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Comparative Earthquake Resistant Design Study of Thin Rectangular 20 Storey Structure in Zone 1 and Zone 3 Using ETABS

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Abstract: An earthquake occurs in the form of seismic waves due to sudden release of energy and results in ground shaking. During earthquake, seismic waves propagate through the soil which results in structural damage due to movements within the earth's crust. It impacts the behavior of interaction of components like building, foundation, underlying soils and also overall system behavior. When earthquake occurs, the behavior of a building depends on distribution of mass, strength and stiffness. Generally, the buildings are subjected to various types of forces throughout their existence. The forces can be static forces due to dead and live loads and dynamic forces due to earthquake. In this study, the analysis is carried out for seismic response of 20 Storey Commercial office building for Zone-I and Zone-III regions through response spectrum method in ETABS. The design details such as reinforcement area for beams, columns and shear walls and resultant parameters like storey displacement, storey drift, storey shear, base shear, PMM Interaction curves, D/C ratios are observed for specified zones.
Keywords: Response Spectrum Method, Storey displacement, Storey shear, Storey drift, Base shear

I. INTRODUCTION

Bracing is one of the most extensively used lateral load resisting systems in multi-storied frame structure. Bracing is a highly efficient and economical method of resisting lateral force in a RC- frame Structure. A braced frame is a structural system designed primarily to oppose the wind and earthquake forces. In braced frames, members are designed to work in tension and compression, just liketruss.

The braced frames are almost always made up of steel members. In many nations of the arena non-public improvement is at a defining moment.

The problems of giving accommodations to vast portions of people are being supplanted progressively by way of the issues running on the nature of accommodations. In many created nations of the sector, in particular in Europe (Italy, England and so forth), workmanship structures are usually utilized forthe improvement of personal structures.

Block and substantial workmanship blocks are tons widelyknown in those international locations, due to the various blessings of brick work.

Consequently, stone work is as yet an important fabric due to its compositional and underlying attributes. According to the constructing attitude, brick work gives adaptability in arrangement, spatial piece,extensive assortment of tones and surfaces and a top notch look for out of doors dividers. According to the improvement perspective, workmanship framework kills the expense of the casing for the reason that the design is also the encasing divider.

II. MODELLING

The objective of this paper is to study the seismic analysis of residential building for Zone-I and Zone-III regions using ETABS. The modeling and analysis can be prepared for RC multi-storey building for various types of zones.

A. Analysis Methodology

In this study, analysis of (G+20) commercial office building for zone I and zone III are carried out for earthquake forces using ETABS. The seismic analysis for the buildings which are not resistantto earthquake forces should be carried out. In this, the building is subjected to dynamic analysis asspecified by code IS: 1893-2002 (Part I). It can be done either by response spectrum method or time history method.

B. The Project Plan

The Plot is of the size of 9x23m. The super structure is a G+20 storey structure.The Plan consists of 8 columns of uniform cross-sections, 1 Core Shear Wall (which is positionednear the entrance on the central east side), 2 longitudinal Shear Wall, 1 in the south-western side and other in the opposite north-western side.The storey height is taken as 4m for the ground floor. The subsequent storey heights are taken as 3.2m.

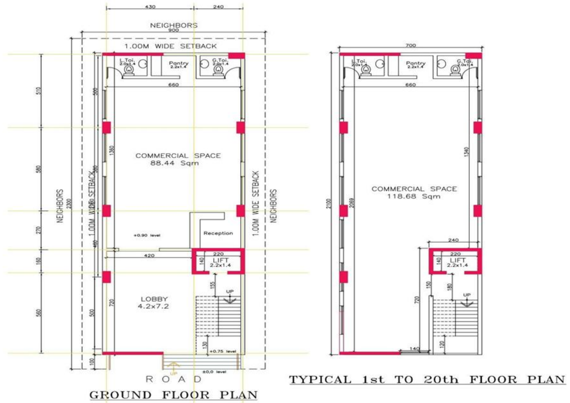


Figure 1 The Project Plan

C. Zone Parameters

TABLE I
ZONE 1 PARAMETERS

CATEGORY	PARAMETER
Zone	I
Zone Factor	0.10
Importance Factor	1.2
Response Reduction Factor	3
Soil Factor	2
Wind Speeds	44 m/s

TABLE III
ZONE II PARAMETERS

CATEGORY	PARAMETER
Zone	II
Zone Factor	0.10
Importance Factor	1.2
Response Reduction Factor	3
Soil Factor	2
Wind Speeds	44 m/s

D. Model Description

The analysis is carried out for proposed building using ETABS. The plan of a commercial buildingis shown in Figure. The elevation of the proposed building can be observed in Figure. The plan consists of ground floor and followed by nineteen upper floors. The total height of building is 63.6m. Number of Stories: (G+20) Grade of Concrete: Beams, Columns and lift wall = M30

E. Material Properties

To carry out the work in ETABS software the properties of the materials such as concrete and steelshould be defined. Similarly, the loads should be defined such as live load, super dead loads.

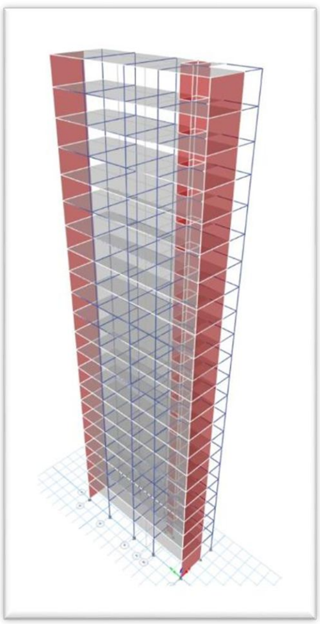
Grade of concrete: M50 Grade of steel: Fe550

F. *Description of Loads*

1) All moving loads come under live loads.
2) Live load: 2.5 kN/m2 Office Building (IS 875:1987 – Part -2)
3) Floor finishes are the super imposed dead loads.Floor Finishes: SDL (floor finish): 1.5 kN/m2
4) Wall loads are the loads of bricks used in construction
5) SDL (wall loads with openings and without openings respectively): 8.25 kN/m2 and
6) 11.0 kN/m2 (wall thickness*height of the floor*density of brick = 0.23*3*18)

G. *Supposed Sections*

1) *Beam size (Inner):* 400mm x 400mm Beam Size (Outer): 400mm x 600mmColumn size: 400mm x 800mm Shear Walls: 400mm x 4200mm
2) *Core Shear Wall:* 400mm thick surrounding the lift (2.2m x 1.4m)



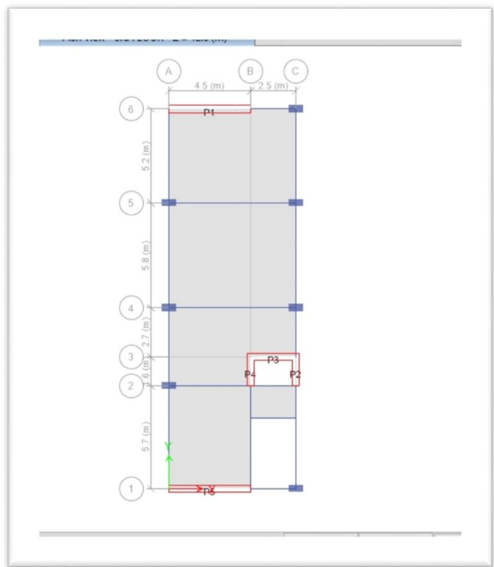


Figure 2: 3d Elevation of the structure Figure 3: Pier assignments on shear walls

III.RESULTS

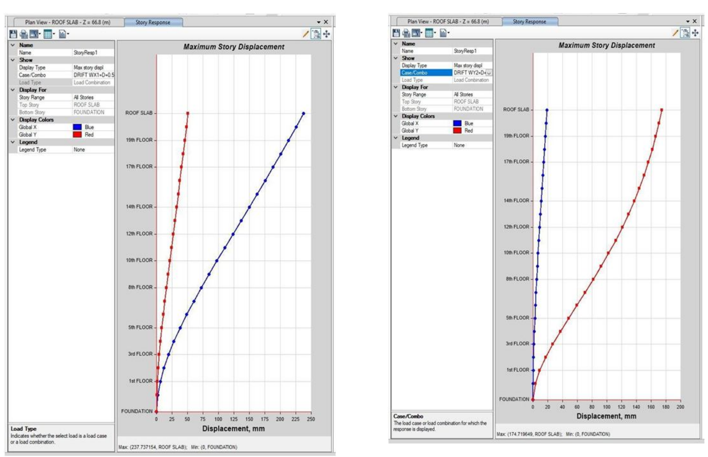


Figure 4 Storey Displacements Graphs in X and Y for Zone 1

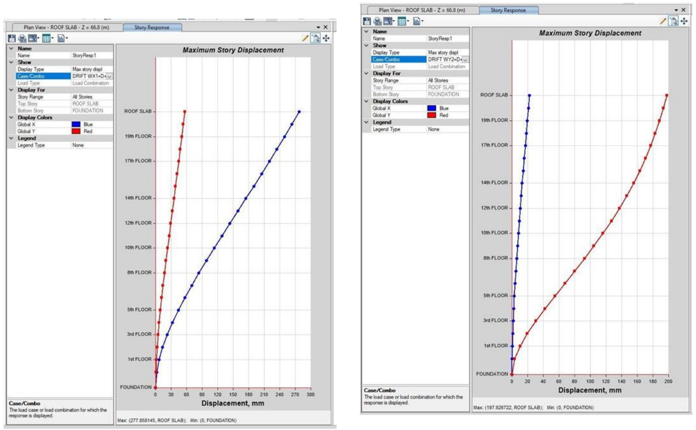


Figure 5 Storey Displacements Graphs in X and Y for Zone 3

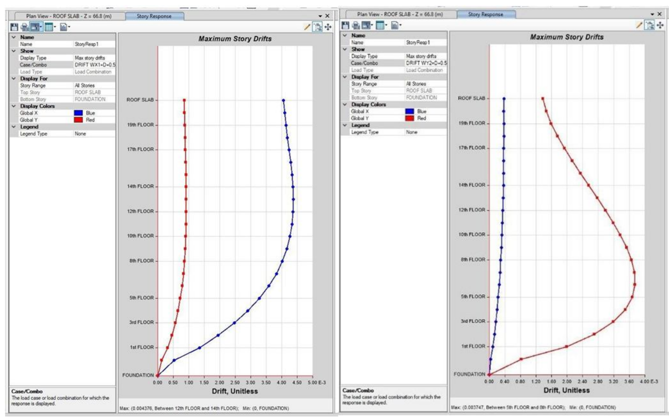


Figure 6 Storey Drift Graphs in X and Y for Zone 1

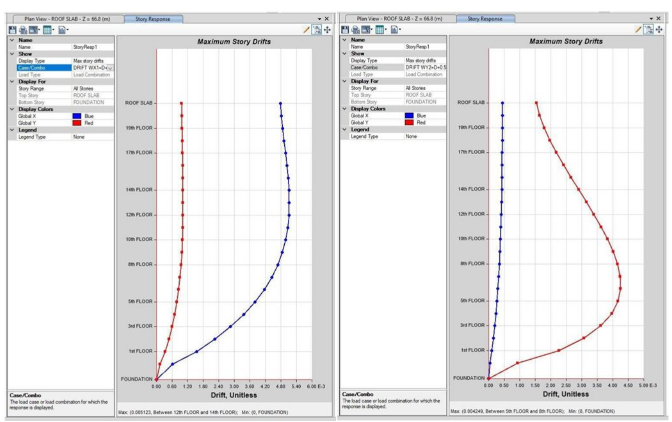


Figure 7 Storey Drift Graphs in X and Y for Zone 3

IV. CONCLUSIONS

1) Column reinforcement: there's an increase of 15.42% area of steel required in zone 3 with respect to zone 1 for the most critically loaded column. The same can be concluded for all column members.
2) Beam reinforcement: there's an increase of 12.75% area of steel in the top fibre and 33.99% area of steel in the bottom fibre in zone 3 with respect to zone 1 for the most critically loaded beam.
3) Wall reinforcement: there's an increase of 18.82% area of steel required in zone 3 with respect to zone 1 at the most critically loaded shear wall.

4) Storey displacement: there's an increase of 16.87% displacement in x direction and 13.28% displacement in y direction at the roof slab of the structure.
5) Storey drift: the storey drift is increased by 17.07% at the 13th floor which is the maximum value for zone 3 with respect to zone 1.
6) Storey shear: the storey shear is increased 13.13% for both x and y directions from zone 1 to zone 3.
7) Base shear: the values for base shear are increased by 20.94% for zone 3 with respect to zone 1.
8) Pmm interaction curve: the pmm values are changed 8.03%, -35.4% and 24.61% respectively at the column at a5 grid for zone 3 with respect to zone 1.
9) D/c ratio: for at the column at a5 grid the ratio is increased by 0.35 for zone 3 with respect tozone 1.

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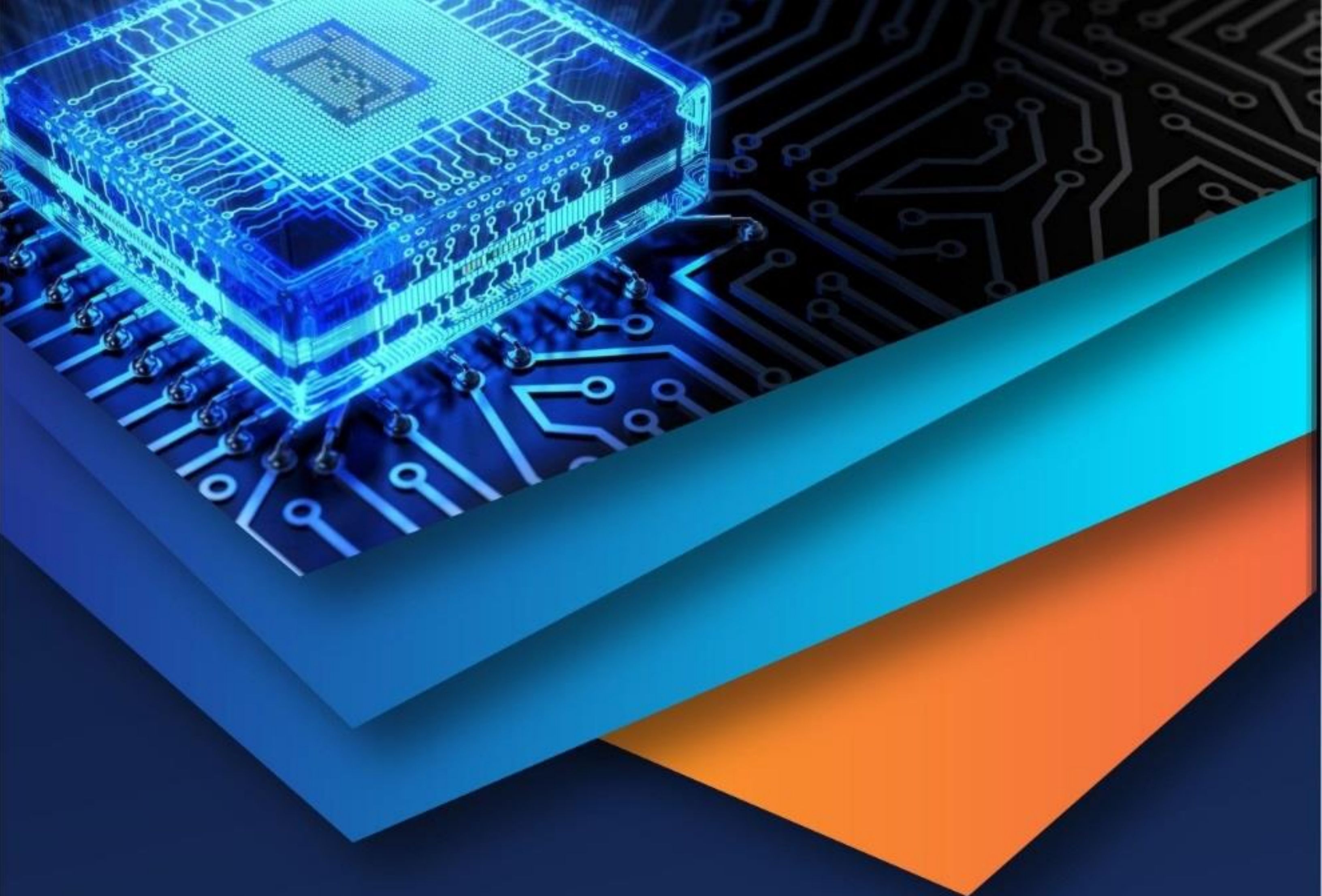

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