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PARAMETRIC STUDY ON VERTICAL IRREGULAR HIGH RISE REINFORCED CONCRETE FRAMED BUILDING

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Abstract- *Now a days, unsymmerical building plans are frequently constructed for artistic intention. These building comprises of irregularities which leads discontinuity in mass, geometry and stiffness of structure , which tends to destruction during earthquake. In the present work an endeavour has been made to study the dynamic behaviour of regular building and building with different vertical irregular buildings using equivalent static analysis method. Analysis of building has been carried out using ETABS software*.

Key Words: Vertical irregularities, Storey Height, Base Shear, Lateral Displacement, Equivalent static analysis.

1.INTRODUCTION

Multi storey buildings are the compound system and multiple items have to be considered during scheduling and scheming of them. It has been found that regular shaped buildings perform better during earthquakes. The structural irregularities cause non-uniform load distribution in various members of a building. There must be a continuous path for these inertial forces to be carried from the ground to the building weight locations. A gap in this transmission path results in failure of the structure at that location.

1.1 EQUIVALENT STATIC ANALYSIS

The seismic design of buildings includes dynamic nature of the loads. This method accounts for only one mode of vibration in each direction during earthquake.

2. OBJECTIVES OF STUDIES

To study the effect of vertical irregularity i.e. vertical geometric irregularity and stiffness irregularity in high rise buildings under severe seismic zone considering parameters like displacement, storey drift, time period and base shear.

3. SELECTION OF THE STRUCTURE

Site location & structural system

The buildings are designed as special moment resisting frame based on Indian Standard code & is analysed by using ETABS software.

Table 3.1 Structural System Details

Type of building	20 storied RC building
Grid spacing	Uniform-6m in x & y direction
Total dimension	36m in each x & y direction
Grid height for base	2m
Grid height for typical storey	3m
Overall height	59m
Type of occupancy	Hotel
Shape of the building	Rectangle regular & vertical irregular
No. of stories	20 stories

Material properties of the structure

The material properties considered for the investigation are given in table underneath.

Table 3.2 Material Properties Details

Grade of concrete	M35(f_{ck})
Grade of steel for main reinforcement	Fe 500
Grade of steel for shear reinforcement	Fe 415
Poisson's ratio	0.2
Damping ratio	5%
Modulus of elasticity	5000*√(f_{ck})

Consideration of loads

The load acting on multi-storeyed building are grouped into two groups

- Gravity load & live loads
- Dynamic load

Table 3.3 Dead & Live Load Details

Self-weight	Considered
Super dead load	1.5 KN/m^2
Live load(Reducible)	4 KN/m^2
Wall load (KN/m)	Considered for only peripheral beams of the structure.

Earthquake load is considered as per code 1893:2002 (part 1) are given in below table.

Table 3.4 Earthquake load details

Earthquake loads -ESA	Mass source is considered
Zone factor	0.24 (zone IV)
Importance factor	1.0
Response reduction factor	5.0(SMRF)
Soil condition	Medium soil
Damping	5%

Physical properties of the members

Table 3.5 members size details

Members	**Size**
Columns for all the floors	600x600
Beams for all the floors	300x600
Slabs for all the floors	150mm thick

4. MODELLING AND ANALYSIS OF BUILDING

For the analysis work, 4 models of high rise RC frame building (G+19) storey for medium soil of regular building and building with different vertical irregular buildings are made to known the practical behaviour of building during earthquake. The parameters considered are lateral displacement, storey drift, time period and base shear.

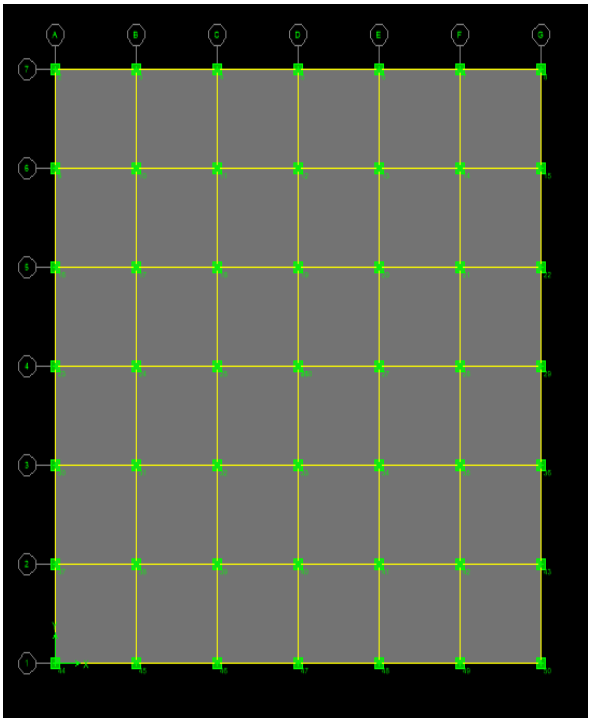

Fig.4 .1. Plan of a structure

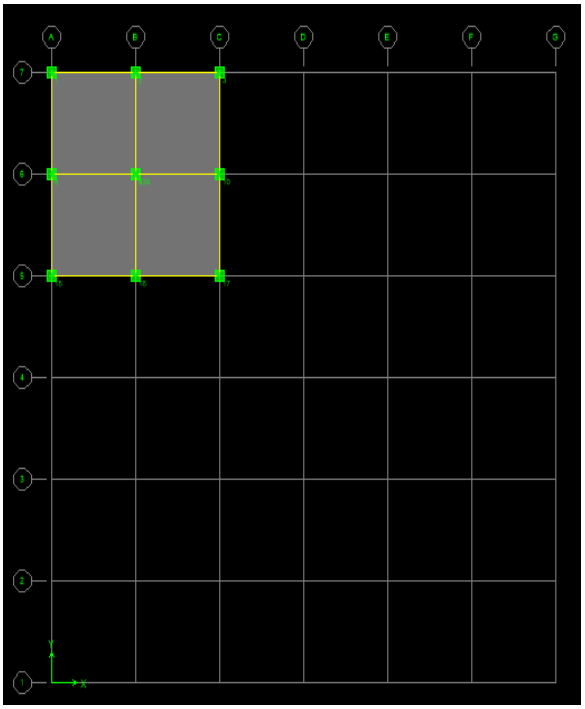

Fig.4. 3.Plan of Corner Irregular Structure

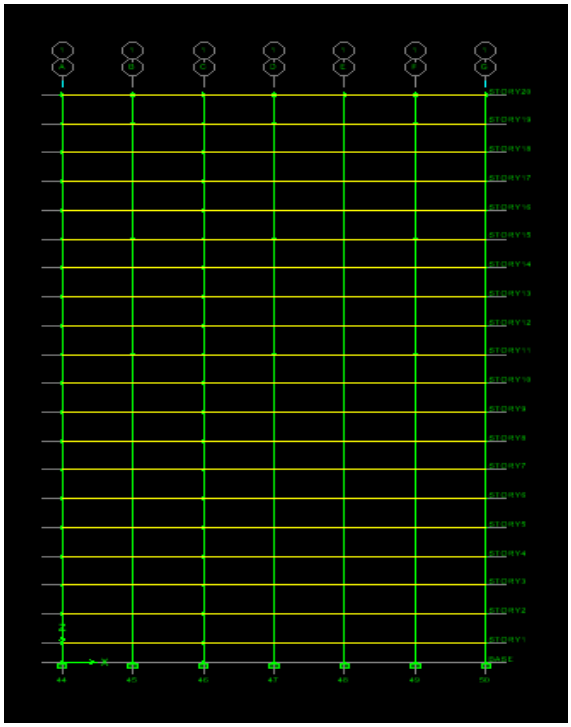

Fig.4.2. Elevation of Structure

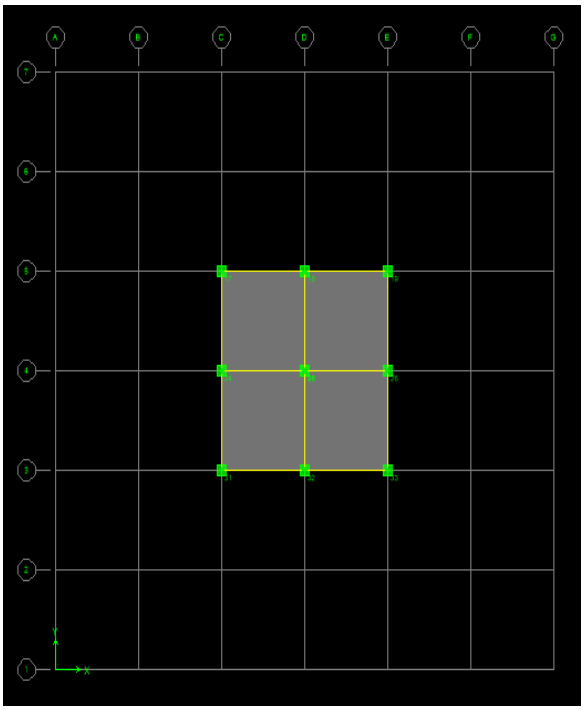

Fig.4.4. Plan of Centre Irregular Structure

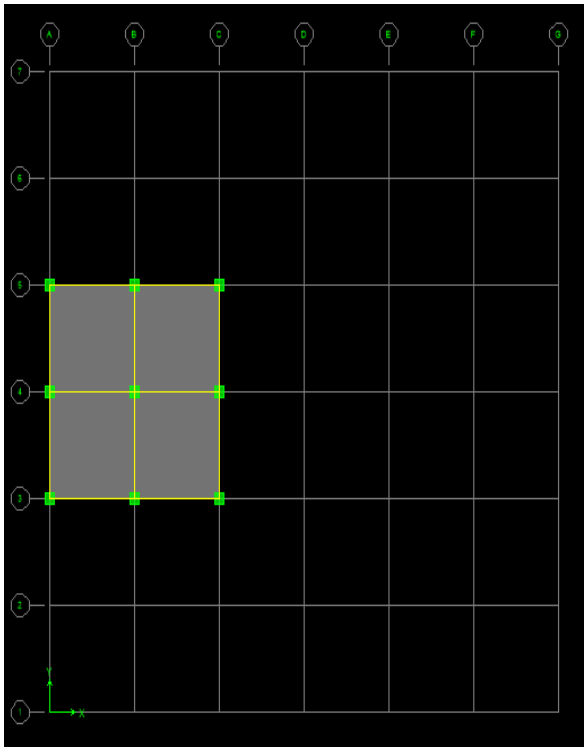

Fig.4.5. Plan of Edge Irregular Structure

5. RESULTS AND DISCUSSIONS

5.1 BASE SHEAR

It can be ascertained from the graph that, the base shear is maximum for regular frame than compare to irregular frames this is due to continuity in strength, stiffness, geometry and mass of the regular frame. In irregular frames, irregular frame at centre has maximum base shear than other two irregular frames.

TABLE 4.3 BASE SHEAR IN KN

MODELS	EQX	EQY
MODEL 1	6025.07	6025.07
MODEL 2	3360.54	3360.54
MODEL 3	3951.76	3951.76
MODEL 4	3360.54	3360.54

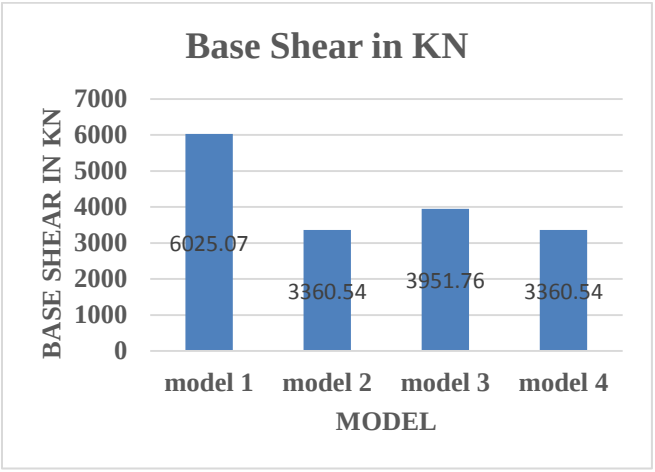

Figure 5.1 CHART SHOWING BASE SHEAR OF ZONE IV MODELS IN KN

5.2 DIAPHRAM DISPLACEMENT

It is observed from the graph that, the diaphragm displacement varies linearly with storey height in case of regular frame, whereas in case of irregular frames there is a sudden increase of diaphragm displacement from the middle of storey height that is from which irregularity starts, this sudden increase is due to change in strength, mass, stiffness and geometry of the frame.

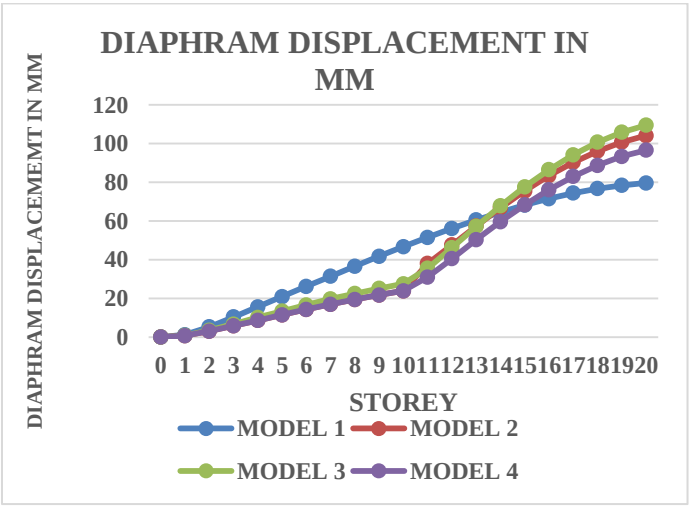

Figure 5.2 CHART SHOWING DIAPHRAGM DISPLACEMENT

5.3 DISPLACEMENT COMPRASION BETWEEN MODELS IN ZONE IV

It is noticed from the graph that; the displacement is minimum for regular frame when compared to irregular frames. In case of irregular frames, it is maximum for irregular frame at centre.

TABLE 5.2DISPLACEMENT IN MM

MODEL	EQX	EQY
1	79.6	79.6
2	104.1	104.1
3	109.5	109.5
4	96.6	96.6

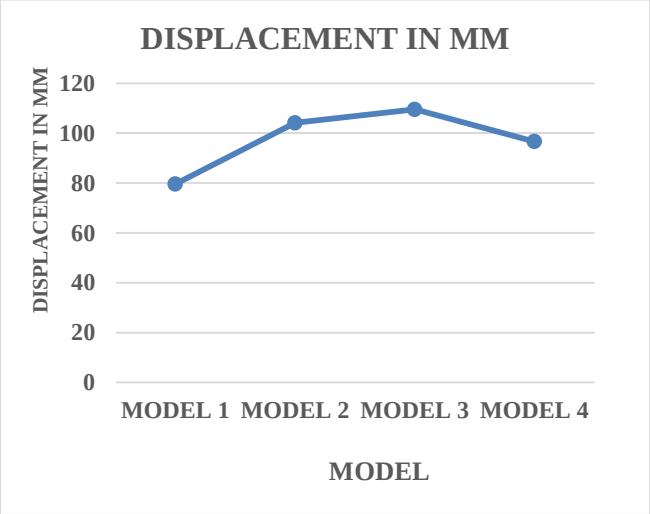

Figure 5.3 CHART SHOWING DISPLACEMENT

5.3 STOREY DRIFT

It is ascertained that, there is a linear variation of drift versus storey height in case of regular frame but in case of irregular frame there is a sudden abrupt parabolic variation of drift in case of irregular frame at centre and edge and linear variation of drift in case of irregular at corner from the middle of the story height.

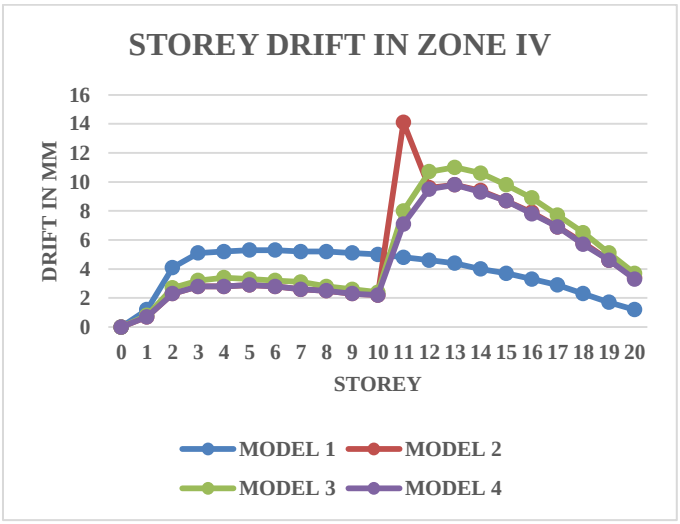

Figure 4.4 CHART SHOWING STOREY DRIFT

5.4 TIME PERIOD

It is noticed that, the time period is varying abruptly till 7th mode of vibration after that there is a linear variation both for regular frame as well as irregular frame respectively.

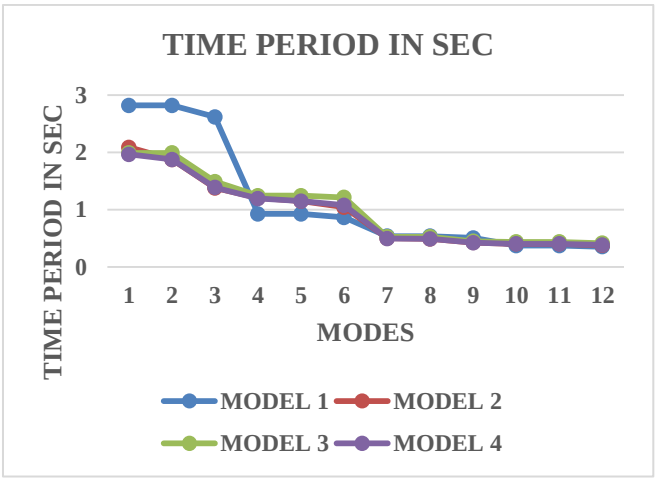

Figure 4.5 CHART SHOWING TIME PERIOD IN SEC

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