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Comparative Study of Seismic Analysis of Grid Slab Frame with Conventional R.C. Frame

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Abstract: **Grid slab frame systems consisting of beams spaced at regular intervals in perpendicular directions, monolithic with slab. Generally they are used for architectural reasons for large rooms for example: auditoriums, vestibules, theatre halls, showrooms of shops where column free space is often the main requirement. A rectangular or square void formed in the ceiling is advantageously utilized for concealed architectural lighting. This paper describe the study of analysis of Grid slab frame for seismic forces and compared with Conventional R.C. frame. The different parameter are studied displacement, storey drift, base shear and moments on the column. For analysis ETAB software is used.**

Keywords: **Grid slab, ETABS, Seismic forces.**

1. INTRODUCTION

Inter-connected grid systems are being commonly used for supporting building floors bridge decks and overhead water tanks slabs. A grid is a planar structural system composed of continuous members that either intersect or cross each other. Grids are used to cover large column free areas and have been constructed in number of areas in India and abroad. Is subjected to loads applied normally to its plane, the structure is referred as Grid. Which is composed of continuous member that either intersect or cross each other. Grids in addition to their aesthetically pleasing appearance provide a number of advantages over the other types of roofing systems.

1.1 Advantages of Grid slabs:

1. Grid slabs are used for larger span slabs or floors and used when there is limited requirement for number of columns.

2. The load carrying capacity of Grid slab is greater than the other types of slabs.

3. They provide good structural stability along with aesthetic appearance. Hence, it is constructed for airports, hospitals, temples, churches etc.

4. The Grid slab can be made of concrete or wood or steel among those concrete waffle slab is preferred for commercial buildings and remaining two are preferred for garages, decorative halls etc.

5. It has good vibration control capacity because of two directional reinforcement. So, it is useful for public buildings to control vibrations created by movements of crowd.

6. Grid slabs are lightweight and requires less amount of concrete, hence it is economical.

7. Concrete and steel volume required is small, hence, light framework is enough for waffle slab.

8. Several services like lighting, plumbing pipes, electrical wiring, air conditioning, insulation materials etc.

9. Can be provided within the depth of waffle slab by providing holes in the waffle bottom surface. This system is called as Holedeck.

1.2 Uses of Grid slabs:

1. Used for specialized projects that involves clean rooms, spaces requiring seclusion from low frequency vibration or those needing low floor deflections.

2. Concrete grid slab is often used for industrial and commercial buildings while wood and metal waffle slabs are used in many other construction sites.

3. This type of construction is used in airports, parking lots, garages, commercial and industrial buildings, residences and other structures requiring extra stability.

4. The main purpose of employing this technology is for its strong foundation characteristics of crack and sagging resistance.

5. Grid slab also holds a greater amount of load compared with conventional concrete slabs.

1.3 Features of the grid slab:

1. Slab panels are on 1 metre grids (approximately).

2. There is minimal concrete volume.

3. Shrinkage of slab is lower than stiffened rafts and footing slabs.

4. They use 30% less concrete than a stiffened raft.

5. They use 20% less steel than a stiffened raft.

2. OBJECTIVES

1. Comparative study of displacement of Grid slab frame with Conventional R.C. frame.

2. Comparative study of storey drift in Grid slab frame with Conventional R.C. frame.

3. Comparative study of base shear in Grid slab frame with Conventional R.C. frame.

4. To study the moments in column of Grid slab frame and Conventional R.C. frame.

3. ANALYSIS OF GRID SLAB AND CONVENTIONAL R.C. FRAME

In this present study ground +5 storey R.C.C building is considered 18m x 18m panel. The constriction Technology is R.C moment resisting frame and Grid slabs. The modelling is done in ETABS. Grid lines are made for the x, y and z coordinates and the wall is drawn from scratch. Boundary conditions are assigned to the nodes wherever it is required. Boundary conditions are assigned at the bottom of the wall i.e., at ground level where restraints should be against all movements to imitate the behavior of structure. The Geometric data is as shown in Table No2.

3.1 Assumptions:

The material properties are shown in Table No1.

TABLE NO. 1: MATERIAL PROPERTIE

Material name	Concrete
Type of material	Isotropic
Mass per unit volume	25 kNm^3
Modulus of elasticity	22360679.77 kN/m^2
Poisson’s ratio	0.2
Concrete strength	20 MPA
Grade of Steel	Fe415

1. The Geometric data for Grid slab frame is as shown in Table No.2 and Geometric data for Conventional R.C. frame is as shown in Table No.3.

TABLE NO. 2: GEOMETRIC DATA

Sr.No.	ITEM	DIMENSION
1	Plane dimension	18m X 18m
2	Grid Beam spacing	1m x 1m
3	Length in X-direction	18m
4	Length in Y-direction	18m
5	No. of stories	G+5
6	Floor to floor height	3.0m
7	Thickness of Slab	100mm
8	Size of Beam	400mm X 450mm
9	Size of Column	450mm X 450mm

TABLE NO. 3: GEOMETRIC DATA

Sr.No.	ITEM	DIMENSION
1	Plane dimension	18m X 18m
2	Panel dimension	6m x 6m
3	Length in X-direction	18m
4	Length in Y-direction	18m
5	No. of stories	G+5
6	Floor to floor height	3.0m
7	Thickness of Slab	200mm
8	Size of Beam	400mm X 450mm
9	Size of Column	380mm X 380mm

The modelling of Grid Slab is shown in figure1 and Conventional R.C.Frame is shown in figure 2.

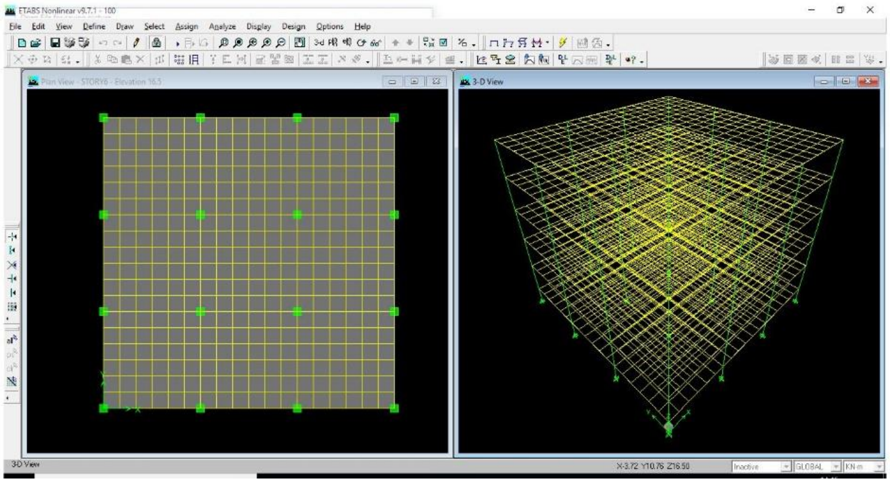

Fig 1: Grid Slab

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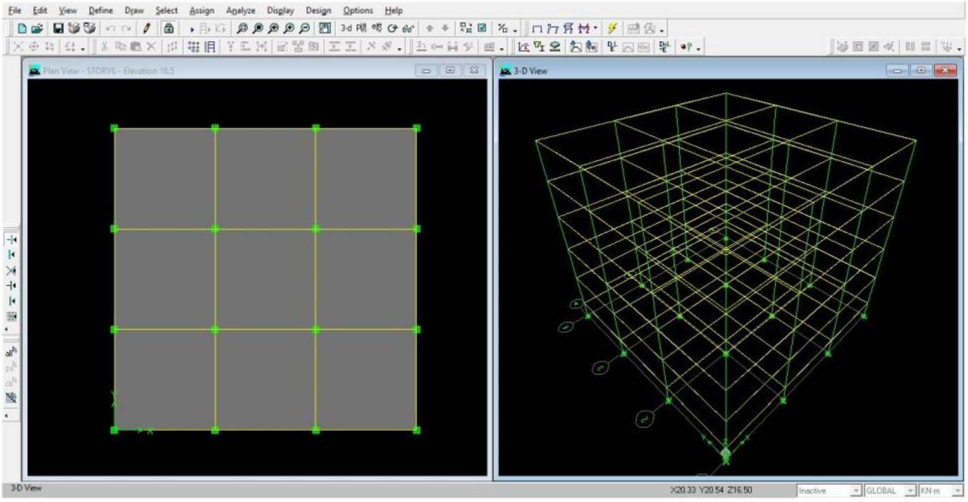


Fig 2: Conventional R.C.Frame

3.2 LOADING:

Loads acting on the structure are dead load (DL), Live load (LL) and Earthquake load (EL)

1. Self-weight comprises of the weight of beam, column and slab of the building.

2. Dead load (D.L.): Wall load = 1 kN/m

3. Live load (L.L): Floor load = 3 kN/m

4. Seismic load:

Seismic zone – Z=0.16, Soil type – III

Importance factor – 1, Response reduction factor – 3, Damping – 3%

As per IS 1893 (part-1): 2002

Here Seismic load is considered along two directions EQlenght (EQX) and EQwidth (EQY).

Loading combination is as shown in Table no. 4

TABLE NO.4: LOADING COMBINATIONS

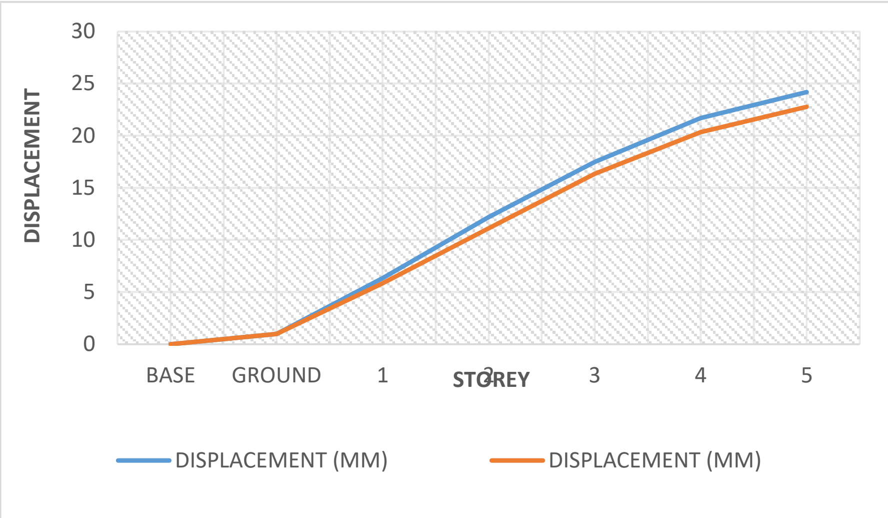
Sr. No.	COMBINATION	FACTOR
1	COMB 1	D.L. + L.L.
2	COMB 2	1.5D.L. + 1.5L.L.
3	COMB 3	1.2D.L. +1.2L.L. +1.2EQX AND 1.2D.L. +1.2L.L. -1.2EQX
4	COMB 4	1.2D.L. +1.2L.L. +1.2EQY AND 1.2D.L. +1.2L.L. -1.2EQY
5	COMB 5	1.5D.L. + 1.5EQX AND 1.5D.L. - 1.5EQX
6	COMB 6	1.5D.L. + 1.5EQY AND 1.5D.L. - 1.5EQY
7	COMB 7	0.9D.L. + 1.2EQX AND 0.9D.L. - 1.2EQX
8	COMB 8	0.9D.L. + 1.2EQY AND 0.9D.L. - 1.2EQY

4. RESULTS AND ANALYSIS

1. DISPLACEMENT:

TABLE NO.5: DISPLACEMENT

STOREY	DISPLACEMENT (MM)	
	CONVENTIONAL	GRID
BASE	0	0
GROUND	0.98	0.98
1	6.34	5.84
2	12.19	11.13
3	17.47	16.35
4	21.70	20.336
5	24.17	22.76

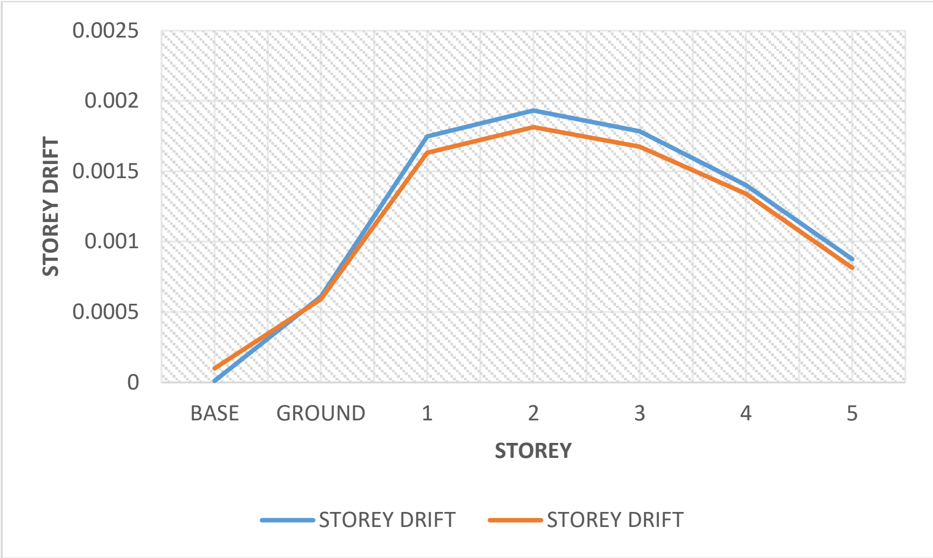


GRAPH 1

2. STOREY DRIFT:

TABLE NO.6: STOREY DRIFT

STOREY	STOREY DRIFT (MM)	
	CONVENTIONAL	GRID
BASE	0.0000105	0.000099
GROUND	0.0006089	0.0005915
1	0.0017480	0.0016317
2	0.0019318	0.0018141
3	0.0017848	0.0016760
4	0.0014016	0.0013408
5	0.0008766	0.0008134

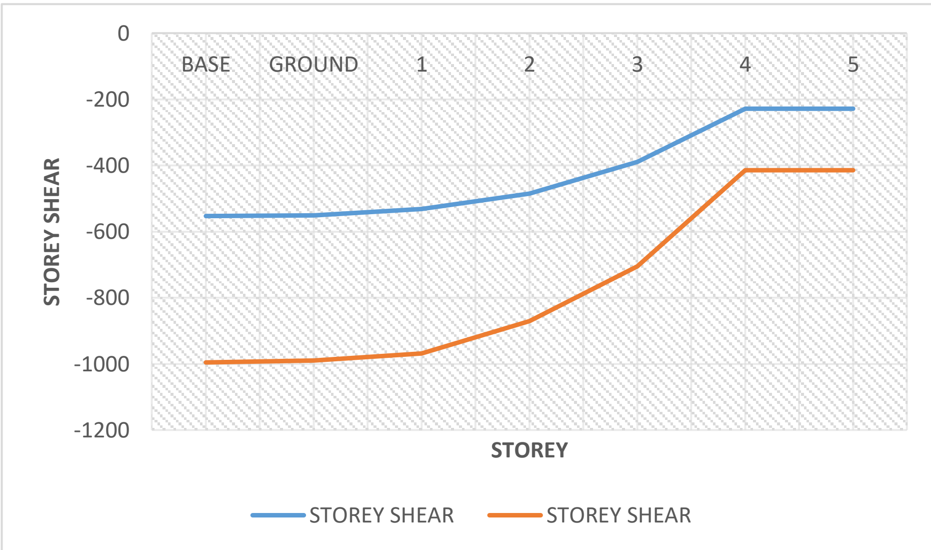


GRAPH 2

3. STOREY SHEAR:

TABLE NO.7: STOREY SHEAR

STOREY	STOREY SHEAR (kN)	
	CONVENTIONAL	GRID
BASE	552.50	995.08
GROUND	551.00	989.80
1	531.50	967.94
2	485.00	870.23
3	389.00	704.67
4	228.50	414.26
5	228.50	414.26



GRAPH 3

4. COLUMN MOMENT:

Column moments for Conventional slab and Grid slab are shown in Table No. 4

TABLE NO.8: COLUMN MOMENTS

STOREY	LOCATION	COLUMN MOMENTS (kN-m)	
		CONVENTIONAL	GRID
GROUND LEVEL	TOP	-5.21	-1.03
	BOTTOM	67.58	115.03
1	TOP	-52.75	-84.19
	BOTTOM	89.82	149.63
2	TOP	-59.20	-96.29
	BOTTOM	79.07	127.83
3	TOP	-60.34	-98.81
	BOTTOM	74.02	119.64
4	TOP BOTTOM	-53.50 63.23	-89.81 102.37
5	TOP	-66.72	-107.80
	BOTTOM	56.76	88.93

5. CONCLUSION

1. Displacement of Grid slab frame is less as compare to Conventional R.C. frame

2. Storey Drift in Grid slab frame is less as compare to Conventional R.C. frame

3. Grid slab frame structure possess maximum Base shear as compare to Conventional R.C. frame

4. Moments on column is more in Grid slab frame as compare to Conventional R.C. frame.

REFERENCES

[1] IS: 456-2000. 'Indian Standard Code of Practice for Design of reinforced concrete", Bureau of Indian Standard, New Delhi

[2] Chintha Santhosh, Venkatesh Wadki, S.Madan Mohan, S.Sreenatha Reddy, "Analysis and Design of Multi story Building with Grid Slab Using ETABS " , International Journal of Innovative Research in Science,Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 5, Issue 9, September 2016

[3] User manual for E tabs

[4] CH.Rajkumar, Dr.D.Venkateswarlu, "Analysis and Design of Multi story Building with Grid Slab Using ETABS" International Journal of Professional Engineering Studies Volume viii /issue 5 / June 2017

[5] A Sathawane R.S Deotale 'Analysis and design of flat and grid slab and their comparison, International Journal of Engineering Research and their applications vol. 1. Issue.3.PP 837-848

[6] N. Krishnaraju, Advanced reinforced concrete design (IS 456-2000) (CBS publications and distributors, CBS plaza, New Delhi)

[7] Ibrahim vepari, Dr.H.S Patrl, study on economical aspects of long span slabs, 13-14 may 2000

[8] Charles, E. Reynolds and James C. Steedman Reinforced concrete design handbook (E&FM span Taylor and Francis group 1988).