Seismic Analysis and Design of Multistoried Educational Building (G+6)

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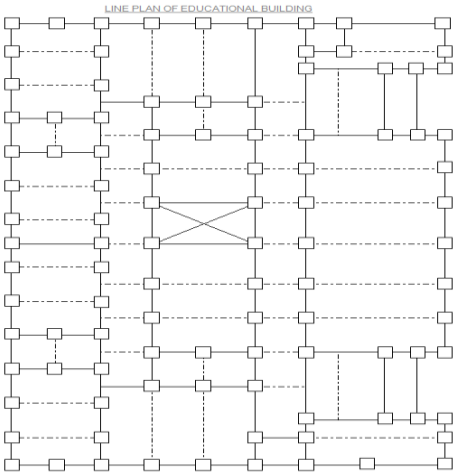
ABSTRACT
The part of static analysis and design of structure consists of calculating live load and dead load (imposed load) of the structure for a given plan and elevation of G+6 story educational building. Then designing of beam, column and slab for the maximum value of corresponding bending moments, and shear force. The load from the slab is transferring to beam and then from beam to column and then to the foundation, further on sub-grade soil. The dynamic analysis consists of finding out the earthquake load by Response spectrum method and Equivalent static lateral force method, by plotting various mode Shape, and finding out the base shear, then story shear and then using that earthquake load, design has been done for suitable load Combination.

1. INTRODUCTION

The project is entitled as "SEISMIC ANALYSIS AND DESIGN OF MULTISTORIED EDUCATIONAL BUILDING (G+6)" the plan of the building is similar to Kalpana Chawla Block, ABES Engineering College. The building needed to be designed is an educational building of G+6 floors. It consists of various rooms such as classrooms, faculty cabin, and computer labs. Moreover corridors and toilets are also present. For the roof the live load taken is 1.5 KN/m2.For the other floors the live load is different i.e. for classrooms and labs it is 3 KN/m2, for corridors it is 3 KN/m2, for washroom. It is 3 KN/m2.The main purpose of the project work is to design the building by finding out the dead loads of the respective slab and then transferring them to the respective beams further which are transferred to the respective columns including the self-weight of the beam, the process is repeated for all the columns and the load from the whole floor is transferred to the columns including the self-weight of the columns, this process is done for all the floors and the whole loads of all the storeys are finally transferred to the columns. The total load on the raft is calculated by adding the final load of all the columns, this total load is used to design the raft, moreover the loads on beams, columns, slabs are used to design the respective beams, columns, slabs.

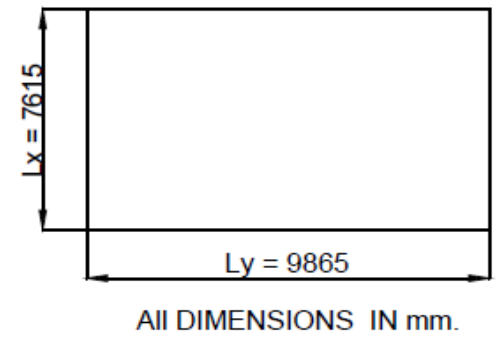
2. OBJECTIVE

The objective of this project is to carry out the seismic analysis and design of G+6 multi-storey educational building. For that purpose, the work has been divided in to following heads.
Calculation of load acting on slab and its design.
2. Calculation of load acting on beam from slab due to live load and dead load, and its self-weight.
3. Design of beam.
4. Calculation of load on the columns and its design.
5. Design of foundation.
6. Modelling of structure in SAP 2000 Software.
7. Dynamic analysis and design of structure by response spectrum method using SAP 2000

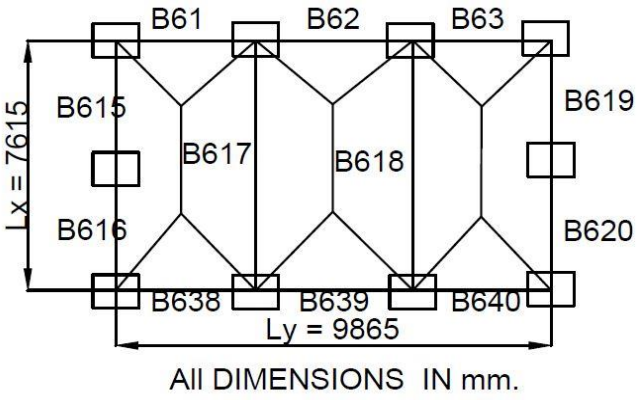


3. METHODOLOGY

DESIGN OF ROOF SLAB



LOAD CALCULATION AT 6TH FLOOR



DYNAMIC ANALYSIS RESULTS BY RESPONSE SPECTRUM METHOD BY SAP2000

MODE SHAPE

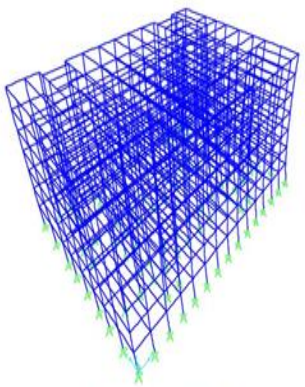


Figure-1.1: Mode 1

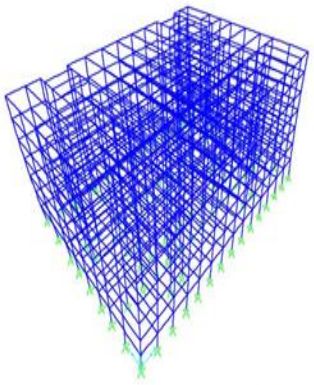


Figure-1.2: Mode 2

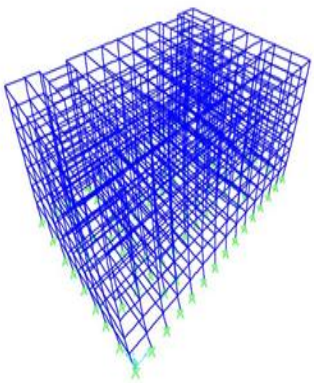


Figure-1.3: Mode 3

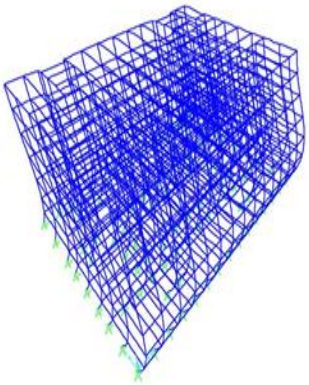


Figure-1.4: Mode 4

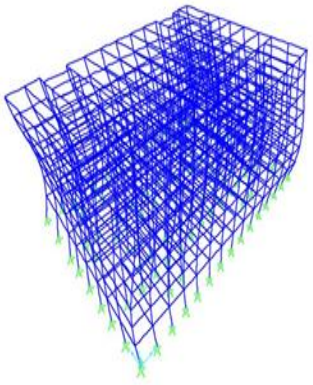


Figure-1.5: Mode 5

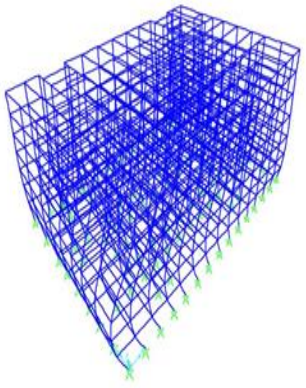


Figure-1.6: Mode 6

BASE REACTIONS TABLE

TABLE NO. - 1.10

Mode no.	GlobalFX (KN)	GlobalFY (KN)
Mode 1	12.215	-1009.796
Mode 2	829.402	23.48
Mode 3	932.253	-4.774
Mode 4	-40.664	3063.841
Mode 5	-2518.762	-83.646
Mode 6	3024.574	-29.225

MODAL PARTICIPATION MASS RATIO TABLE

TABLE NO. - 1.2

Mode no.	Period (sec)	X-Direction (%)	Y-Direction (%)
Mode 1	1.999401	0.013	90.633
Mode 2	1.87428	47.216	0.00038
Mode 3	1.727418	43.041	0.001129
Mode 4	0.599749	0.00119	0.06755
Mode 5	0.549581	3.219	0.00355
Mode 6	0.515509	3.593	0.0003355

MODAL PERIOD AND FREQUENCY TABLE

TABLE NO. – 1.3

Mode no.	Period (sec)	Frequency (Hz)	Frequency (rad/sec)
Mode 1	1.999401	0.50015	3.1425
Mode 2	1.87428	0.53354	3.3523
Mode 3	1.727418	0.5789	3.6373
Mode 4	0.599749	1.6674	10.476
Mode 5	0.549581	1.8196	11.433
Mode 6	0.515509	1.9398	12.188

RESULT AND DISCUSION

Designs of beam, column, slab and raft footing have been carried out. The Reinforcements detailing for which have been shown hare as follows.

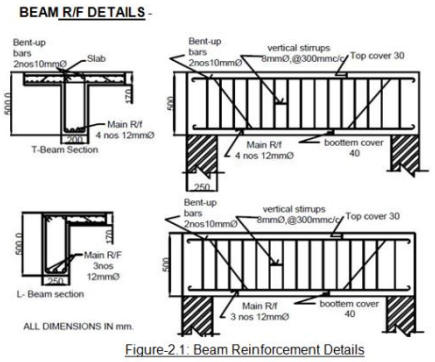


Figure-2.1: Beam Reinforcement Details

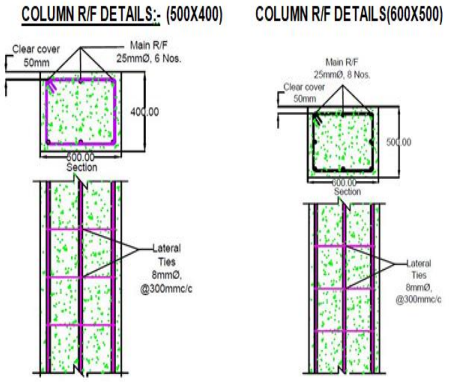


Figure-2.3: Column R/F Details (500x400)

Figure-2.4: Column R/F Details (600x500)

Discussion

Modal participation ratios are decreasing on increasing of mode number. So we have shown results up to only six mode

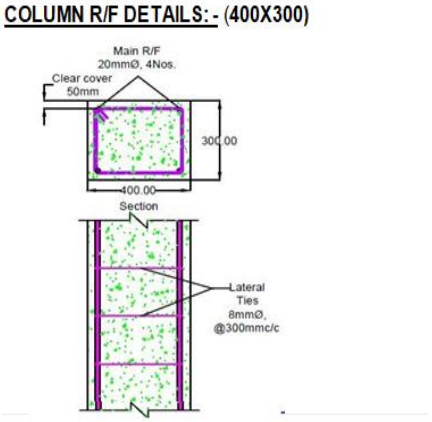


Figure-2.2: Column Reinforcement Details (400x3000)

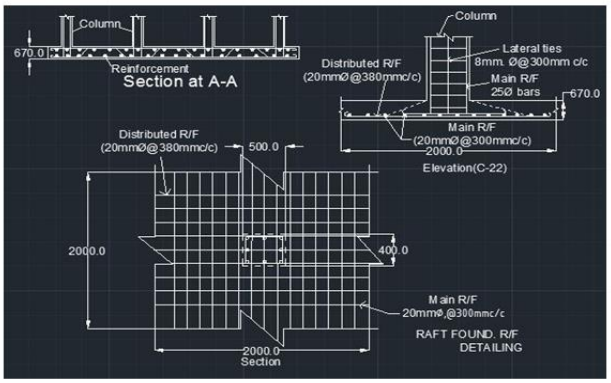


Figure-2.5: Raft Foundation R/F Details

CONCLUSION AND RECOMMENDATION FOR FURTHER STUDIES

Designing of G+6 multi-storey educational building has been carried out and design details of beam, column, slab, and foundation have been completed which is able to withstand under seismic condition of up to zone-4 and soil condition of hard soil.

Building could also have been designed for ductile detailing as per IS-13920, to make it SMRF (Special RC moment resisting frame).

Building can also be analysed by another advance methods like.

1. Modal Time history method.
2. P-Δ Analysis.
3. Nonlinear Pushover method.

Analysis by taking stiffness of infill

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