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Effects Of Wind And Seismic Analysis And Design Of Multistoried Residential Building Of (G+30) By Using ETABS

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ABSTRACT

It is the prime duty of a civil engineer to ensure safety to the life of occupants of a building by replacing conventional construction practices by modified techniques so that huge population can be accommodated in given area and large commercial space can be created in a confined area for upgrading the living environment. So it is important to replace conventional construction practices with modified one. In an RC building columns are the structural elements which are predominantly subjected to axial compressive forces, moments, and transfers total load from the super structure to substructure. In this study the behavior of a G+30 Buildings are designed as per IS: 456 and later subjected to earthquake loads & Wind loads.

ETABS stands for Extended Three dimensional Analysis of Building Systems. ETABS is commonly used to analyze: Skyscrapers, parking garages, steel & concrete structures, low and high rise buildings, and portal frame structures. Post analysis of the structure, maximum story drifts , Displacements, and maximum storey displacement are computed and then compared for all the analyzed cases.

Keywords-Structure Design, ETABS, High Rise Buildings.

INTRODUCTION

ESTIMATION OF WIND LOAD ON HIGH RISE BUILDING

Wind load on a high rise building can be determined by:

- Analytical Method given in the code IS 875: part 3-1987 which is given by A.G.Davenport. The analytical method is usually acceptable for a building with regular shape and size and is almost based on the geometric properties of the building and without incorporating the effects of the nearby buildings.
- The Estimation of Wind Load through Wind tunnel testing with a scaled building model used. In Wind Tunnel Testing for the structural design the Dynamic analysis of the scaled model building is done with design. The Surface Pressure Measurement analysis with Pressure Measurement system is done. Also the effects of the nearby buildings have been taken into consideration as the Interference effects on the buildings in a same procedure being used for an Isolated building model.

1.1 DYNAMIC EFFECTS OF WIND

Flexible slender structures and structural element s shall be investigated to as certain the importance of wind induced oscillations or excitations along and across the direction of wind. In general, the following guidelines may be used for examining the problems of wind induced oscillations:

- Buildings and closed structures with a height to minimum lateral dimension ratio of more than about 5.0.
- Buildings and closed structures whose natural frequency in the first mode is less than1.0 Hz.

Any building or structure which satisfy either of the above two criteria shall be examined for dynamic effects of wind.

1.2 IMPORTANCE OF WIND LOAD ON HIGH RISE BUILDINGS

High rise buildings are defined as structures utilized by the people as shelter for living, working or storage. As now a days there is shortage of land for building more buildings at a faster growth in both residential and industrial areas the vertical construction is given due importance because of which high rise buildings are being build on a large scale.
Wind in general has two main effects on the High rise buildings:

- Firstly it exerts forces and moments on the structure and its cladding.
- Secondly it distributes the air in and around the building mainly termed as Wind Pressure.

Sometimes because of unpredictable nature of wind it takes so devastating form during some Wind Storms that it can upset the internal ventilation system when it passes into the building. For these reasons the study of air -flow is becoming integral with the planning a building and its environment.

1.3 WIND DIRECTIONALITY FACTOR

The factor recognizes the fact of (i) reduced probability of maximum winds coming from any given direction (ii) reduced probability of the maximum pressure coefficient occurring for any given wind direction. This factor has not been included in the 1987 version of the Code. Some of the other Codes (ASCE/Australian) give varying values of the factor for different situations based on a more detailed study of wind directionality. A flat value of 0.9 has been used in the present revision except for circular, near – circular and ax symmetric sections which offer a uniform resistance, irrespective of the direction of wind. These have been assigned a value of 1.0 for the factor Kd.

1.4 Earthquake

Rocks are made of elastic material, and so elastic strain energy is stored in them during the deformations that occur due to the gigantic tectonic plate actions that occur in the Earth. But, the material contained in rocks is also very brittle. Thus, when the rocks along a weak region in the Earth's Crust reach their strength, a sudden movement takes place there opposite sides of the fault (a crack in the rocks where movement has taken place) suddenly slip and release the large elastic strain energy stored in the interface rocks. The sudden slip at the fault causes the earthquake - a violent shaking of the Earth when large elastic strain energy released spreads out through seismic waves that travel through the body and along the surface of the Earth. And, after the earthquake is over, the process of strain build-up at this modified interface between the rocks starts all over again. Earth scientists know this as the Elastic Rebound Theory. The material points at the fault over which slip occurs usually constitute an oblong three-dimensional volume, with its long dimension often running into tens of kilometers.

1.5 Seismic Zones of India

The varying geology at different locations in the country implies that the likelihood of damaging earthquakes taking place at different locations is different. Thus, a seismic zone map is required to identify these regions. Based on the levels of intensities sustained during damaging past earthquakes, the 1970 version of the zone map subdivided India into five zones – I, II, III, IV and V. The seismic zone maps are revised from time to time as more understanding is gained on the geology, the seismic tectonics and the seismic activity in the country. The Indian Standards provided the first seismic zone map in 1962, which was later revised in 1967 and again in 1970.

The map has been revised again in 2016, and it now has only four seismic zones – II, III, IV and V.

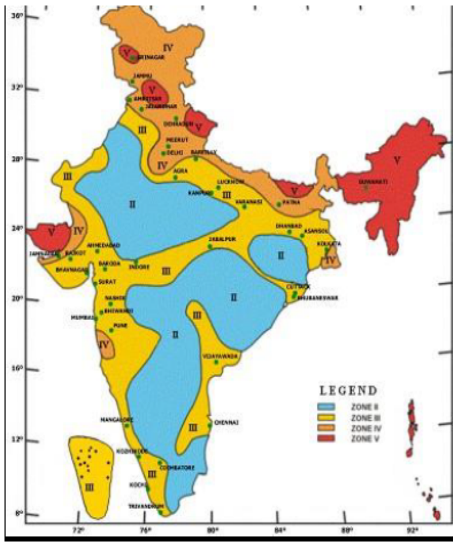


Figure 1.2: Seismic Zoning Map of India

1.6 Indian Seismic Codes

Seismic codes are unique to a particular region or country. They take into account the local seismology, accepted level of seismic risk, building typologies, and materials and methods used in construction. Further, they are indicative of the level of progress a country has made in the field of earthquake engineering. The first formal seismic code in India, namely IS 1893, was published in 1962. Today, the Bureau of Indian Standards (BIS) has the following seismic codes:

- IS 1893 (Part I), 2016, Indian Standard Criteria for Earthquake Resistant Design of Structures (6th Revision)
- IS 4326, 1993, Indian Standard Code of Practice for Earthquake Resistant Design and Construction of Buildings (2nd Revision)
- IS 13827, 1993, Indian Standard Guidelines for Improving Earthquake Resistance of Earthen Buildings.
- IS 13828, 1993, Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings.

- IS 13920, 1993, Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces

Buildings constructed in India can be broadly categorized into three groups

- Buildings designed for gravity loads without considering seismic forces
- Buildings properly designed with ductile detailing as per seismic guidelines,
- Buildings designed as per Indian codes but not detailed for ductility.

Although some structures are designed without consideration of lateral loads, they still possess an inherent lateral strength which may be capable of resisting some minor and moderate earthquakes. However the deficient detailing of members can lead to inadequate structural performance during seismic activity.

The code of practice for seismic analysis IS: 1893:2016 has been revised to reflect the increased seismic demand in many parts of the country. Many existing buildings lack the seismic strength and detailing requirements of IS 1893:2016, IS 4326:1993 and IS 13920: 1993, because they were built prior to the implementation of these codes.

The last decades have seen an increased interest in seismic performance of existing building designed for gravity loads. First of all, it is necessary to address a large population of structures with different characteristics and built with different techniques. Second, there is often lack of information on the geometry, the material properties, the reinforcement etc. Finally, the past history (earthquakes, time dependent deformation etc.) of an existing building may have reduced its seismic resistance.

LITERATURE REVIEW

Y. Singh &PhaniGade (2011): This paper presents some observations about seismic behavior of hill buildings during the Sikkim earthquake of September 18, 2011. An analytical study is also performed to investigate the peculiar seismic behavior of hill buildings.Dynamic response of hill buildings is compared with that of regular buildings on flat ground in terms fundamental period of vibration, pattern of inter-storey drift, column shear, and plastic hinge formation pattern. The seismic behavior of two typical configurations of hill buildings is investigated using linear and non-linear time history analysis. It is observed that hill buildings have significantly different dynamic characteristics than buildings on flat ground. The storey's immediately above the road level, in case of down-hill buildings, are particularly vulnerable to earthquake action. The analytical findings are corroborated by the damage pattern observed during Sikkim earthquake.

UmakantArya ,AslamHussain , Waseem Khan (2014) the effect of wind velocity and structural response of building frame on sloping ground has been studied. Considering various frame geometries and slope of grounds. Combination of static and wind loads are considered. For combination, 60 cases in different wind zones and three different heights of building frames are analyzed. STAAD-Pro v8i software has been used for analysis purpose. Results are collected in terms of axial force, Shear force, moment, support reaction, Storey-wise drift and Displacement which are critically analyzed to quantify the effects of various slope of ground.

METHODOLOGY

3.1 GENERAL

This standard gives wind forces and their effects (static and dynamic) that should be taken into account when designing buildings, structures and components thereof.

The wind load on a building shall be calculated for:
a) The building as a whole.
b) Individual structural elements as roofs and walls.
c) Individual cladding units including glazing and their fixings.
When calculating the wind load on individual structural elements such as roofs and walls, and individual cladding units and their fittings, it is essential to take account of the pressure difference between opposite faces of such elements or units. For clad structures, it is, therefore, necessary to know the internal pressure as well as the external pressure.
Then the wind load, F, acting in a direction normal to the individual structural element or cladding unit is:
F=(Cpe-Cpi) A Pd
where
Cpe = external pressure coefficient,
Cpi = internal pressure- coefficient,
A = surface area of structural element or cladding unit,
Pd = design wind pressure.
If the surface design pressure varies with height, the surface areas of the structural element may be sub-divided so that the specified pressures are taken over appropriate areas. Positive wind load indicates the force acting towards the structural element and negative away from it.
Wind is air in motion relative to the surface of the earth. The primary cause of wind is traced to earth's rotation and differences in terrestrial radiation. The radiation effects are primarily responsible for convection either upwards or downwards. The wind generally blows horizontal to the ground at high wind speeds. Since vertical components of atmospheric motion are relatively small, the term 'wind' denotes almost exclusively the horizontal wind, vertical winds are always identified as such. The wind speeds are assessed with the aid of anemometers or anemographs which are installed at meteorological observatories at heights generally varying from 10 to 30 metres above ground.
The buildings/structures are classified into the following three different classes depending upon their size:
Class A - Structures and/or their components such as cladding, glaxing, roofing, etc, having maximum dimension (greatest horizontal or vertical dimension) less than 20 m.
Class B - Structures and/or their components such as cladding, glazing, roofing, etc, having maximum dimension' (greatest horizontal or vertical dimension) between 20 and 50 m.
Class C - Structures and/or their components such as cladding, glazing, roofing, etc, having maximum dimension (greatest horizontal or vertical dimension) greater than 50 m.

NATURE OF WIND IN ATMOSPHERE

In general, wind speed in the atmospheric boundary layer increases with height from zero at ground level to a maximum at a height called the gradient height. There is usually a slight change in direction (Ekman effect) but this is ignored in the Code. The variation with height depends primarily on the terrain conditions. However, the wind speed at any height never remains constant and it has been found convenient to resolve its instantaneous magnitude into an average or mean value and a fluctuating component around this average value. The average value depends on the averaging time employed in analyzing the meteorological data and this averaging time can be taken to be from a few seconds to several minutes. The magnitude of fluctuating component of the wind speed, which represents the gustiness of wind, depends on the averaging time. Smaller the averaging interval, greater is the magnitude of the wind speed.

3.3 TERRAIN AND HEIGHT FACTOR

Selection of terrain categories shall be made with due regard to the effect of obstructions which constitute the ground surface roughness. The terrain category used in the design of a structure may vary depending on the direction of wind under consideration. Wherever sufficient meteorological information is available about the wind direction, the orientation of any building or structure may be suitably planned.

3.4 DESIGN WIND SPEED (VZ)

The basic wind speed (Vb) for any site shall be obtained and shall be modified to include then following effects to get design wind velocity at any height (Vz) for the chosen structure:

a) Risk level
b) Terrain roughness, height and size of structure
c) Local topography

.It can be mathematically expressed as follows:
where
Vz, = Vb k1k2k3
Vz = design wind speed at any height z in m/s;
k1 = probability factor (risk coefficient)
k2 = terrain, height and structure size factor.
K3 = topography factor

Basic wind speed at 10 m for hight for some important cities/town:

Cities Speed	Basic Speed(m/s)	Cities Speed	Basic Speed(m/s)
Cuttack	50	Pune	39
Agra	47	Jhansi	47
Durbhanga	55	Raipur	39
Ahmadabad	39	Jodhpur	47
Darjeeling	47	Rajkot	39
Ajmer	47	Kanpur	47
Dehra dun	47	Ranchi	39
Alomar	47	Kohima	44
Delhi	47	Roorkee	39
Amritsar	47	Kurnool	39
Alanson	47	Rourkela	39
Gauhati	50	Srinagar	39
Bahraich	47	Ludhina	47
Gaya	39	Surat	44
Bangalore	33	Madras	50
Gorakhpur	47	Tiruchchirappalli	47
Varanasi	47	Madurai	39
Hyderabad	44	Trivandrum	39
Bareilly	47	Mandi	39
Impale	47	Udaipur	47
Bhatinda	47	Mangalore	39
Jabalpur	47	Vododara	44
Bhalali	39	Moradabad	47
Jaipur	47	Varanasi	33
Bhopal	39	Mysore	50
Jamshedpur	47	Vijayawada	50
Bhuvaneshwar	50	Nagpur	44
Bhuj	50	Vishakhapatnam	50
Bikaneer	47	Nainital	47

Design wind pressure

The design wind pressure at any height above mean ground level shall be obtained by the following relationship between wind pressure and wind velocity:

Pz = 0.6Vz2
where
Pz= design wind pressure in N/ms at height z,

Vz - design wind velocity in m/s at height z.

Pressure coefficient

The pressure coefficients are always given for a particular surface or part of the surface of a building. The wind load acting normal to a surface is obtained by multiplying the area of that surface or its appropriate portion by the pressure coefficient (Cp) and the design wind pressure at the height of the surface from the ground. Average values of pressure coefficients are given for critical wind directions in one or more quadrants. In order to determine the maximum wind load on the building, the total load should be calculated for each of the critical directions shown from all quadrants. Where considerable variation of pressure occurs over a surface, it has been sub divided and mean pressure coefficients given for each of its several parts.

ANALYSIS DESIGN

Site selection has an important bearing on planning and designing of buildings. Generally, therefore an architect has either to make a choice of suitable site or to plan his building structure to suit the available site. Natural defects of a site will involve considerable expenditure on construction and maintenance of the building.

1. A site which comes within the limits of an area where the by-laws of the local authority enforce restrictions regarding proportions of plots to built up, vacant spaces to be left in front and sides, heights of buildings etc. should be preferred.
2. The site should be situated on an elevated place and also leveled on with uniform slopes from one end to the other so as to provide good and quick drainage of rain water.
3. The soil surface of the site should be good enough to provide economical foundations for the intended building without causing any problem. Generally for most satisfactory instructions, the site should have rock, sand or firm soil below 60 to 120cm. layer of light or even black cotton soil.

MODELLING OF G+30 STORIED BUILDING

4General

In this study, analysis is made for multi-storied G+30 building. These are designed as per IS:456 and later subjected to earthquake loads & Wind load.

Overview of Software (Etabs)

The analysis model of the case study building was constructed in extended 3D Analysis of Building Systems (ETABS), version 17.0.1(Computers and Structures, Inc, 2017). ETABS is finite element analysis software which is specifically designed for high-rise building analysis. The initial model of the building is given by Tyrens, and then modifications to the model are carried out. Both static analysis and dynamic analysis are performed by the ETABS program using the finite element analysis method. Finite element method (FEM) is a numerical technique for finding approximate solutions to boundary value problems for differential equations. It uses variation methods to minimize an error function and produces a stable solution.

Finite element method in structural engineering analysis is to divide the structural components into small elements and connect them through notes. Each simple element will be solved with individual equations and then all the elements from each sub domain will be used to approximate a more complex equation and be solved over a larger domain. The number of elements is determined depending on the need for accuracy and the similarity to the actual behavior of the components. Therefore, the results from the finite element analysis are the only approximation to the actual results.

In the ETABS program, the elements that are used in the finite element analysis progress are defined by 'meshing' of the structural components. With the mesh function in the program, one can determine both the size and number and even geometrical shape of the elements to make sure the analysis can reflect the right behavior of the structure with reasonable accuracy. The program also provides an 'Auto mesh' function which automatically determines the mesh by given input.

Design Considerations

In order to understand the behavior of the bare frame, shear wall and steel bracing concrete frame, RC bracing concrete frame, a 31-storey frame with the typical plan is considered for the present study. Plan, Elevation and 3D view of the frame models considered for the study are shown in below Figures.

FINITE ELEMENT METHOD (FEM)

The Finite Element Method (FEM) is a numerical technique to find approximate solutions of partial differential equations. It was originated from the need of solving complex elasticity and structural analysis problems in Civil, Mechanical and Aerospace engineering. In a structural simulation, FEM helps in producing stiffness and strength visualizations. It also helps to minimize material weight and its cost of the structures. FEM allows for detailed visualization and indicates the distribution of stresses and strains inside the body of a structure.

Many of FE software are powerful yet complex tool meant for professional engineers with the training and education necessary to properly interpret the results. Several modern FEM packages include specific components such as fluid, thermal, electromagnetic and structural working environments. FEM allows entire designs to be constructed, refined and optimized before the design is manufactured.

This powerful design tool has significantly improved both the standard of engineering designs and the methodology of the design process in many industrial applications. The use of FEM has significantly decreased the time to take products from concept to the production line. One must take the advantage of the advent of faster generation of personal computers for the analysis and design of engineering product with precision level of accuracy.

Modelling of Structure in Etabs

Step By Step Procedure

1) Open the ETABS program.
2) Check the units of the model in the drop-down box in the lower right-hand corner of the ETABS window, click drop-down box to set units to kN-m
3) Click the File menu > New model command.
4) Set the options according to IS codes. Fig 4.5 shows the model initialization

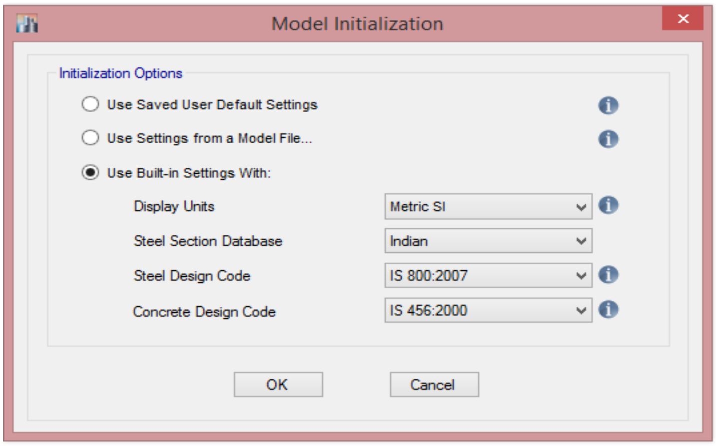
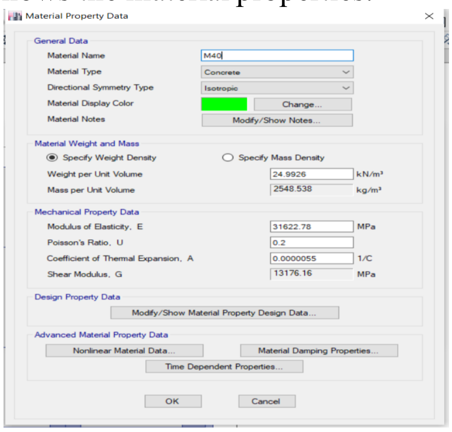


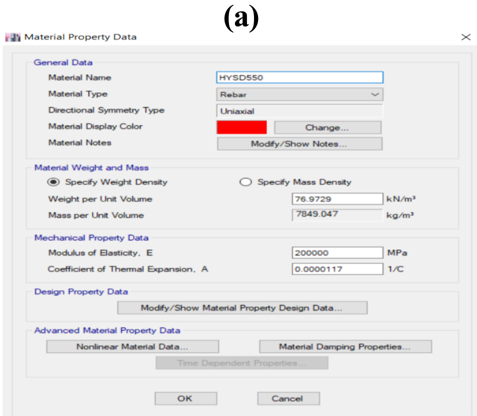
Figure 4.5 Model Initialization

5) The next form of Building plan grid system and story data definition will be displayed. Set the grid line and spacing between two grid lines. Set the story height data using Edit Story Data Command as per model to be generated.
6) Click the Define menu > Material Properties

Add New Materials or Modify/Show Material used to define material properties. Define M30 concrete and HYSD415. Fig 4.6 shows the material properties.



(a)



(b)

Figure 4.6 Defining Material Properties

7) Define section columns and beams using Define > Frame section

Define Beam sizes and Column sizes and used two options Reinforcement checked or designed. Fig 4.7 and 4.8 shows the defining of beam and column sections.

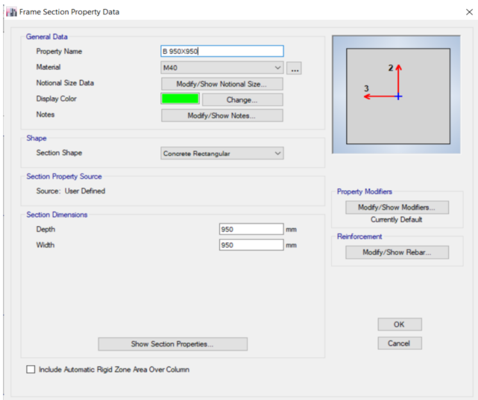


Figure 4.7 Defining Beam section 950mmX950mm

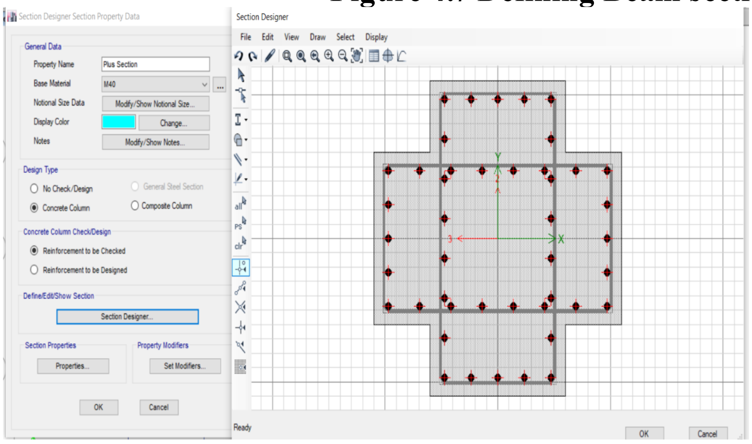


Figure 4.8 Defining Column in section designer

8) Define Slab. Fig.4.9 shows the slab properties.

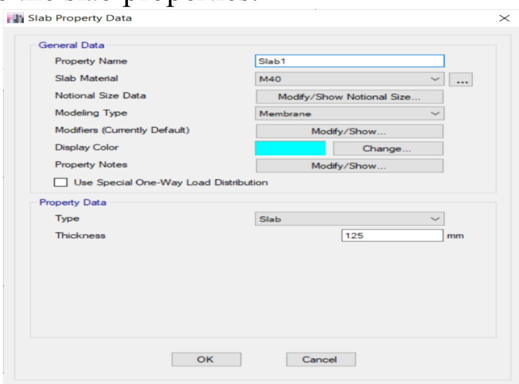


Figure 4.9 Defining Slab

9) Define various loads (Dead load, Live load)

Dead load: Self weight multiplier is used 1 to calculate dead load as default.
Live load: Self weight multiplier is used 0.25 as per IS Code 1893:2002 (Table 8). Fig 4.10 shows the mass source data.

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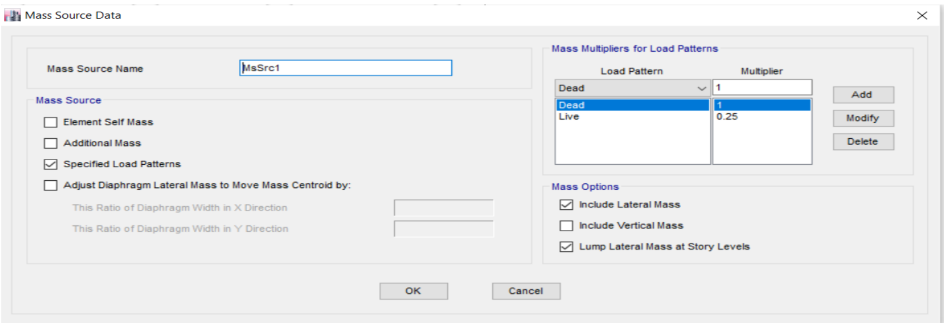

Figure 4.10 Defining Mass Source Data

Select the frame elements and Assign > Frame loads > distributed

Assign the dead load as calculated. Fig 4.11 shows the assigning of frame loads

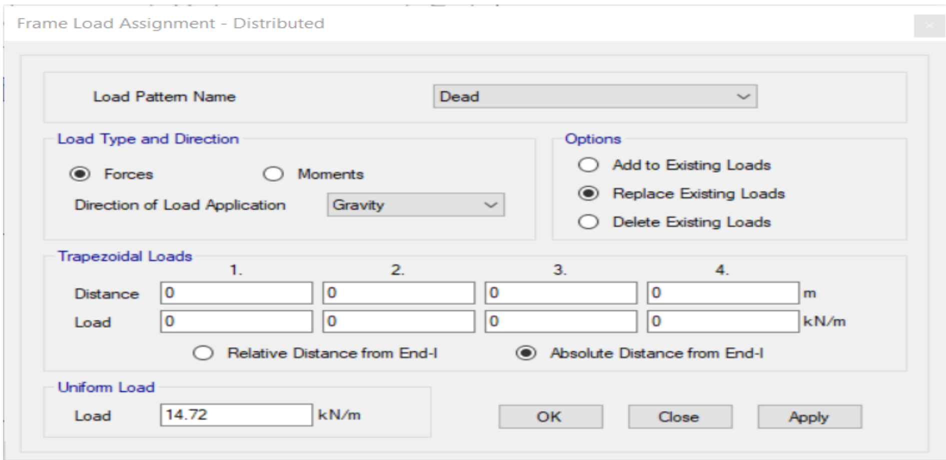

Figure 4.11 Assigning Frame Loads

Select the Slab elements and Assign > shell loads > Distributed. Fig 4.12 shows the assigning of shell loads.

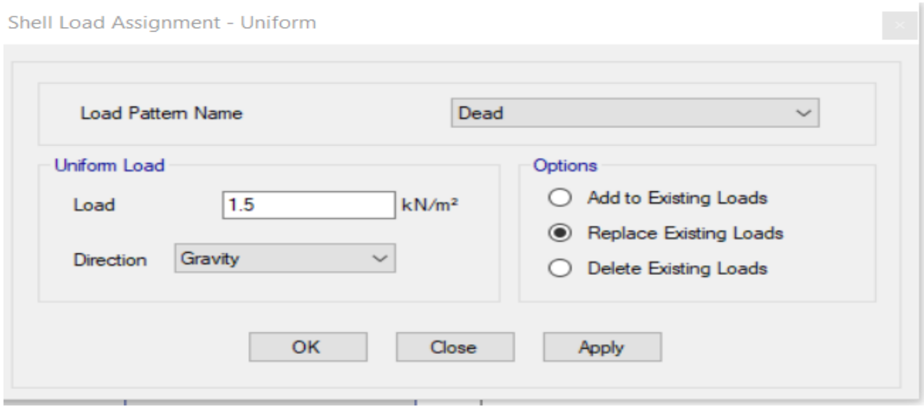

Figure 4.12 Assigning Shell Loads

10) Assign Fixed Support condition

Drop-down box in the lower right-hand corner of ETABS window, select only bottom single storey level to assign fixed support using Assign > Joint/point > Restrain (support) command. Fig 4.13 shows the assigning of joint constraints.

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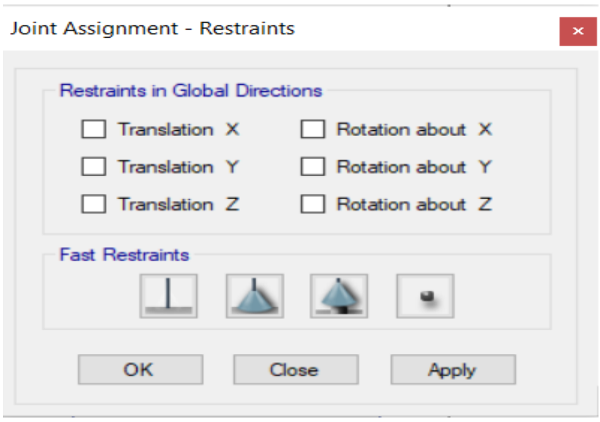


Figure 4.13 Joint Restraints

11) In building, slab is considered as a simple rigid member during earthquake analysis. For that, all slabs are selected first and apply diaphragm action for rigid condition.

- **Equivalent static analysis**

i. Click on Unlock Model button.

Click on "OK" to confirm to unlock the model and delete all analysis results.

- Go to Define > Load patterns > Load > EQX > Type> seismic > Auto lateral load > IS1893-2016> and click on "Add new load" and give the required data. Fig. 4.20 shows the data required.

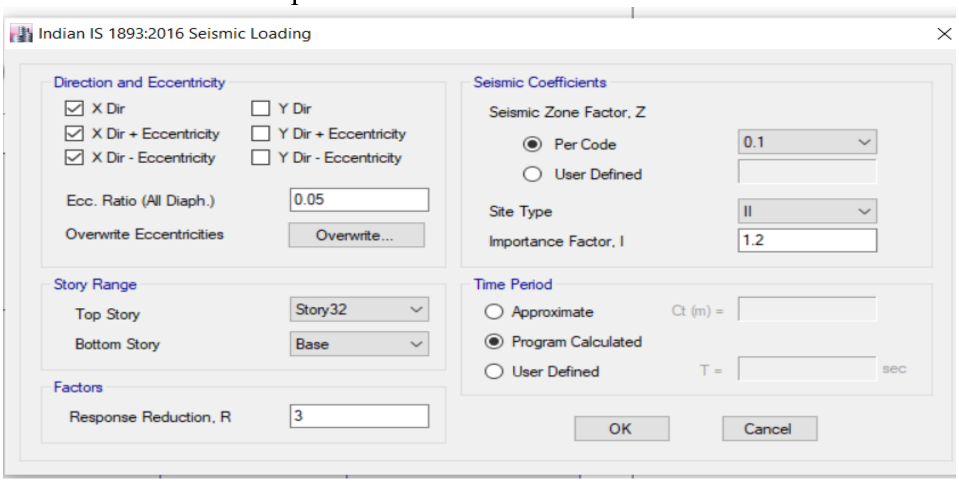


Figure 4.14: EQ-X Seismic Load Pattern Data

- Similarly Do the same for EQ-Y Seismic Load Pattern Data
- Analyze>Set load case to Run > click on "Run analysis".

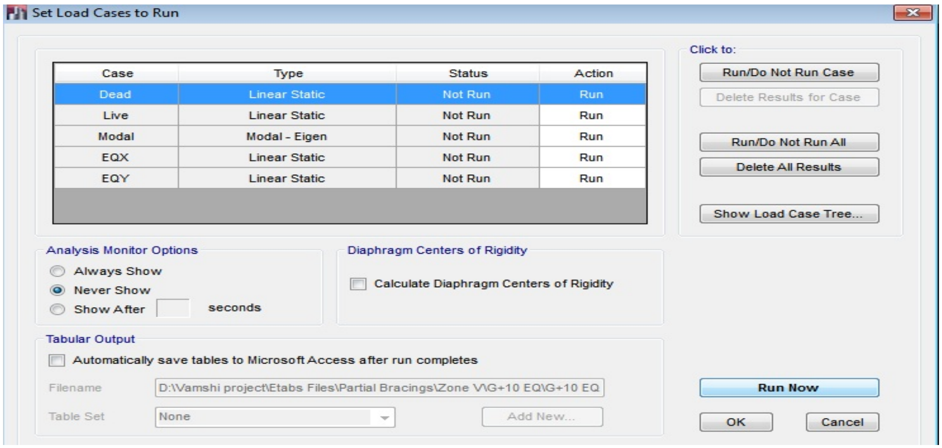


Figure 4.15: Set Load Cases to run for EQ-X and EQ-Y Loads

- Check the Results.

4.5 Closure

In this chapter the details of the structure geometry, material properties, sectional properties and other input data in the analysis of the system has been discussed. The following chapter includes the observation and discussions derived for the above analysis.

The dimensions of the cross section are to be assumed initially which enable to estimate the dead load from the known weights of the structure. The values of the unit weights of the structure and the values of the unit weight of the materials are specified in IS 875:1987(Part-I). As per IS 875: 1987 (part I). The dead load assigned in the ground floor.

LOAD CALCULATIONS

- Unit weight of brick = 19.1 kN/m
- Unit weight of concrete = 25kN/m Here sample calculation is done:

1.1.1. Wall load

1 Main wall load Thickness of wall = 150 mm

2. unit weight of brick x thickness of wall x(floor height –beam depth)

=19.1 x 0.150 x (3 -0.45)

3. 7.305 kN/m

2 Partition wall load

Thickness of wall = 100 mm

1 19.1 x 0.10 x (3 -0.45)

2 4.875 kN/m

5. Parapet wall load

Thickness of wall = 100 mm

1. 19.1 x 0.10 x 1.5
2. 2.865 kN/m

1.1.2. Dead Load

Floor finish = 1.25kN/m (as per IS 875 part 1)

Total floor load = 1.25 kN/m

1.1.3. Floor Finish Load (Super Dead)

1.1.4. Live loads

They are also known as imposed loads and consist of all loads other than the dead loads of the structure. The standard values are stipulated in IS875:1987 (part II).The live loads considered are given in table. The assigned live load on ground floor in Etabs will be as shown in the figure 5

Area	Live load (kN/m^2)
All rooms and kitchens	2
Toilet and bathrooms	2
Corridors, Passages, Staircases	3
Balconies	3
Parking	5
Electrical Room	5
Machine room	5

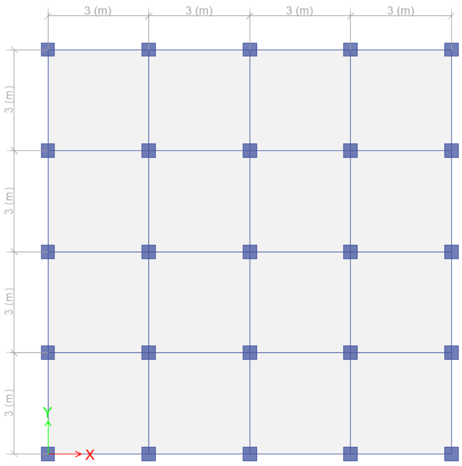
LOAD COMBINATIONS

Design of the structures would have become highly expensive in order to maintain either serviceability and safety if all types of forces would have acted on all structures at all times. Accordingly the concept of characteristics loads has been accepted to ensure at least 95 percent of the cases, the characteristic loads are to be calculated on the basis of average/mean load of some logical combinations of all loads mentioned above.

IS 456:2000, IS 875:1987 (Part-V) and IS 1893(part-I):2002 stipulates the combination of the loads to be considered in the design of the structures. The different combinations used are:

All these combinations are built in the Etabs 2015. analysis results from the critical combinations are used for the design of structural member.

DL - Dead load
LL - Live load
EL - Earthquake load in x direction x
EL - Earthquake load in z direction z



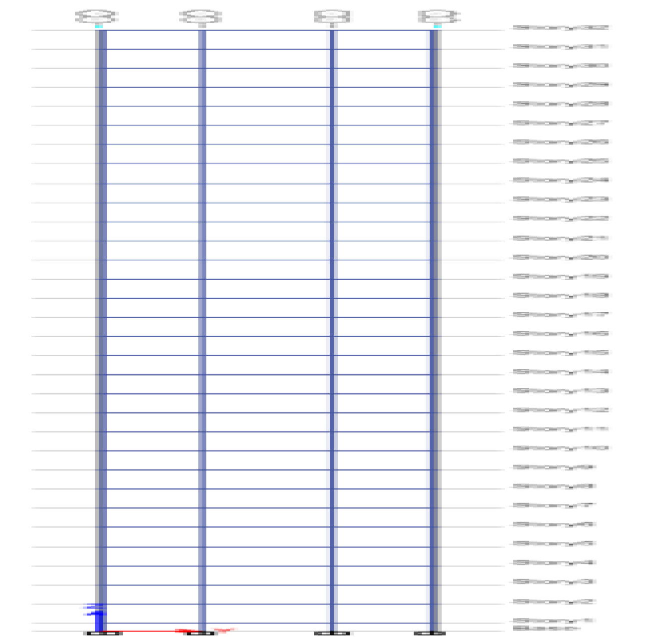
PLAN VIEW

PRELIMINARY DATA:

Type of frame :Ordinary RC moment resisting frame fixed at the base

Seismic zone	:II
Number of storey's	:30
Floor height	:3 m
Plinth height	:1.5 m
Depth of Slab	:125 mm
Spacing between frames	:3m along both directions
Live load on floor level	:3kN/m^2
Live load on roof level	:1.5kN/m^2
Floor finish	:1.0kN/m^2
Terrace water proofing	:1.5kN/m^2
Materials	:M 25 concrete, Fe 500 steel and Brick infill
Thickness of infill wall	:230mm (Exterior walls)
Thickness of infill wall	:150 mm (Interior walls)
Density of concrete	:25kN/m^3
Density of infill	:20kN/m^3
Type of soil	:Rocky
Response spectra	:As per IS 1893(Part1):2002
Wind load	: As Per IS 875 Part II
Damping of structure	:5 %

**Live load on floor level and roof level are taken from IS-875 (Part-) considered RC framed buildings as residential usage



Elevation of buildings

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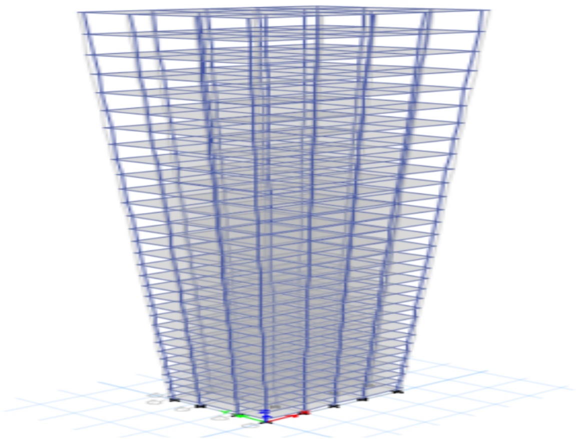


3D model

RESULTS AND DISCUSSIONS

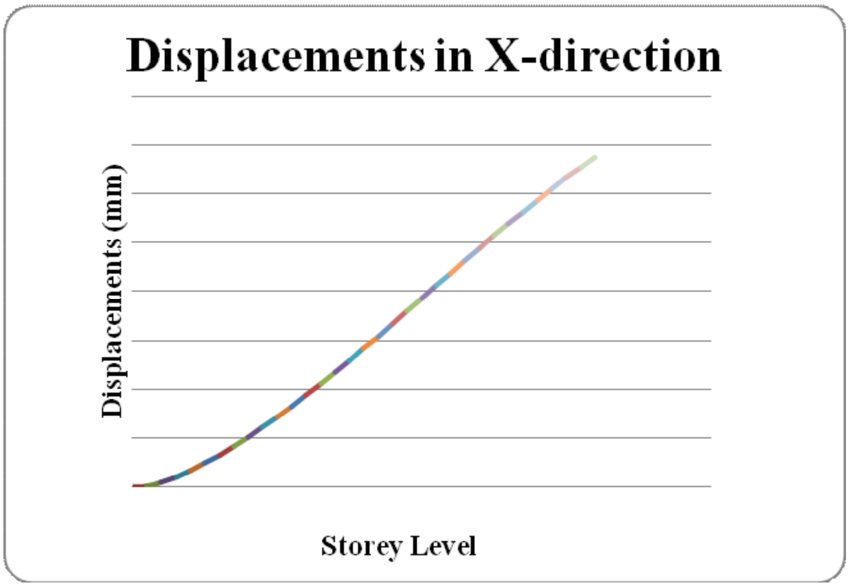
5.1 GENERAL

This chapter discusses the results obtained in the present work. To understand the static behavior of G+30 structures for RC Framed building, the building models have been subjected to dead load, live load, seismic load , wind loads and load combinations and their responses are studied. The results obtained from the analysis are represented by tables and graphs and also plane ground.

Storey displacements

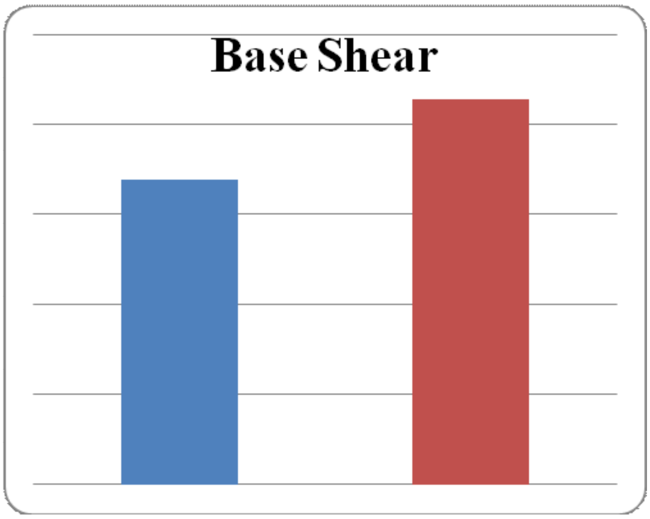
From the analysis, maximum displacement and story drift values are evaluated for the models.

Storey's	Building without Shear wall
Story32	0.000557
Story31	0.000574
Story30	0.000593
Story29	0.00061
Story28	0.000626
Story27	0.00064
Story26	0.000652
Story25	0.000663
Story24	0.000671
Story23	0.000677
Story22	0.00068
Story21	0.000682
Story20	0.000681
Story19	0.000678
Story18	0.000673
Story17	0.000666
Story16	0.000656
Story15	0.000644
Story14	0.000629
Story13	0.000613
Story12	0.000594
Story11	0.000572
Story10	0.000549
Story9	0.000523
Story8	0.000495
Story7	0.000464
Story6	0.000431
Story5	0.000395
Story4	0.000355
Story3	0.000305
Story2	0.000214
Story1	6.50E-05
Base	0



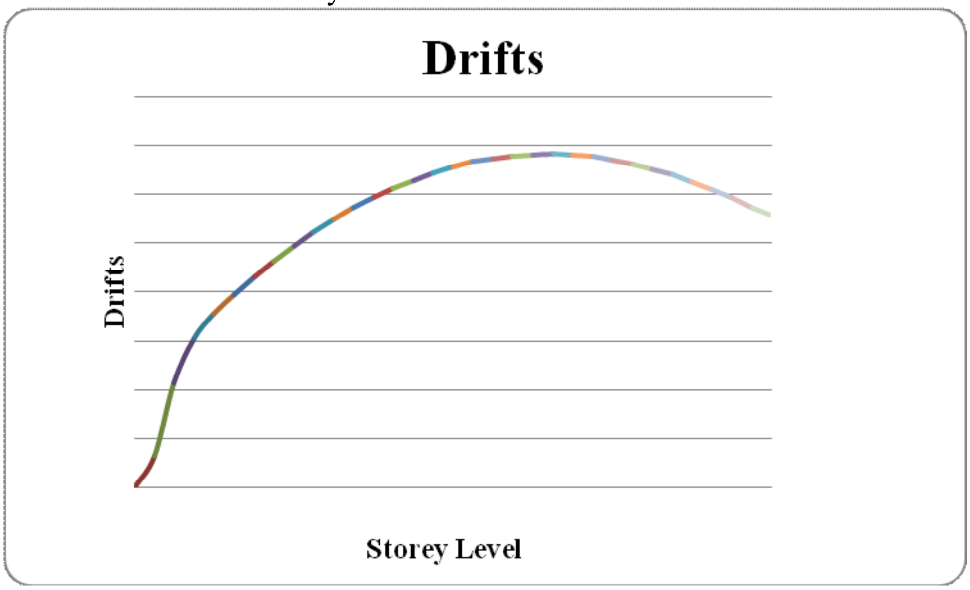
Variation of displacements

Base Shear (kN)



Storey drifts

Story drift is expressed as the difference of the deflections at the top and bottom of the story under consideration: this is also often expressed as a ratio between the deflection and the story, or floor-to-floor height. Drift limits serve to prevent possible damage to interior or exterior walls that are attached to the structure and which might be cracked or distorted if the structure deflects too much laterally.



CONCLUSION

6.1 General

In this thesis, an attempt has been made to study the effect of specially RC Framed structures .Reinforced Columns without shear wall as shown in the elevation plan on the seismic analysis and wind load of RC building. To achieve this objective of the study, building with different loads were assumed for the study. Gravity (Self weight, dead and imposed loads wind load) and Seismic load corresponding to Seismic Zone II of IS 1893 (part 1): 2016 are considered for the analysis. The two building models are analyzed in Etabs software and the following conclusions are drawn:

6.2 Conclusions

- The study clearly helps us to understand the significant difference between the seismic behavior of buildings.
- The value of dead, live and floor finish loads obtained by the ETABS program are similar to the manually calculated values
- The analysis results of the structural integrity of building in withstanding the design earthquake loadings were conducted and were judged to be safe.
- Various important results like Displacements, story drift and base shear results are nearly similar to the manually calculated values.
- The story drift increases from top story to bottom story in both zone4 and zone5 at story 31 the drift is maximum as compared to other stories
- The story shear is maximum for the moments as we compared with the forces in all stories.
- The Z direction force for support reactions has maximum value as we compared with X direction and Y direction support reactions.
- The X direction moment for support reactions has maximum value as we compared with Y direction moment and Z direction

Scope of Future Work
This thesis is limited to inclusion of specially shaped columns and shear walls
The following are few recommendations for further study:

- ➢ Member forces for the same structure can be checked and compared for better understanding.
- ➢ It would be useful to examine the seismic behaviour of the existing structures with shear walls as strengthening or retrofitting technique.

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