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Comparative Study of Flat &Traditional Slab using ETABS

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ABSTRACT

The use of flat slab in today's construction activity is common as it minimizes weight, enhances construction speed, and is also competitively priced. Traditional slabs, on the other hand, have a place in offering better features. This paper uses ETABS software to do a comparative study of the flat slab and traditional slab systems under seismic stress for various multi-story buildings of G+ 14 storeys with a plan area of 1225 m^2. The software is used to model all four models. The seismic analysis results were compared for the various slab systems. It's worth noting that the research is being done for seismic properties. Seismic Zone 5 encompasses the structures. The value obtained for the maximum shear force. In recent years, it has been seen that flat slabs are increasingly replacing traditional slabs in construction systems. In a study comparing flat slab with conventional slab, it was discovered that traditional slab carries greater load than flat slab, traditional slabs, on the other hand, have various drawbacks, such as greater loading, increased storey height, and lesser cost, whereas flat slabs are more reliable. In addition, when comparing the two slabs on the basis of appearance, the flat slabs system appears to be superior to the normal slab.

Key words: G+ 14 storeys, ETABS, seismic zone5, story drift.

INTRODUCTION

Flat Slabs and Traditional Slabs

When compared to its other two dimensions, a slab can have a flat surface, two-dimensional dimensions, and a thin thickness. It can also be a structural element with a flat shape. It provides a smooth working surface or a shelter for the structures to be covered. Flat slabs, like flat plates, can carry largely transverse loads that are transferred to support primarily through the employment of bending components. Traditional slabs are those in which the slabs are supported by beams and the beams are supported by columns. These slabs are known as traditional -slab construction. The skin of traditional slabs has two-directional reinforcement, giving them the appearance of pockets or waffles. Furthermore, as compared to normal concrete slabs, these slabs are far better at bearing a bigger amount of load. Beams always reduce the potential net clear height of the ceiling. As a result, in some workplaces, warehouses, and public halls or celebration halls, the slab is directly put or supported on the column. These kinds of structures are usually appealing from an aesthetic standpoint. Interconnected grid systems are often utilized in building floors, water tanks, and bridges.

OBJECTIVE

Following are the key objectives of this strategy, which are frequently abbreviated:
1. To determine the reaction of a flat slab and a traditional slab when seismic loads are applied.
2. ETABs Software performed the analysis.
3. To see if there is a difference in lateral displacement between the Flat Slab and the Traditional Slab.

METHODOLOGY

During the research period, a proposed methodology was proposed. This project work uses ETABS software to compare the performance of flat slab and traditional slab systems under seismic stress. For this aim, four different multi-story structures with a total plan area of 1225 sq.m were examined. The plan considers an exhaustive collection of R.C.C. flat slab building models with the same aspect ratio and slenderness ratio, as well as a constant plan area. For both models to be analyzed, we are using the Equivalent Static Analysis approach. Shear forces, Bending Moments, and seismic storey drift are among the results of this Equivalent Static Analysis of models that may be analyzed and compared.

MODELING AND ANALYSIS

Computational Model

Modeling a building entails putting together and modelling the various load-bearing parts. The deformability mass distribution, strength, stiffness, and deformability must all be represented by the model. The following section discusses the modelling of structural elements and material attributes that were used in this investigation. For all of the frame models used in this study, the grade of concrete M-30 is employed, and the grade of reinforcing steel Fe-415 is used. These materials with elastic material qualities are classified as IS 456 in India (2000). The value of the concrete's modulus of elasticity (Ec) is taken as Ec=5000fckMPa. Where fck is the concrete cube's typical compressive strength in MPa at 28 days. For the purpose of steel bar, modulus of elasticity (Es) and yield stress (fy) are taken as per IS code 456 (2000)

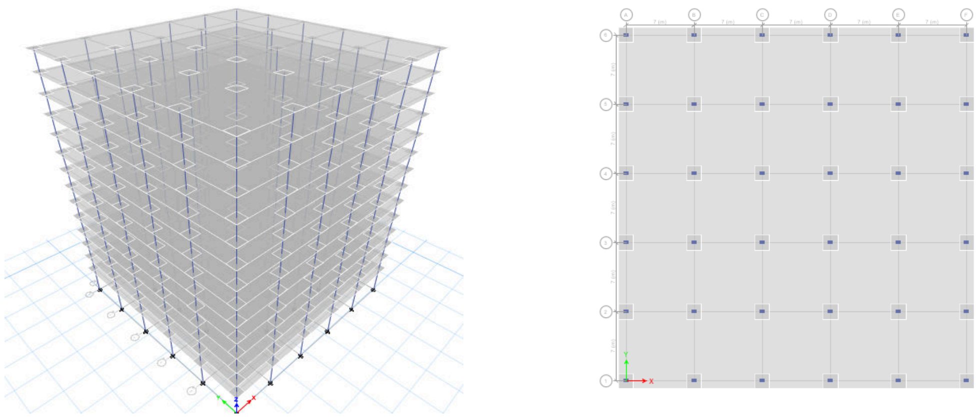


Fig. 1 3D View of G+ 14 storey Building and Plan Area

Analysis Methods

The study will be based on the assumption of external action, structure or structural material behavior, and hence the type of structural model chosen. The analysis is further classified as, based on the structure's behavior and the type of external action. 3.2.1 The lateral force must initially be computed as a whole in the building design for Earthquake Lateral Force Analysis.There are two types of lateral force methods that are typically utilised in seismic design:

1. Analysis of equivalent static forces

Equivalent static force analysis is the method that is utilized for seismic lateral force design. This method is used to replace the major and minor loading effects that are dynamic in nature and which occurduetoexpectedearthquakes.

Dynamic Analysis

The lateral force design method used in earthquake design i.e. Dynamic analysis is divided into two categories: The Time history technique is the first, while the Response spectrum method is the second.

Building Geometry

The study is predicated on a three-dimensional R.C.C. building with varying Flat slab and grid slab and same plan ratio, but with a continuing plan area. Same building geometries were taken for the study. These building geometries represent the same

Table-1 Primary and cargo combinations assigned to structure

L/C	TYPE	NAME
1	Primary	DL
2	Primary	LL
3	Primary	EQXA
4	Primary	EQXB
5	Primary	EQYA
6	Primary	EQYB
7	Combinations	1.5 (DL+LL)
8	Combinations	1.2 (DL+LL+EQXA)
9	Combinations	1.2 (DL+LL+EQXB)
10	Combinations	1.2 (DL+LL+EQYA)
11	Combinations	1.2 (DL+LL+EQYB)
12	Combinations	1.5 (DL+EQXA)
13	Combinations	1.5 (DL+EQXB)
14	Combinations	1.5 (DL+EQYA)
15	Combinations	1.5 (DL+EQYB)
16	Combinations	0.9 (DL+EQXA)
17	Combinations	0.9 (DL+EQXB)
18	Combinations	0.9 (DL+EQYA)
19	Combinations	0.9 (DL+EQYB)

Assumed Data

- Material properties and geometric parameters
- Load considered for designing building
- Seismic design data

RESULTS AND DISCUSSION

Parameter for Comparative Study

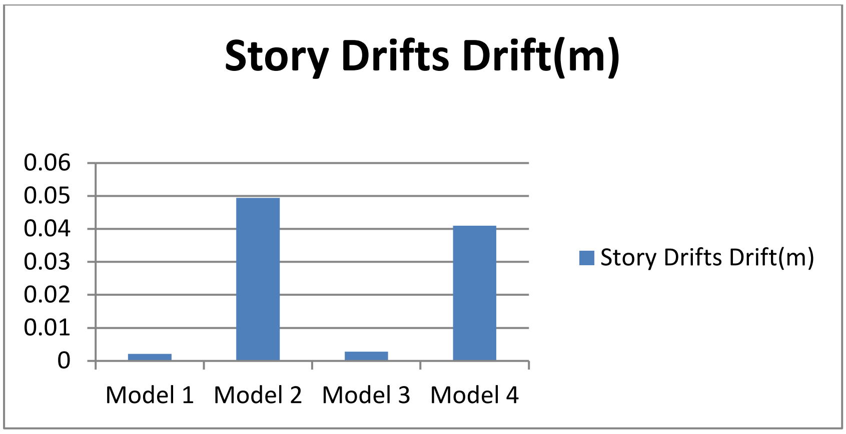
Following parameters are considered for comparative study of software analysis results of all 4 models.

- Shear Force
- Bending Moment
- Storey drift

Results obtained from software analysis of both models were filtered then arranged to match it with respective values of each-other models. Results for individual model are shown first in tabular form then compared with models of same ratio within the sort of graphical representation.

Table-2 Story Drifts

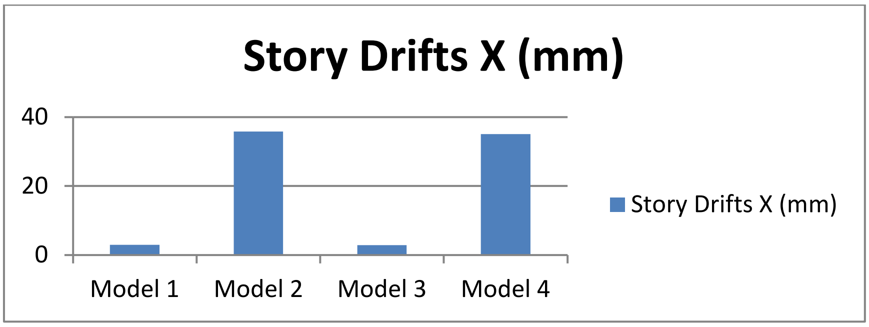
Models	Drift
Model 1	0.0021233
Model 2	0.0491411
Model 3	0.0028755
Model 4	0.041



Graph 1 Maximum Story Drifts

Table-3 Story Drifts

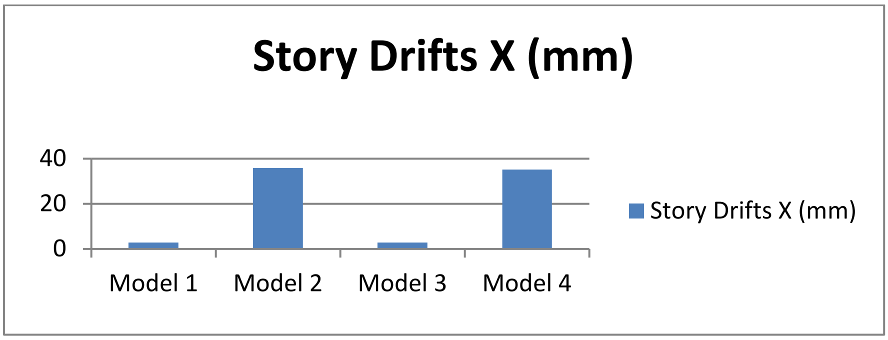
Models	X (mm)
Model 1	2.865
Model 2	35.55
Model 3	2.75
Model 4	35.09



Graph 2 Maximum Story Drifts in X-direction

Table-4 Story Drifts

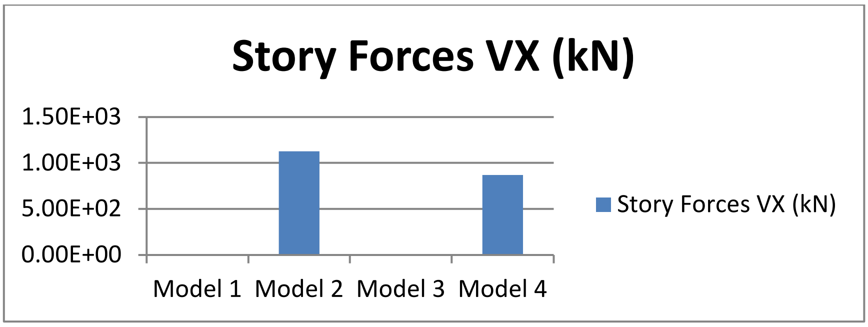
Models	Y (mm)
Model 1	2.865
Model 2	35.85
Model 3	2.755
Model 4	35.09



Graph 3 Maximum Story Drifts in Y-direction

Table-5 Story Forces

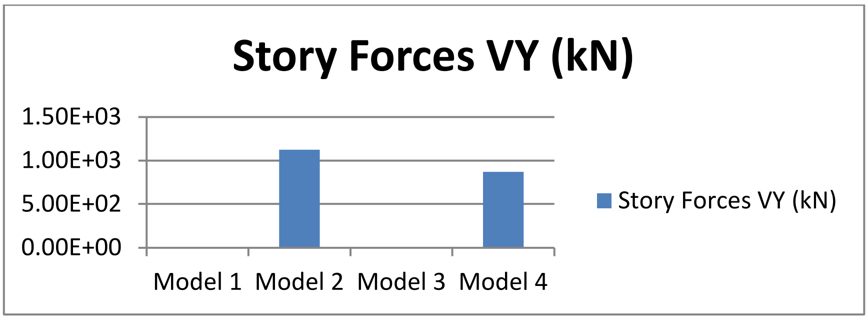
Models	VX (kN)
Model 1	0.968
Model 2	1124.23
Model 3	0.6597
Model 4	869.1657



Graph 4 Maximum Story Forces VX (kN)

Table-6 Story Forces

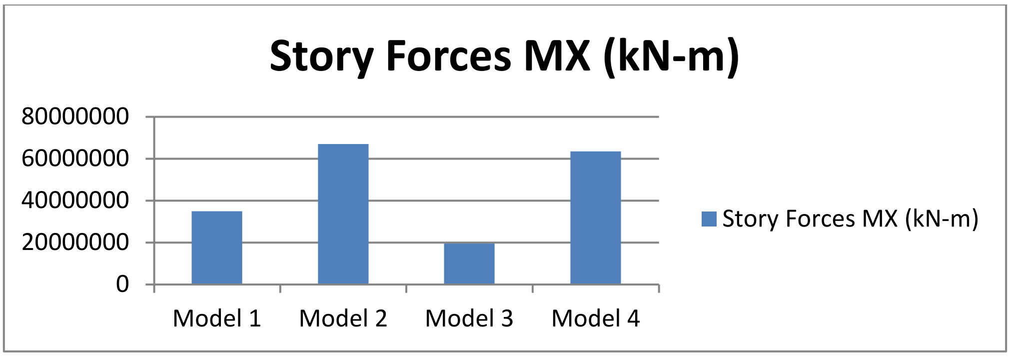
Models	VY (kN)
Model 1	0.9584
Model 2	1124.23
Model 3	0.6587
Model 4	869.1757



Graph 5 Maximum Story Forces VY (kN)

Table-7 Story Moments in X

Models	Mx(kn-m)
Model 1	34842160
Model 2	66915977
Model 3	19410207
Model 4	63414294



Graph 6 Maximum Story Moments in X

CONCLUSION

1. When drops panels are present, the fundamental mode of frequencies of a flat slab construction increase by 20%, and when stiffness is increased by supplying Grid slab, those values increase by 96 percent.
2. As the load on the structure increases from model 1 to 4, the base shear values increase.
3. When a flat slab is used instead of a grid slab, it adds more shear value.
4. When a column is dropped to a flat slab, storey displacements are reduced little, as stiffness rises slightly. The Weather Grid Slab increases the structure's overall lateral rigidity.
5. Punching shear stresses in interior columns increase linearly from the top to the bottom stories.
6. As earthquake moments progress from the top to the bottom of the storey. However, the variations in punching shear and gravity loads are not as noticeable from storey to storey.
7. This suggests that earthquakes are more effective and forceful in creating punching shear towards the bottom of the storey.
8. Shear pressures in outer columns fluctuate barely randomly due to the impact of outside panel moments and earthquake moments. Outside columns with the highest shear forces have higher shear forces than those with the lowest shear values.
9. In a flat plate, shear failure occurs. When a column is provided, the shear stress lowers by up to 25%.
10. A grid slab may not be more effective in lowering or reducing shear stresses on in-between stories, but it may be more effective in the topmost and bottommost stories because it draws lateral moments from columns.

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