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Comparative Analysis of Mono Column Building

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Abstract: A building is the first structure, which pops into anyone's head as soon as one thinks of civil engineering. A building not only provides housing to its habitants but it also safeguards them from many natural adversities. Preventing all the forces causing such incidents is the need for designing the building.
But designing a building requires going through a myriad of processes. The various factors have to be taken into consideration before commencing the actual work of designing a building, which is carried out before the construction work. Various steps involved in designing of RCC structure supported on a single column using STAAD Pro are Geometric modeling, providing material properties and section properties, fixing supports and boundary conditions, providing loads and load combinations, special commands, analysis specification and Design Command.
Keywords: single column, lateral loads, earthquake loads, wind loads and STAAD

I. INTRODUCTION

A large number of structures that are being constructed at present tend to be wind-sensitive because of their shapes, slenderness, flexibility, size and lightness.

Added to these are the uses of materials which are stressed too much higher percentage of their ultimate strength than the in earlier days because of better assurance of quality of materials. In the social environment that is developing world over , the ancient philosophy of accepting continuing disasters due to wind as ordained by 'fate' and gods is giving place to demands for economical wind resistant Updating of some international codes of practice, notably the British, Australian, Canadian , American and French has been effected fairly frequently over the last two decades and the present versions incorporate most of the advances made in understanding the wind characteristics and its effect on structures.

II. REVIEW OF LITERATURE

Isaković, et al [2] presented the results from seismic analyses performed on 24 RC buildings with three different co figurations like, Step back building; Step back Set back building and Set back building are presented. 3 –D analysis including tensional effect has been carried out by using response spectrum method.

The dynamic response properties i.e. fundamental time period, to p storey displacement and, the base shear action induced in columns have been studied.

Macleod et al [3] studied research static analysis is performed to determine the displacements, stresses, strains, and forces in structures and their components caused by loads that do not induce significant inertia and damping effects. Steady loading and response conditions are assumed; that is, the loads and the structure's response are assumed to vary slowly with respect to time.

Mohanraj et al [4] studied

The paper comprises of RCC building having G+4 floors which have been elevated from the ground floor for four floors. The proposed building is a commercial building. The shear wall will act as a single core. The shear wall will be connected to each other with a network of beams/ slabs with the slabs acting as in plane rigid diaphragms for each of the floors.

III. MODELING

The modeling is carried out in the STAAD software, mentioned as follows.

The following models are prepared in the project

1) Model-I: Normal-G+3 building (Zone-II)
2) Model-II: Normal-G+3 building (Zone-III)
3) Model-III: Normal-G+3 building (Zone-IV)
4) Model-IV: Normal-G+3 building (Zone-V)
5) Model-V: Normal-G+4 building (Zone-II)

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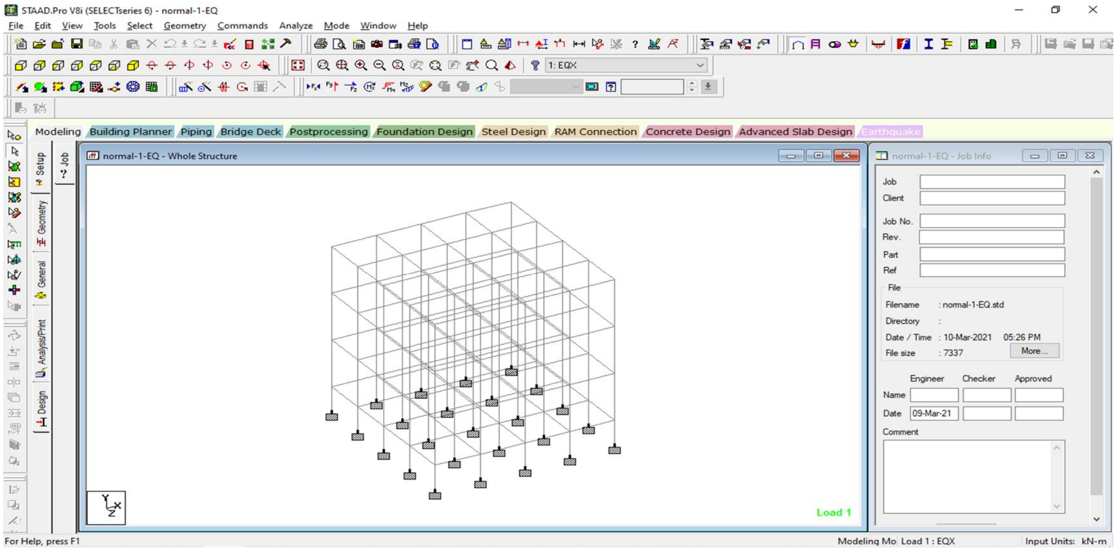

Fig.1: Model-I: Normal-G+3 building (Zone-II)

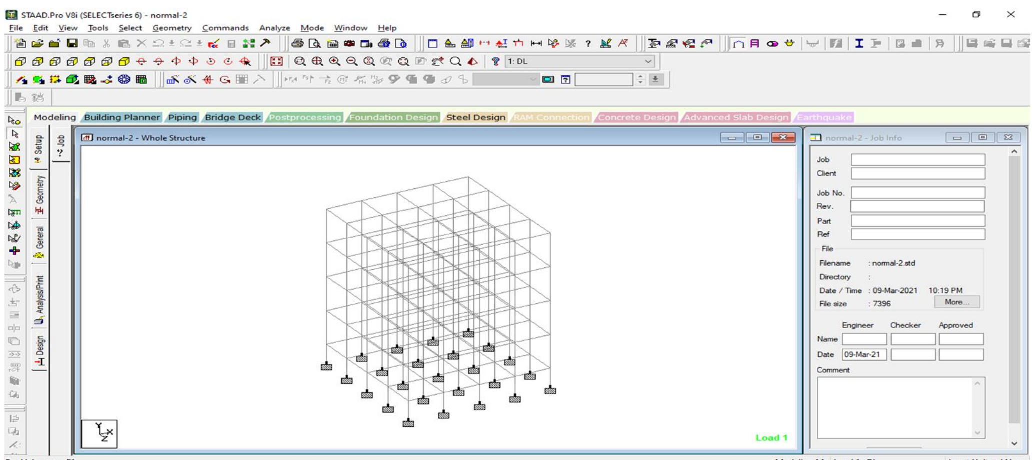

Fig.2: Model-V: Normal-G+4 building (Zone-II)

IV. RESULTS

The analysis is carried out in STAAD software and the results in terms of shear force, bending moment and other parameter is obtained as follows.

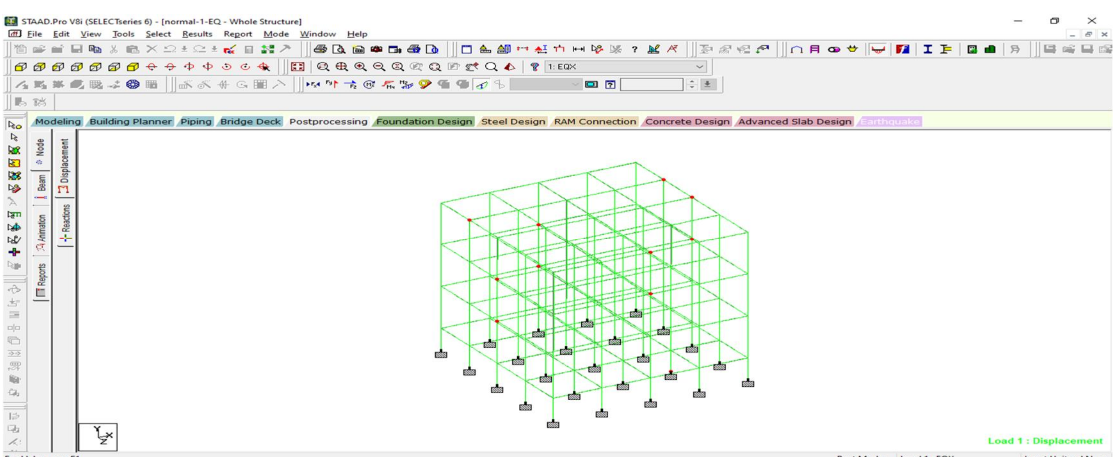

Fig.3: Displacement of Model-I

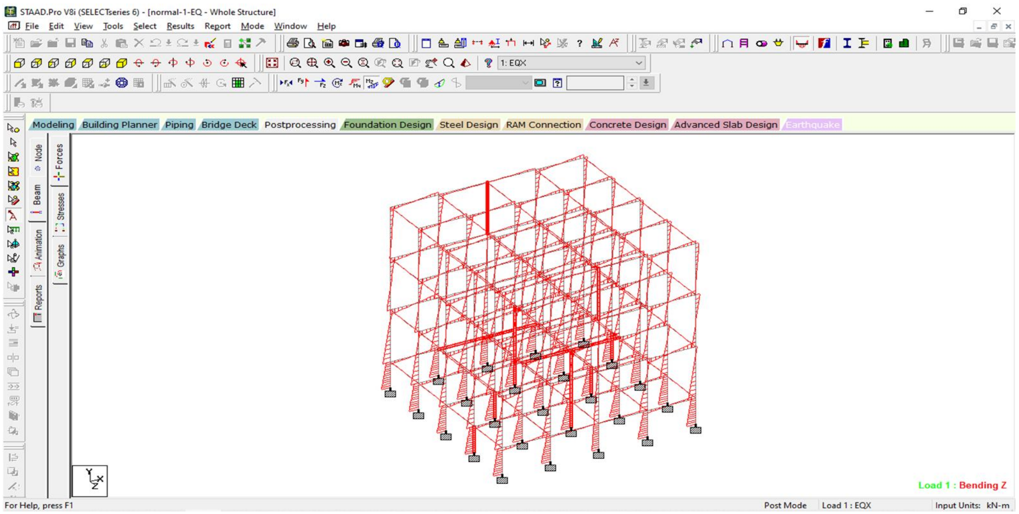

Fig.4: Beam forces of Model-I

Table No.1: Nodal Displacement of Model-II

		Horizontal	Vertical	Horizontal	Resultant
	Node	X mm	Y mm	Z mm	mm
Max X	49	7.847	-0.11	0.004	7.847
Min X	49	-7.847	-0.11	0.004	7.847
Max Y	63	-0.001	0.05	5.099	5.099
Min Y	108	0	-0.287	0	0.287
Max Z	52	-0.004	-0.11	7.847	7.847
Min Z	52	-0.004	-0.11	-7.847	7.847
Max rX	36	0.002	-0.1	5.128	5.129
Min rX	36	0.002	-0.1	-5.128	5.129
Max rY	17	2.369	-0.073	0	2.371
Min rY	19	0	-0.073	2.369	2.371
Max rZ	33	-5.128	-0.1	-0.002	5.129
Min rZ	33	5.128	-0.1	-0.002	5.129
Max Rst	49	7.847	-0.11	0.004	7.847

Table No.2: Frequencies for mode of Model-III

MODE	FREQUENCY(CYCLES/SEC)	PERIOD(SEC)
1	48.286	0.02071
2	49.011	0.0204
3	49.011	0.0204
4	49.427	0.02023
5	49.819	0.02007
6	50.258	0.0199
7	50.331	0.01987
8	50.331	0.01987
9	50.479	0.01981
10	50.665	0.01974
11	50.665	0.01974
12	51.072	0.01958

Table No.3: Nodal Reactions for Model-V

		Horizontal	Vertical	Horizontal	Moment		
	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	77	18.741	242.237	1.535	0.563	0.031	-35.58
Min Fx	79	-18.741	242.237	1.535	0.563	-0.031	35.58
Max Fy	117	0	418.412	0	0	0	0
Min Fy	73	-8.181	-44.42	-0.004	-0.004	-0.021	22.222
Max Fz	73	1.535	242.237	18.741	35.58	-0.031	-0.563
Min Fz	75	1.535	242.237	-18.741	-35.58	0.031	-0.563
Max Mx	118	0	293.559	18.02	35.814	0	0
Min Mx	119	0	293.559	-18.02	-35.814	0	0
Max My	65	-5.374	178.157	1.135	0.438	0.457	28.614
Min My	67	0.681	106.894	-5.374	-28.614	-0.457	-0.263
Max Mz	121	-18.02	293.559	0	0	0	35.814
Min Mz	120	18.02	293.559	0	0	0	-35.814

Table No.4: Beam forces and moments for Model-V

	Beam	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	236	117	418.412	0	0	0	0	0
Min Fx	129	9	-44.42	8.181	0.004	-0.021	-0.002	-9.951
Max Fy	186	100	0.017	28.344	-0.28	0.083	0.446	24.129
Min Fy	197	100	0.017	-28.344	0.28	-0.083	0.446	24.129
Max Fz	131	11	226.201	-1.535	18.741	0.031	7.469	-1.739
Min Fz	129	9	226.201	-1.535	-18.741	-0.031	-7.469	-1.739
Max Mx	281	49	39.148	-1.196	2.288	3.656	-2.612	-5.061
Min Mx	282	50	39.148	-1.196	-2.288	-3.656	2.612	-5.061
Max My	29	11	204.582	-1.257	-17.849	0.025	35.922	-1.813
Min My	27	9	204.582	-1.257	17.849	-0.025	-35.922	-1.813
Max Mz	33	15	204.582	17.849	1.257	-0.025	-1.813	35.922
Min Mz	31	13	204.582	-17.849	1.257	0.025	-1.813	-35.922

V. CONCLUSION

The conclusions from the above study are as follows:

A. The nodal reactions are found to be more in the Model-V Normal-G+4 building (Zone-II)
B. The nodal displacement is also found to be maximum in Model-V Normal-G+4 building (Zone-II)
C. The storey drift, mass participation factor in percentage and frequencies for mode shapes are also obtained for all the models
D. The concrete quantity and the steel quantity is also found in the all models and it was found that the model no. V Normal-G+4 building (Zone-II) gives the maximum result.

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