spans,
And
(b) Those in which stability is a criterion for design. Reduction in gravity force due to vertical ground motions can be detrimental particularly in prestressed horizontal members, cantilevered members and gravity structures. Hence, special attention shall be paid to effects of vertical ground motion on prestressed or cantilevered beams, girders and slabs.

The response of a structure to ground vibrations depends on

(a) Type of foundation;
(b) Materials, form, size and mode of construction of structures;
(c) Duration and characteristics of ground motion. This standard specifies design forces for structures founded on rocks or soils.

2.6 STAAD PRO ANALYSIS METHODS

In the current years it has been portion of integrated structural analysis and design solutions importantly utilizing an open API named Open STAAD to enter and drive the software utilizing a Visual Basic macro system attached in the software or by adding Open STAAD workability in applications that themselves attached appropriate programmable macro systems. STAAD Pro has also included some applications and linked directly like RAM connection as well as STAAD Foundation to allow Engineers to work with the those applications which manage design post processing not managed by STAAD Pro itself. The other form of integration supported by the STAAD Pro is the analysis schema of the CIM steel integration Ideals, version 2 generally familiar as CIS/2 and utilized by a couple modeling and analysis applications.

So, Staad Pro is a 3D analysis and design software used across the world by the Civil Engineering community. Especially people using this software for steel and concrete structure analysis and design, personally I use this program for steel structure analysis and design.

Figure 6 Screen Shot of Main Screen of STAAD PRO V8i

Major disadvantage of this type of analysis is that because STAAD PRO V8i is software user can only change modulus values of each layer in vertical direction and modulus is assumed constant throughout the layer. This does not represent the actual behavior of the granular material whose resilient modulus is also varying in the horizontal direction within the layer. Actually modulus values change throughout the layer because stress is variable within the layer.This type of modeling can only be achieved by using "**Finite Element Method".**

CHAPTER 3

METHODOLOGY OF THE STUDY

3.1. GENERAL

This study is carried out to analysis FLOATING COLUMN FOR EARTHQUAKE ANALYSIS OF MULTISTOREY BUILDING using STAAD PRO V8i SS6. Optimal solution also worked out from the analysis.

3.2. UNITS FOR ANALYSIS WORK

SI units are used for this analysis work. Stresses and pressures are measured in "kn/m-sq", strains in "m/m", deformation in "m", bending moment in “kn/m.

3.3.PROBLEM STATEMENT

In accordance with IS-1893-2002 (part-1), to study the performance levels and performance points of the building. Building data used for modeling for G+6. Dimension of beams and columns as well as other properties of the building is specified in table 1.

Table 1.Geometrical dimensions of the building and material properties.

Member properties

Sr No.	Parameters	G+6 Building
1	Utility of the building	Residential
2	Type of construction	Special R.C Framed Structure
3	Feature	Floating column
4	Height of building	21 m
5	Floor height	3 m
6	Seismic Zone	V
7	Zone Factor (***Z***)	0.36
8	Importance Factor (***I***)	1.5
9	Response Reduction Factor (***R***)	5
10	Soil Type	Medium
11	Beam Size	400X400 mm
12	Floating column	650X650 mm
13	Column Size	500x500 mm
14	Spacing of columns	3 m
15	Slab Thickness	150 mm
16	Live Load	4 kN/m²
17	Floor Finish	1.5 kN/m²
18	Material Properties (Concrete)	M30
19	Number of bays along X-direction	5
20	Number of bays along Y-direction	7
21	Grade of steel	Fe415
22	Length of building	15

3.4. GENERAL DATA COLLECTION

The data used for analysis work in this thesis is taken as follows:

1. Assumed design of beam and column.
2. Elastic modulus and Poisson’s ratio is taken from IS 456:2000 code of practice for plain and reinforced concrete.
3. Strength of concrete and steel strength is taken from IS 456:2000 code of practice for plain and reinforced concrete and IS 800:2007 Code of practice for general construction in steel.
4. Dead load, live load, floor load is also assumed.

5. Thickness of slab is taken from IS 456:2000 code of practice for plain and reinforced concrete.
6. Some other important parameters are also taken from , IS 1893:2002, IS 875 (Part-I) Bureau of Indian Standards (1987) code {Guidelines for the Design of Loads (Other than Earthquake) for Buildings and Structures: Dead Loads-Unit Weights of Building Materials} IS 875 (Part-II) Bureau of Indian Standards (1987) Code of Practice for Design Loads For Buildings Structures: Imposed Loads (Second Revision).

3.5. MATERIAL PROPERTIES

The main material properties used for the analysis work in this study are modulus of elasticity, Poisson's ratio, and unit weight.

3.6. METHODOLOGY OF DATA ANALYSIS

Present study is carried out with following five objectives:

1. To analysis a G+6 RCC frame structure designed as per Indian standard guidelines, using Staad Pro V8i software.

2. To study the effect of floating column in multistory building in seismic zone.

3. To obtain an optimal economic building for a target design life using Staad Pro V8i software.

4. To obtain the Base shear, Storey drift, Storey displacement and maximum displacement of each storey.

5. to study the effect of floating column at corners of multistory building in seismic zone.

Methodology used to achieve each objective in briefly explained in this section of the thesis.

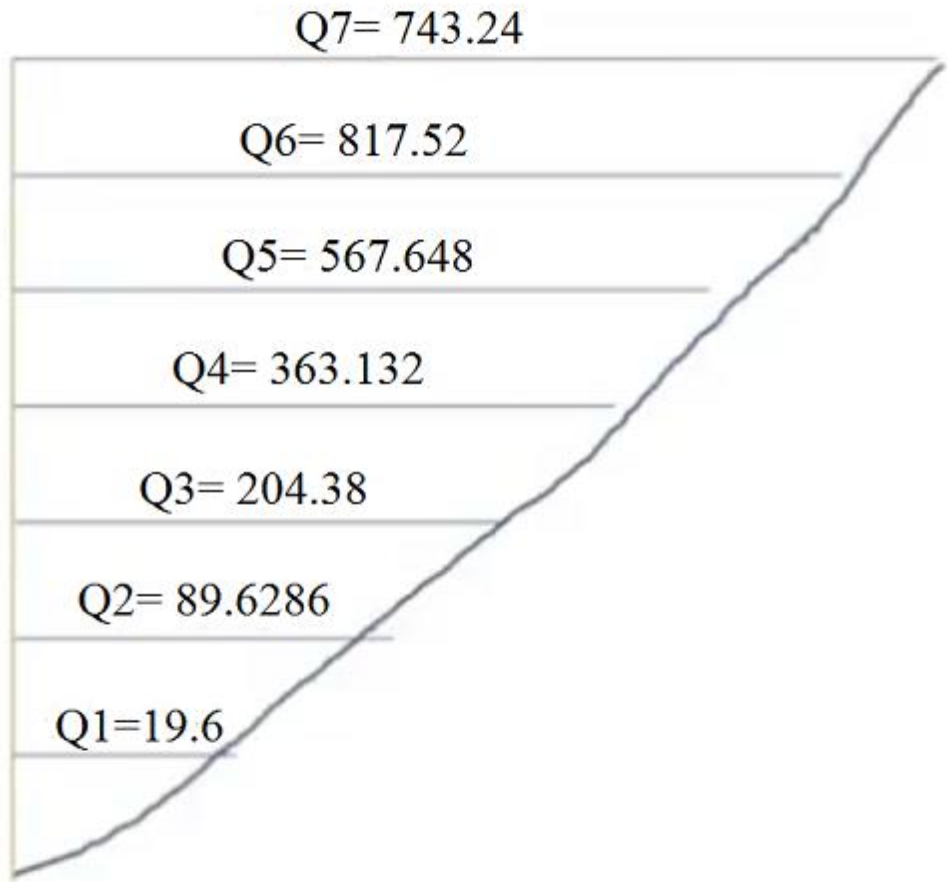


Fig 7- graph of story shear floor wise

Fig 8-cumulative graph of story shear floor wise from 1 to 7

First of all, the total load is being calculated including dead load, live load including wind load also for the calculation of base shear. Stepwise, dead load of beam, column and roof is being calculated after then live load is also being calculated respectively. As we know, there is no live load on the roof so the live load of roof is being taken as zero.

By calculating the lumped mass, we calculate the seismic weight of each floor including roof and ground floor. The method we are using is EQUIVALENT STATIC METHOD.

In this method, the lateral loads are being calculated which is used in this multistory building. The lateral forces on the structure which depends on the structural mass and fundamental time period of the building is called as designed Base shear. This base shear is distributed along the height of the building using the formula presented in IS guidelines. This method is also called as Seismic coefficient method because we use horizontal seismic coefficient to find the Base shear of the building. According to the IS guidelines, the Base shear is calculated as below:

Design Seismic Base Shear, V_B

From IS 1893- 2002, Clause 7.5.3, the design base shear

$$V_B = A_h W$$

where,

W - seismic weight of the building
A_h - horizontal seismic coefficient

Horizontal Seismic Coefficient, A_h

As per IS 1893(Part 1)-2002, Clause 6.4.2

$$A_h = \frac{Z\, I\, S_a}{2\, R\, g}$$

Provided that for any structure with T < 0.1 s, the value of A_h will not be taken less than Z/2 whatever be the value of *I/R*.

The Base shear calculated from above procedure can be distributed over the height of building using the formula stated as per IS 1893 provision clause no 7.7.1.

Vertical Distribution of Base Shear to Different Floor levels

The lateral force induced at any level h_i as per Clause 7.7.1, IS 1893-2002, can be determined by,

$$Q_i = V_B \frac{Wihi^2}{\sum_{j=1}^{n} Wj \; hj^2}$$

where,

Q_i - Design lateral force at floor i

W_i - Seismic weight of floor i

h_i - Height of floor i measured from base, and

n - Number of storey's in the building is the number of levels at which the masses are located.

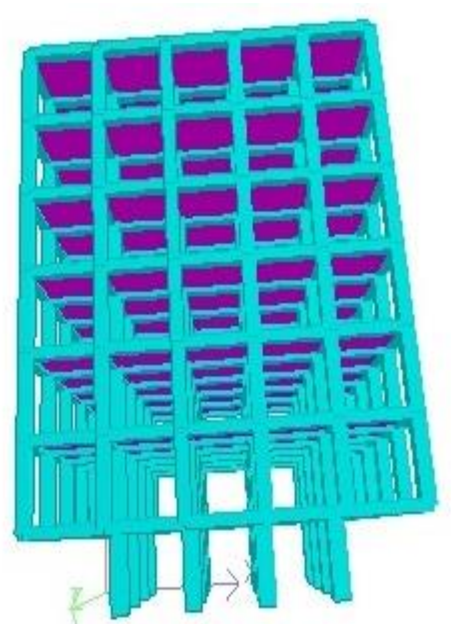
RESPONSE SPECTRUM METHOD:
Response spectrum analysis is applicable for the structures whose modes other than fundamental mode are affected. The response of multi degree of freedom structures is predicted by superposing the response of each single degree of freedom structure and these individual responses are finally combined to get the response of MDOF structures. The Elastic response spectrum analysis is an improvement over the equivalent static method to get the accurate responses of the structure. In this method the shear forces in each floor are accurately divided when compared to equivalent static method. Due to this reason the Base shear in response spectrum analysis and equivalent static analysis is equalized to get the accurate shear forces that are produced due to lateral loads applied. We can see in code IS:1893-2002 from clause 7.8.2, that if the base shear from the dynamic analysis is less than the base shear obtained from the static analysis which is multiplied to fundamental time period, then all response quantities shall be multiplied by the factor obtained from dividing the static base shear and base shear from dynamic analysis.

PUSH OVER ANALYSIS: This is a type of analysis in which a structure is analyzed under permanent vertical loads and gradually increasing lateral loads. It is a non-linear static analysis which is a popular tool in finding the performance levels of the building for maximum displacements. We can get the plots for total base shear versus max displacement. First create a structure model that we need to analyze, then the properties and the acceptance criteria for the push over hinges are need to be defined. Then assign the defined hinges by selecting the frames and define the pushover load cases by following the displacement control method i.e., giving the target displacement for which we find the performance levels of the structure. Run the Pushover analysis followed by static analysis. Now we can see the push over curve and the performance levels of the buildings. We can also plot the capacity spectrum curve and we can review the results in a step-by-step process. For the building which are to be rehabilitated this method is most preferable than any other seismic methods.

MODEL DETAILS

The structure must be modeled and analyzed so that the values of the response parameters of earthquake are calculated with sufficient accuracy for design purpose. The acceptance criteria of result of response parameter may vary on whether static or dynamic non-linear analysis is used.

G+6 RCC frame structures are modeled by using Staad Pro V8i software. The Building frames are special RC moment- resisting frame (SMRF). All details of size, properties are tabulated above.



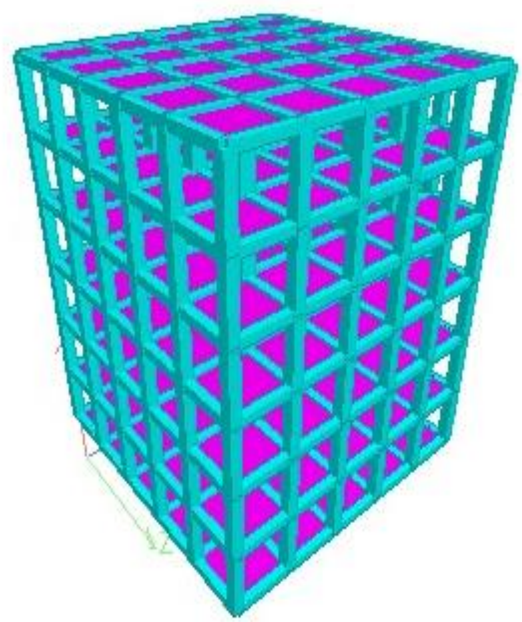


Fig. 9 G+6 FRONT VIEW Building model with floating column. Fig. 10 G+6 TOP VIEW Building model with floating column

CHAPTER 4

4.1 INTRODUCTION

In this section, data collected from the relevant studies as discussed in chapter 3, is analyzed by using computer program STAAD PRO V8i SS6. The complete details regarding data collection and methodology used for this analytical study are provided in chapter 2 and chapter 3 of this thesis. This analysis work is carried out to find the earthquake analysis of multistory building with floating column. The following sections present the analytical output data obtained by STAAD PRO V8i SS6 analysis for the provided inputs to complete the objectives.

4.2 STAAD PRO V8i SS6 DATA ANALYSIS

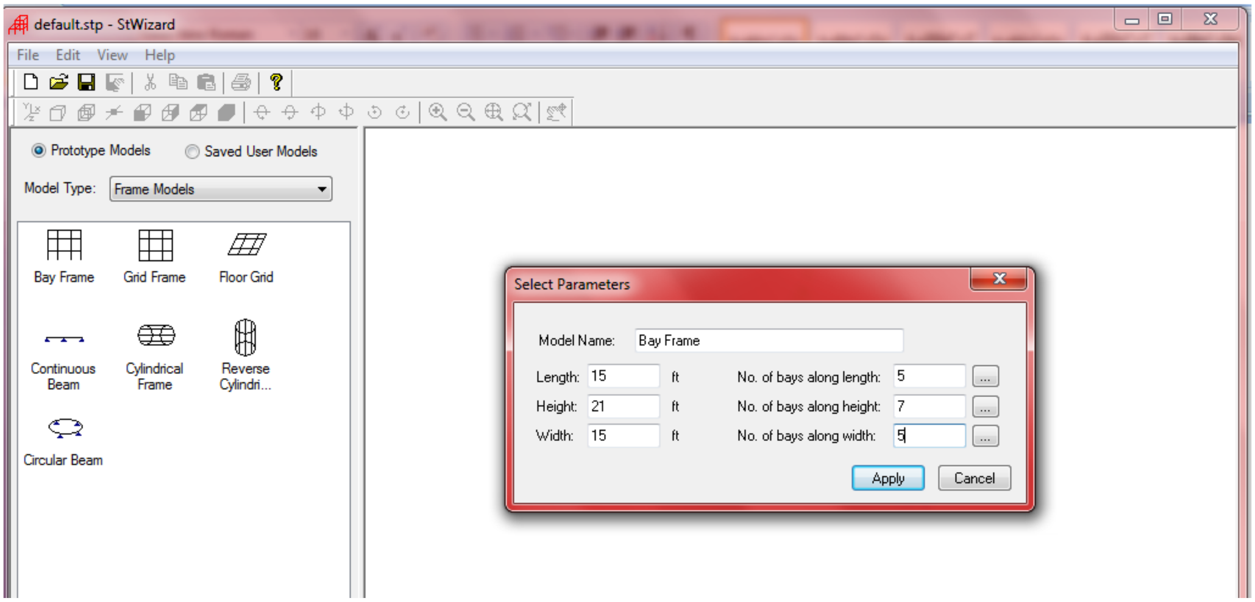


Fig 11- length, width and height of G+6 building

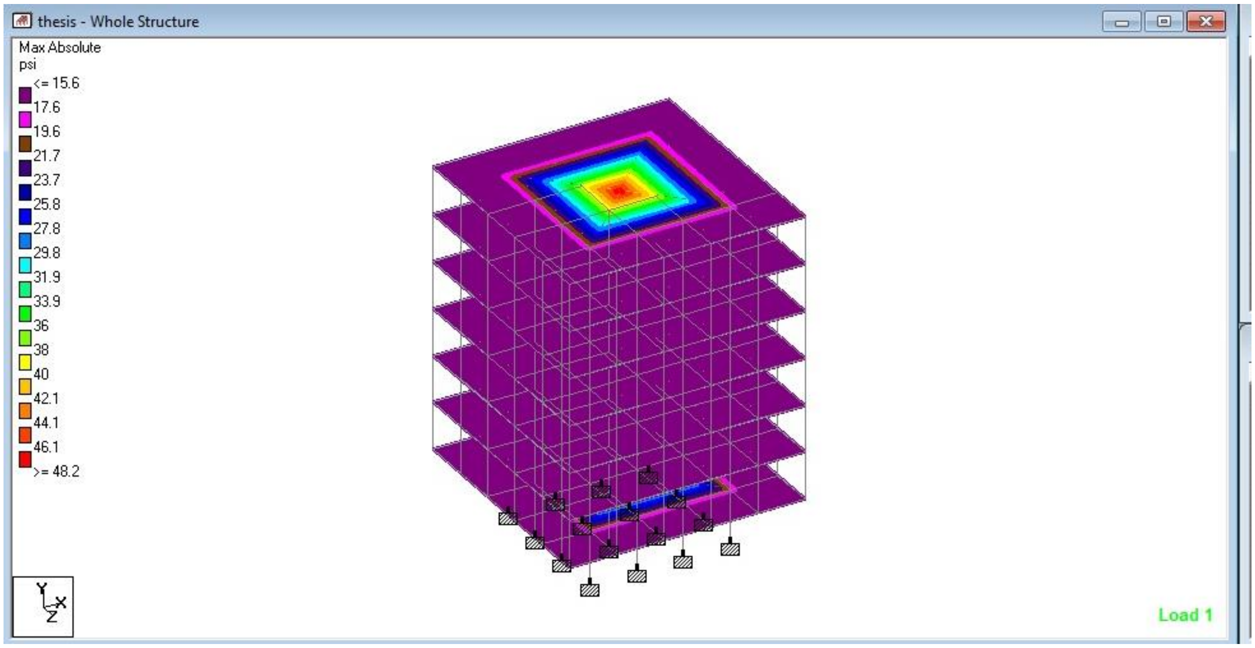


Fig 12- 3-d view of G+6 structure

4.3 FLOATING COLUMN IN SEISMIC ZONE

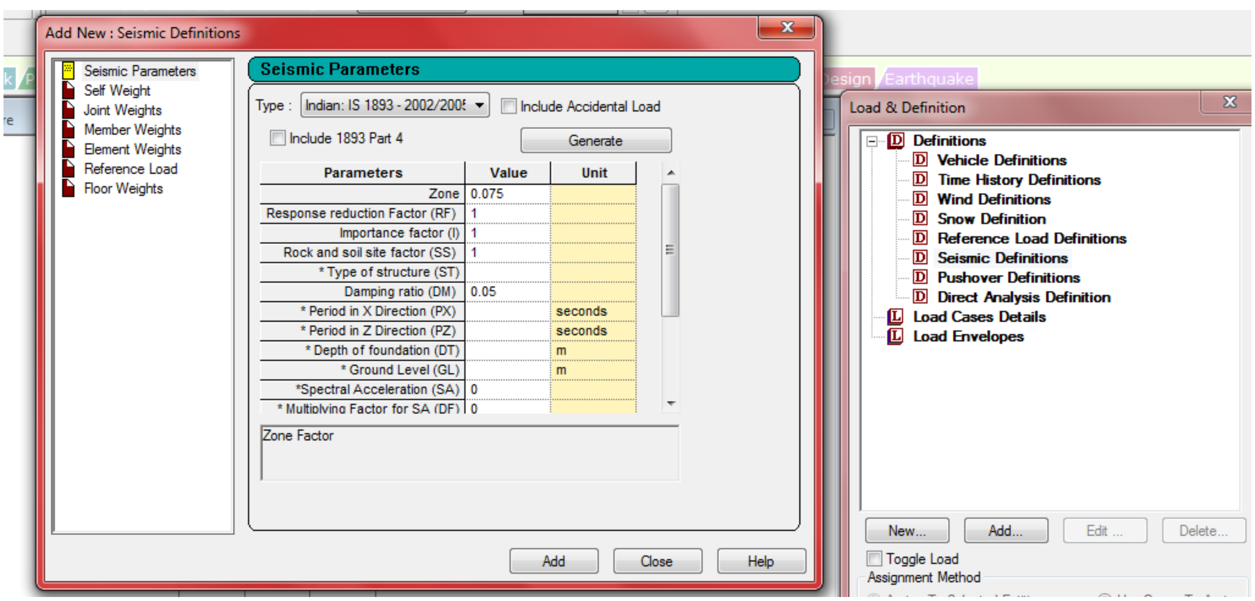


Fig 13-earthquake analysis parameters of staad pro

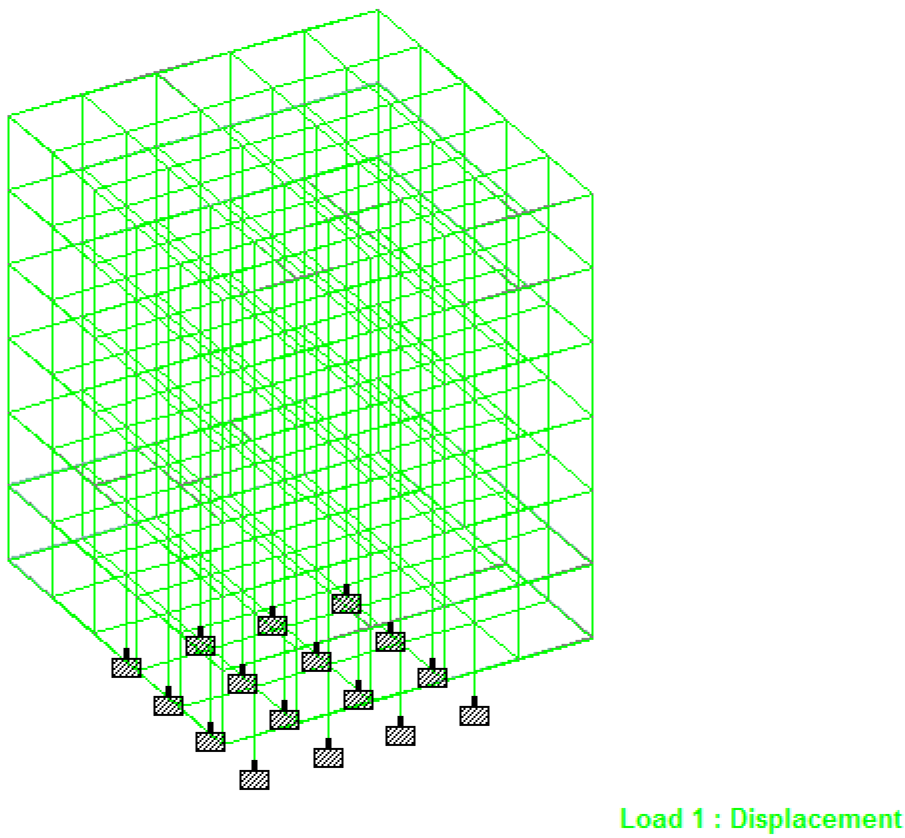


Fig 14- deflection diagram of G+6 structure

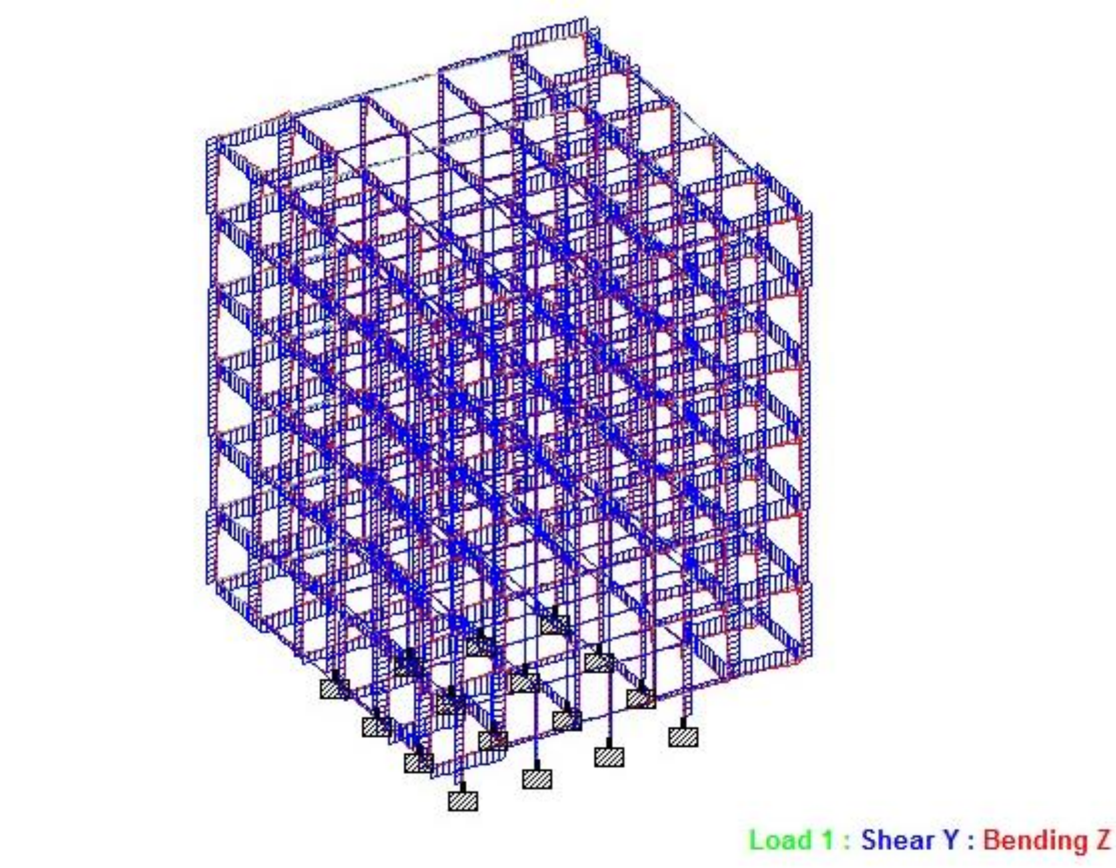


Fig 15- shear and bending diagram of G+6 structure

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STAAD.Pro Query Concrete Design

Beam no. 390

Design Code: IS-456

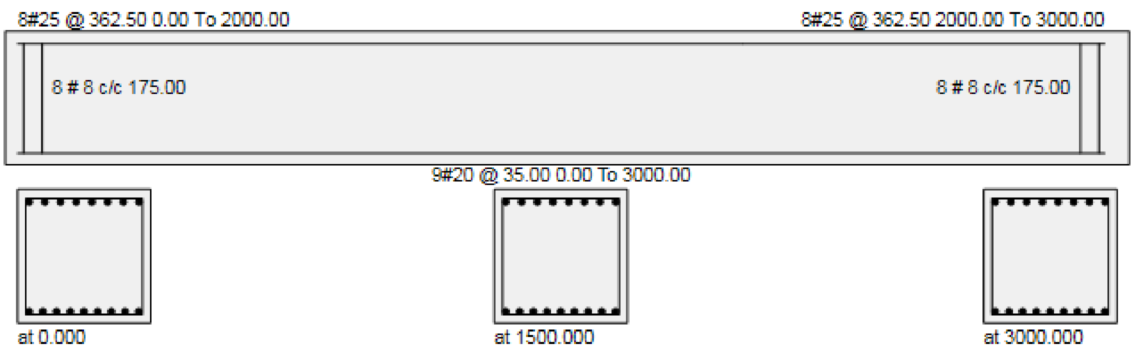
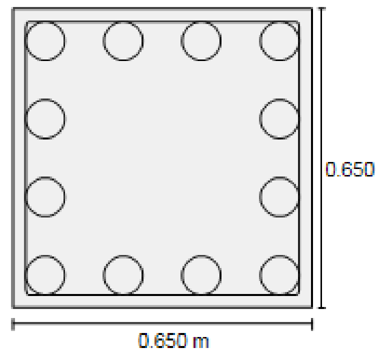


Fig 16-beam concrete design diagram of G+6 structure

STAAD.Pro Query   Concrete Design

Beam no. 345

Design Code: IS-456



Design Load

Load	1
Location	End 1
Pu(Kns)	1761.260010
Mz(Kns-Mt)	55.549999
My(Kns-Mt)	55.549999

Design Results

Fy(Mpa)	550
Fc(Mpa)	30
As Reqd(mm²)	1053.000000
As (%)	0.321000
Bar Size	12
Bar No	12

Fig 17- column concrete design diagram of G+6 structure

Isolated Footing 50

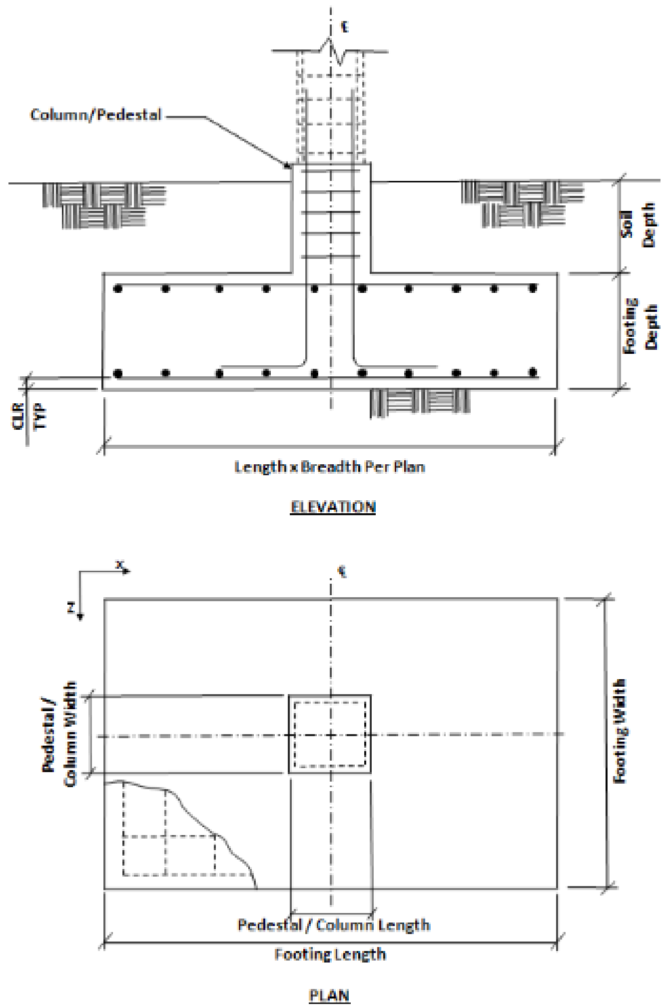


Fig 18- elevation and plan view of column design

CHAPTER 5

RESULTS AND DISCUSSION

5.1 INTRODUCTION

The main objective of this study is to evolve a new framework for multistory building designs with mechanistic approach. This chapter summarizes the findings / results and conclusions of the study and provides recommendations for further studies to extend the frontiers of knowledge in flexible pavement designs. The section presents the findings in relation to the study objectives, while the second section provides the study conclusions. The final section is devoted to the study's recommendations and areas for further research.

5.2 FINDINGS / RESULTS

The findings of the study are summarized as follows according to the objectives considered in the study:
The first objective of the thesis is "To earthquake analysis of multistory building with floating column designed as Per IS 1893 guidelines, using STAAD PRO V8i SS6". The findings of this objective are as follows:

1. STAAD PRO V8i analysis results shows that the multistory building design life get affected with the change in floating column building to normal multistory structure.

2. The deflection, bending moment is shown in fig.   respectively.

3. According to IS:1893:2002 (part I), maximum story shear calculated is 2805.1576 KN. Here, for 3 m height and load factor of 1.5, though maximum drift will be 15.7 mm.

4. It is observed from analysis results that considered drift values follow around similar path along storey height with maximum value lying somewhere near about the middle storey.

5. In the model drift value is higher for zone V because the magnitude of intensity will be the more for higher zones.

6. The storey drift is more for floating column buildings because as the columns are removed the mass gets increased and hence drift also increases.

7. According to IS 456:2000, maximum limit for lateral displacement is H/500, where H is building height. For 7 story building model it is 42 mm.

8. The displacement is more for floating column buildings because as the columns are removed the mass gets increased and hence displacement also increases.

9. In zone V 7 storey building model displacement values crosses the maximum permissible limits in case of without shear wall but it becomes safe in case of building models with shear wall.

10. In zone V 7 storey model is not safe without shear wall. Hence it is advised to increase size of column to reduce the displacement values.

11. According to IS:1893:2002 (part I), maximum base shear calculated is 2716.02 KN for G+6 story building.

5.3 CONCLUSIONS

This study mainly a Floating column building and then followed with the recommendations for a safe and economical design of a floating column building which can be defined as an earthquake resistant design i.e. to resist against the disaster like earthquakes and following conclusions are drawn from the analysis:
1. In the present study, it is observed that the Normal column building is more efficient having allowable displacements and storey drifts when compared with other models i.e. floating column buildings.

2. Similarly, when the floating column models are compared with each other, it is observed that the floating column building at one Edge column position has higher displacements and storey drifts followed by floating column at Centre portion and finally the floating column at the parallel positions.

3. The introduction of floating columns in the RC frames increases the time period of bare frames due to decrease in the stiffness.

4. The story drift and displacement was more for floating column buildings because as the columns were removed the mass gets increased and hence drift and displacement also increases.

5. The Increase in size of beams and columns improve the performance of building with floating column by

reducing the values of story displacement.

6. As we have done analysis for the v zone it is safe for the third and fourth zone also.

7. Finally, it is concluded that the After the analysis of building, it is found that quantity of steel and concrete have to increase in floating column building to keep it safe in earthquake excitation. So Floating column building becomes uneconomical as compare to normal building.

8. It is observed that bending moment in columns are greater in the top stories and lesser in the bottom stories. Bending moment varies in each model for every corner column, internal column and peripheral column.

9. By the lateral stiffness calculation at each floor for the structure it is observed that the building with floating column will make the soft storey effect very worse while the normal building without any floating columns have less soft storey effect. So the floating column building is unsafe.

10. The torsional effect in earthquake excitation is more in floating column building as compare to normal building, as a result overturning effect occurs in floating column building and structure becomes unsafe.

From the above analysis it is concluded that floating column building should not be prefer in severe seismic prone area. When we increase the sizes of beam and column than the structure gives more displacement in floating column building as compare to normal building. Due to increase in sizes the cost of construction increases so that the building with floating columns becomes uneconomical. So construction of floating column building should be avoided.

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