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Study of Principal Stresses in Flat Slab with and without Shear Wall of Multi-Storied Building Frames

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Abstract - *A reinforced concrete flat slab is a slab supported directly by columns without beams. A part of the slab bound on each of the four sides by centre lines of column is called panel. The flat slab is often thickened near to supporting columns to provide adequate strength in shear and to reduce the quantity of negative reinforcement in the support regions. In tall multistoried structures, the flat slab floor system has weak resistance to lateral loads like wind and earthquake; hence shear walls are to be provided if flat slabs are to be used in high rise construction.*

In the present investigation, the design and analysis of 10,20and30 storied frames with flat slab supported system, and flat slab floor system with shear wall conducted using STAAD Pro. software. The system is termed as dual system as it depends mainly on height of building. A shear wall acting as a vertical cantilever has a bending mode deflection while a frame (flat slab system) under horizontal loads has a shear mode of deflection.

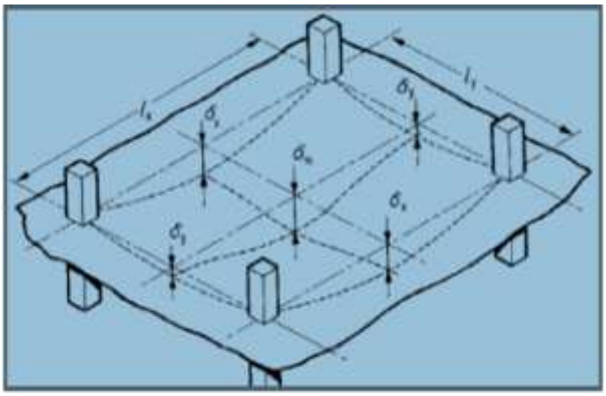
A comparison is made between the flat slab corner stresses, center stresses, storey drift, Principal Von Mis Tresca stresses , surface forces of shear wall of varying thickness due to static and earthquake loads on structure for 10,20 and 30 storied flat slab floor system with and without shear wall of varying thickness in building are also analyzed, compared, and results are brought out.

1. INTRODUCTION

1. GENERAL:

1.1 FLAT SLAB:

A flat slab, also called as beamless slab, it is a slab that is supported directly on columns without placing beams. A part of the slab that is bounded on each of the four sides by centre line of column is known as panel. Flat Slabs of constant thickness does not have drop panels or column heads are known to as flat plates. The strength of the flat plate structure is limited, and therefore they are used for light loads and relatively small spans. Bands of slab in both directions along the column lines act as beams. The deflections is minimum at supports and maximum at mid spans. The deflected flat slab at the center of panel have saucer shape shown below:



1.1.1 Method of analysis of Flat Slab:

1. The Finite Element Analysis

2. The Simplified Method

3. The Equivalent Frame Method

Finite Element Method: In the finite element modelling of a two dimensional shear wall and flat plate. The wall and plate is divided into smaller elements having finite size and number. These elements may be triangular, rectangular or quadrilateral. It has three degrees of freedom at each node (two translations and one rotation). The finite element method is widely used not only in modelling multi-storey structures but also for all kinds of engineering problems.

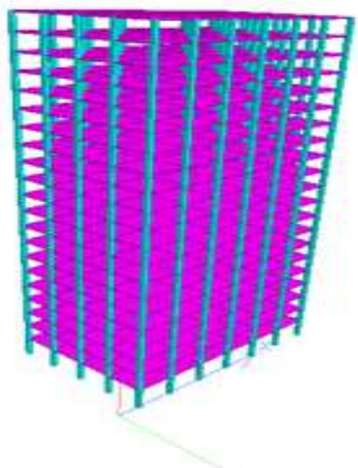


FIGURE 1: Flat slab in multistorey building frame

2. BUILDING MODELING

Study and analysis, three cases of multi-storey buildings are considered.

Case I – 10 Storey buildings. Case II – 20 Storey buildings.

Case III – 30 Storey buildings.

- The structural analysis of each case is done considering the building frame provided with shear wall and without shear wall.
- These flat slab structure are subjected to the dead load, live load and seismic load.
- The accuracy and the efficiency of the proposed models are tested by performing static lateral load analysis and time history analysis on flat slab system and shear wall-flat slab frame systems.
- The structural analysis is carried out by the means of finite element modeling considering flat slab as plate element and shear wall as surface element on the software STAAD.PRO.
- Then maximum value of both major and minor principal stresses produced on the top and bottom plane of flat slab on each storey due to applied load are found.
- Then the principal stresses variation profile for different case are compared and results are drawn out.

FOR 10 STOREY BUILDING

Case I: Plan Area is 20m x 30m, shear wall is not provided.

Case II: Plan Area is 20m x 30m, shear wall of thickness 150mm is provided up to 10 storeys.

FOR 20 STOREY BUILDING

Case I: Plan Area is 20m x 30m, shear wall is not provided.

Case II: Plan Area is 20m x 30m, shear wall of thickness 250mm is provided up to 20 storeys

FOR 30 STOREY BUILDING

Case I: Plan Area is 20m x 30m, shear wall is not provided.

Case II: Plan Area is 20m x 30m, shear wall of thickness 300mm is provided up to 30 storey.

2.1 Loads Considered:

2.1.1 Dead Load:

The loads considered are as follows:

In the present work, the self weight of the members calculated as:

The self weight of slab =0.2 x 1 x 1 x 25 = **5** kN/m^2

Load considered due to floor finish= **1** kN/m^2

2.1.2Live Load:

Live load adopted for floor slab and roof according to IS 875 part-II: **3** kN/m^2.

2.1.3 Earthquake Load:

Response Reduction Factor: was taken from table-7(clause 6.4.2) IS1893 Part-1:2002.

Importance Factor: Depends on the functional use of building characterised by hazardous consequences of its failure, it is taken from table-6(clause 6.4.2) of IS1893 Part-1 :2002.

Time Period of undammed free vibration.

In the present work, parameters of earthquake load were considered as:

Earthquake Load and seismic parameters	
Earthquake Parameters Zone (Z)	IV
Response Reduction factor (RF)	3
Importance factor (I)	1
Rock and soil factor (SS)	2
Type of structures	1
Damping ratio (DM)	0.05
Time Period	Ta=0.09H/√D

2.1.4 Load Combinations as considered for static analysis:

The load combinations were adopted according to IS 1893 Part-1: 2002 & IS 456:2000:

1. 1.5(DL + LL)

2. 1.2(DL + LL + EQX)

3. 1.2(DL + LL - EQZ)

4. 1.2(DL + LL + EQZ)

5. 1.2(DL + LL – EQZ)

6. 1.5(DL + EQX)

7. 1.5(DL – EQX)

8. 1.5(DL + EQZ)

9. 1.5(DL – EQZ)

10. 0.9DL + 1.5EQX

11. 0.9DL - 1.5EQX

Here X &Z are the directions of earthquake loads considered in the analysis.

2.2. Preliminary Sections and materials considered:

The plan area for the proposed work is 20x30 m in which size of panels is 5x5 m. The properties of material adopted are:

2.2.1 The Young's modulus of elasticity of concrete adopted was 25,000 MPa while the Poisson's ratio was 0.2.

2.3.2 The preliminary sections of columns and beams were fixed on the basis of deflection criteria [i.e. span to depth ratio].

Table -1: Size of structural elements of flat slab without shear wall in multistoried building

Size of structural elements of flat slab without shear wall in multistoried building				
Description	No. of stories	Column		Slab
		Width(mm)	Depth(mm)	Thickness (mm)
Flat Slab without shear wall	10	500	500	300
	20	500	500	300
	30	500	500	300

Table -2: Size of structural elements of flat slab with shear wall in multistoried building

Size of structural elements of flat slab without shear wall in multistoried building					
Description	No. of stories	Column		Slab	Shear Wall
		Width(mm)	Depth(mm)	Thickness(mm)	Thickness(mm)
Flat Slab with shear wall	10	500	500	300	300
	20	500	500	300	300
	30	500	500	300	300

3. CONCLUSIONS

Considering the results of the analysis for the principal stresses in flat slab of 10,20, 30 storied flat slab multi-storeyed building with and without shear wall under the action of seismic load we reached the following conclusions.

1. The principal stresses are maximum on flat slab at lowest height and we obtain a sudden step down in stresses at adjacent upper storey then the stresses decreases linearly with increase in height for a multi-storeyed building without shear wall
2. We obtain a sudden hike or peak in the principal stresses in the flat slab at a height of 40 % of the total height of the multi-storeyed building with shear wall
3. The value principal stresses in flat slab increases with increase of number of storeys in multi-storeyed building
4. The graphs plotted for the variation of Max top principal stresses, Max bottom principal stresses, Min top principal stresses, Min bottom principal stresses along the height of a flat slab structure with and without shear wall shows similar variation profile for all four type of stresses.
5. We found that the maximum value of bottom principal stresses are more than the maximum value of top principal stresses for 10, 20 and 30 storied flat slab building with and without shear wall.
6. The Principal top stress varied by 14.02% and bottom stress varied by 10.41% for 10 storied building (without and with shear wall) building.
7. The Principal top stress varied by 3.18 % and bottom stress varied by 8.07% for 20 storied building (without and with shear wall) building.
8. The Principal top stress varied by -7.14% and bottom stress varied by -0.76% for 30 storied building (without and with shear wall) building.

REFERENCES

[1] SHAIK TAHASEEN: (2015) :Shear wall design for G+8 FLOOR residential building.

[2] SALMAN I. KHAN AND ASHOK R. MUNDHADA :(2014) : Comparative study of Seismic Performance of multi-storeyed R.C.C buildings with Flat slab & Grid slab.

[3] NAVYASHREE AND SAHANA (2014): Compared the behaviour of multi-storey commercial buildings having

flat slabs and conventional RC frame with that of having two way slabs with beams.

[4] ANUJA WALVEKAR, H.S.JADHAV: (2014): Parametric study of flat slab building with and without shear wall to seismic performance.

[5] SHYAM BHAT M, N.A.PREMANAND SHENOY, and ASHA U RAO: (2014): Earthquake behaviour.

[6] SANJAY P N, MAHESH PRABHU, UMESH S :(2014): Behaviour of Flat Slab Rcc Structure Under Earthquake Loadingr of buildings with and without shear.

[7] MOHD MOHIBUR RAHMAN, BANULATHA.G.N, DR. NARAYANA.G, MANU.J:

[8] Studied the Behaviour of R.C. Frames Structures with Different Floor Systems Under the Effect of Lateral Loads.

[9] SHRIKANT HARLE :(2014): Analysis and Design of Earthquake Resistant Multi-Storied Braced R.C.C. Building using NISA Software.

[10] KY LENG, CHATPAN CHINTANAPAKDEE, AND TOSHIRO HAYASHIKAWA (2013):Seismic Shear Forces in Shear Walls of a Medium-Rise Building Designed By Response Spectrum Analysis.

[11] KHAN:(2013):Comparative Analysis of a 15 Story Flat Plate Building with and Without Shear Wall and Diagonal Bracing Under Wind and Seismic Loads.