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Comparison between RCC and steel structure with wind and earthquake effect using Staad pro

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Abstract
The principle objective of this project is to comparison between RCC and Steel Structure and design a multi-storeyed building using STAAD Pro. The design involves load calculations and analyzing the whole structure by STAAD Pro. The design methods used in STAAD Pro analysis are Limit State Design conforming to Indian Standard Code of Practice. The Thesis involves Staad Modeling, Analysis the members due to the effect of Wind & Seismic load & Compare them for a 35 meter height Building with Concrete & Steel construction. The proposal structure is a 10 storied building with 3.50 m as the height of each floor. The overall plan dimension of the building is 30.0 m x 20.0m**.**

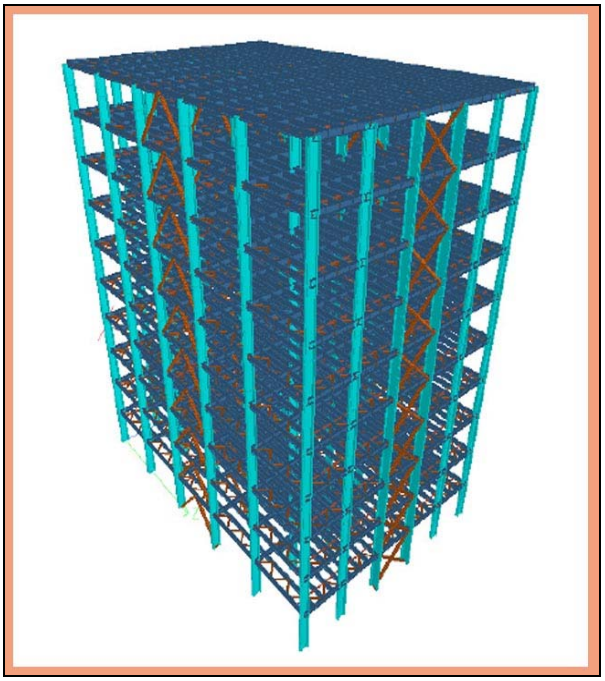
Keywords: Dead load, Live load, Wind load, Seismic load, Comparison between Steel and RCC Structure.

1. Introduction & Objective
The focus of this study, in the field of wind and earthquake engineering, is on the comparison of the dynamic behavior of a multi-story reinforced concrete building and steel structure building & how they respond to wind and earthquake induced excitations. Tall buildings are often of complex geometry while the building design codes, used to evaluate the dynamic properties of structures in the design phase, are based on simplified generic assumptions, which are primarily appropriate for relatively simple structures. Therefore a full-scale validation of dynamic behavior of buildings undergoing wind and earthquake excitations is important.

2. Methodology
In this paper a 3-D model ion staad pro has been developed to analyze the behavior of reinforced concrete tall building & steel structure building under wind and earthquake loads. This paper explain briefly also the effect of wind or earthquake loads on the structures for the comparative study between wind and earthquake effects on RCC framed building & steel framed building. Importance factor of building and finally soil factor were talking into considerations and there effects on the performance of tall buildings were discussed. Our purpose is to analyse & design both the structure & study the effect on foundation & as well as the effect on costing of material for construction purpose. The model has been designed for 10 storied building & this comparison will guide us in choosing the type of structure for a 35m height building.

3. Staad Model For Concrete Structure

4. Staad Model For Steel Structure



5. Load Parameters

i. ***Dead Load***

A) SELF WEIGHT OF BEAM & COLUMNS OF STRUCTURE
B) SELF WEIGHT OF RCC SLAB
C) BRICK WALL LOAD

ii. ***Live Load***

A) 400 KG/ m2 AS PER IS 875 PART II

iii. ***Wind Load***

AS PER IS 875 PART III
A) BASIC WIND SPEED: 50 M/SEC
B) PROBABILITY FACTOR (RISK CO- EFFICIENT): K1 = 1.08
C) TERRAIN, HEIGHT AND STRUCTURE SIZE FACTOR :
K2 =

0.91	From 0 to	10.00	M.
0.97	From 10 to	15.00	M.
1.01	From 15 to	20.00	M.
1.06	From 20 to	30.00	M.
1.06	From 30 to	31.50	M.

D) TOPOGRAPHY FACTOR: K3 = 1

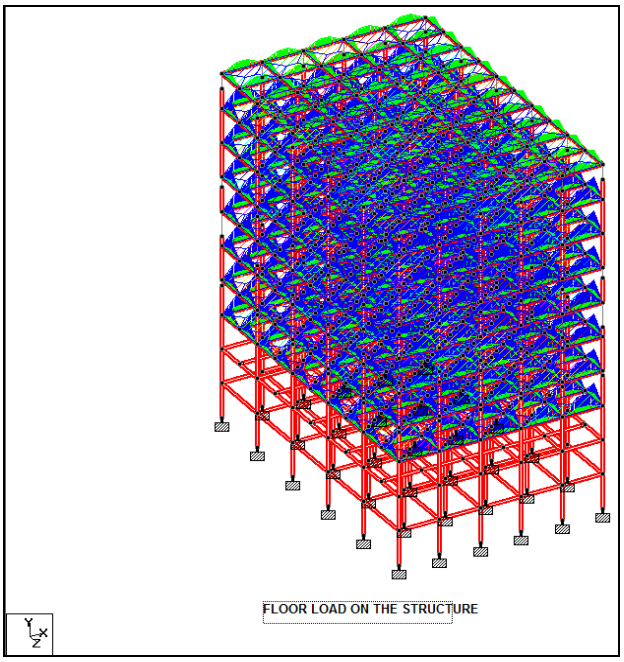
iv. ***Seismic Load***

AS PER IS 1893 – 2002 PART II
A) ZONE FACTOR : Z = 0.16
B) RESPONSE REDUCTION FACTOR : R.F = 5
C) IMPORATNCE FACTOR : I = 1
D) ROCK & SOIL SITE FACTOR : SS = 2
E) TYPE OF STRUCTURE : ST = 1
F) DAMPIG RATIO : DM = 5 FOR RCC & 2 FOR STEEL
G) PERIOD IN X DIRECTION : PX = 3.5
H) PERIOD IN X DIRECTION : PZ = 3.5

6. Load Combinations

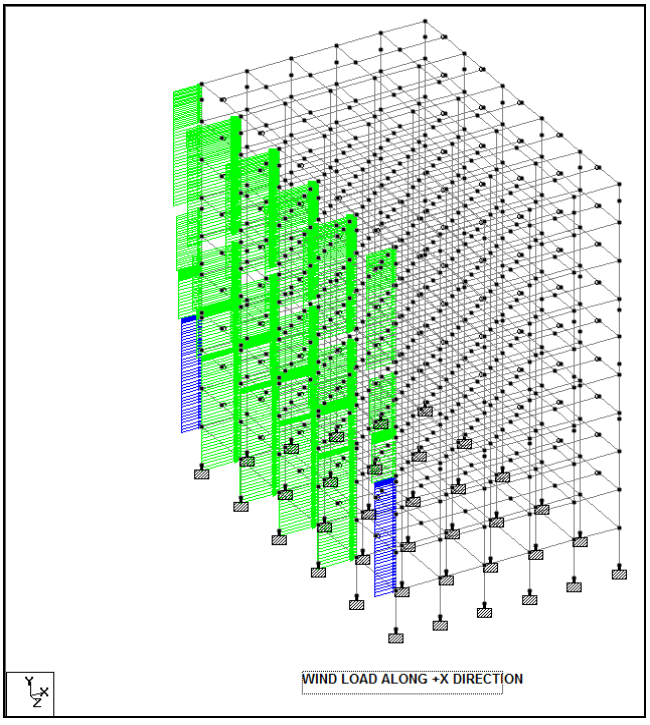
i. DEAD LOAD + LIVE LOAD
ii. DEAD LOAD + LIVE LOAD + WIND LOAD
iii. DEAD LOAD + LIVE LOAD + SEISMIC LOAD
iv. DEAD LOAD + WIND LOAD
v. DEAD LOAD + SEISMIC LOAD

Application of DEAD LOAD & LIVE LOAD:



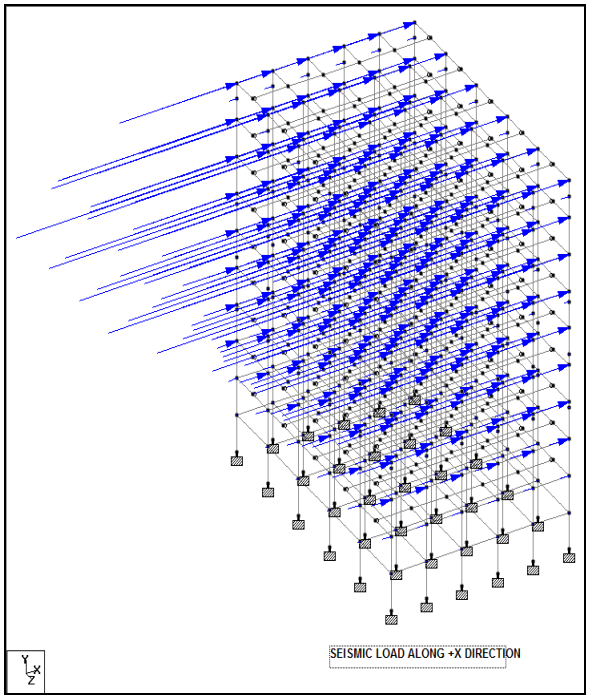
Dead Load & Live Load has been applied on the structures. Load of floor slab has been applied as Floor Load & Brick Wall Load has been applied as member Load. Self Weight of the structure also being applied.

Application of wind load along +X direction



Wind Load has been calculated in pressure co-efficient method for cladded building. On the basis of the intensity & influence area of the wind the wind load has been applied as member load on the structure.

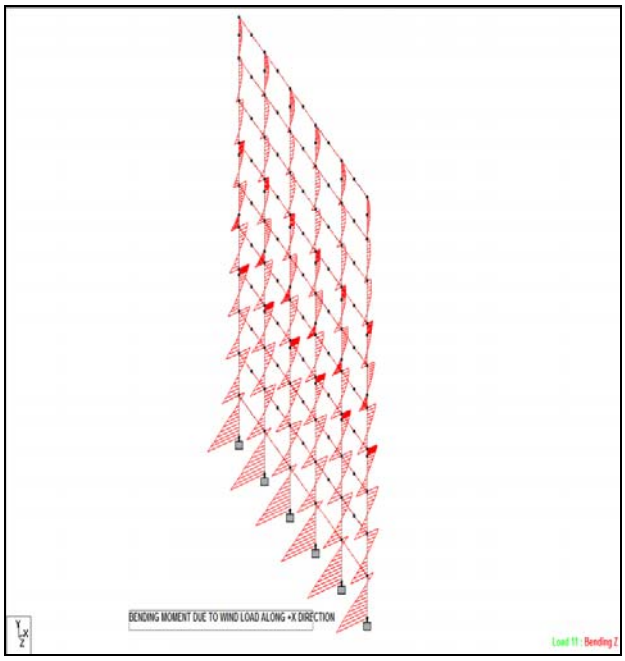
Application of Seismic load along +X direction



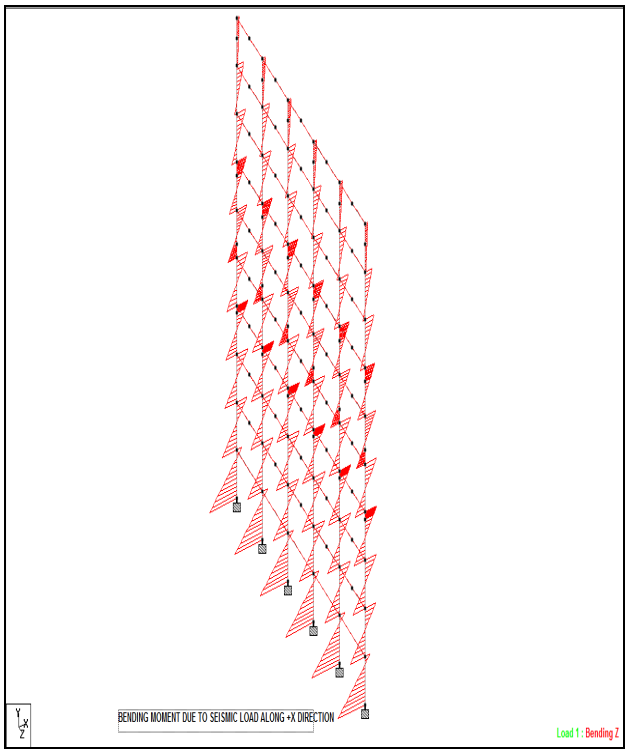
Seismic Load has been calculated as the effect of Dead Load of structure along with 50% of Live Load on the structure. The Joint Weight has been calculated & the same being applied on the structure.

Graphical Representation of Bending Moments on Structure

Wind Load on RCC Structure

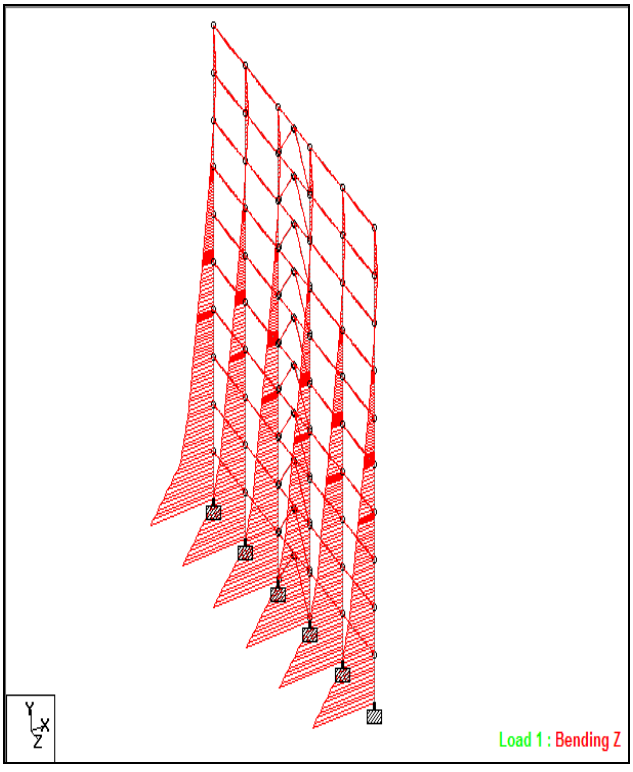


Seismic Load on RCC Structure

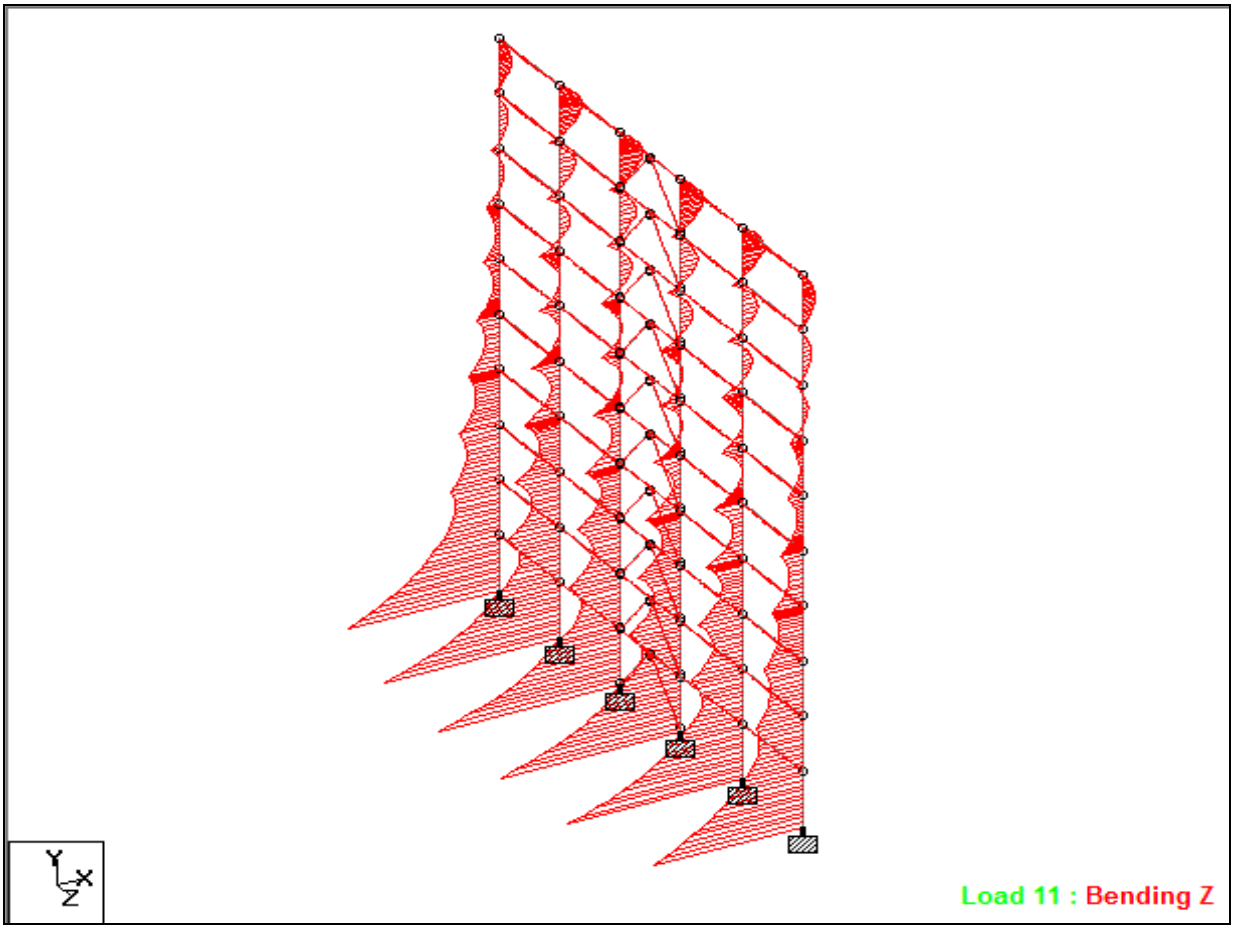


Above Bending Moment diagram shows the effect on the RCC structure when wind load is applied on the structure at +X direction.

Wind Load on Steel Structure



Seismic Load on Steel Structure



Above Bending Moment diagram shows the effect on the RCC structure when Seismic load is applied on the structure at +X direction.

7. Result

COMPARISON BETWEEN REACTION FOR SEISMIC LOAD IN CONCRETE & STEEL STRUCTURE							
Node	L/C	Horizontal (Fx Mton)		Vertical (Fy Mton)		Moment (Mz MTon-m)	
		Concrete	Steel	Concrete	Steel	Concrete	Steel
1	1 SL+X	-0.89	-0.07	-7.54	0.03	25.57	0.53
2	1 SL+X	-1.17	-0.07	-0.35	-0.21	28.72	0.54
3	1 SL+X	-1.16	-0.46	0.02	-7.28	28.68	0.02
4	1 SL+X	-1.16	-0.46	-0.02	7.28	28.68	0.02
5	1 SL+X	-1.17	-0.07	0.35	0.21	28.72	0.54
6	1 SL+X	-0.89	-0.07	7.54	-0.03	25.57	0.53
7	1 SL+X	-0.92	-0.07	-7.71	0.04	26.10	0.54
8	1 SL+X	-1.19	-0.08	-0.59	-0.40	29.25	0.55
9	1 SL+X	-1.19	-0.48	0.05	-7.36	29.21	0.02
10	1 SL+X	-1.19	-0.48	-0.05	7.35	29.21	0.02
11	1 SL+X	-1.19	-0.08	0.59	0.40	29.25	0.55
12	1 SL+X	-0.92	-0.07	7.71	-0.05	26.10	0.54
13	1 SL+X	-0.92	-0.08	-7.77	0.18	26.24	0.55
14	1 SL+X	-1.20	-0.08	-0.60	-0.73	29.40	0.57
15	1 SL+X	-1.19	-0.51	0.04	-7.38	29.36	0.03
16	1 SL+X	-1.19	-0.51	-0.04	7.38	29.36	0.03
17	1 SL+X	-1.20	-0.08	0.60	0.74	29.40	0.57
18	1 SL+X	-0.92	-0.08	7.77	-0.18	26.24	0.55
19	1 SL+X	-0.92	-0.07	-7.77	0.10	26.24	0.55
20	1 SL+X	-1.20	-0.08	-0.60	-0.78	29.40	0.56
21	1 SL+X	-1.19	-0.51	0.04	-7.35	29.36	0.03

COMPARISON BETWEEN REACTION FOR SEISMIC LOAD IN CONCRETE & STEEL STRUCTURE							
Node	L/C	Horizontal (Fx Mton)		Vertical (Fy Mton)		Moment (Mz MTon-m)	
		Concrete	Steel	Concrete	Steel	Concrete	Steel
22	1 SL+X	-1.19	-0.50	-0.04	7.35	29.36	0.03
23	1 SL+X	-1.20	-0.08	0.60	0.78	29.40	0.56
24	1 SL+X	-0.92	-0.07	7.77	-0.10	26.24	0.55
25	1 SL+X	-0.92	-0.07	-7.71	0.04	26.10	0.53
26	1 SL+X	-1.19	-0.08	-0.59	-0.39	29.25	0.54
27	1 SL+X	-1.19	-0.48	0.05	-7.23	29.21	0.02
28	1 SL+X	-1.19	-0.47	-0.05	7.22	29.21	0.02
29	1 SL+X	-1.19	-0.08	0.59	0.40	29.25	0.54
30	1 SL+X	-0.92	-0.07	7.71	-0.05	26.10	0.53
31	1 SL+X	-0.89	-0.07	-7.54	0.02	25.57	0.51
32	1 SL+X	-1.17	-0.07	-0.35	-0.20	28.72	0.52
33	1 SL+X	-1.16	-0.45	0.02	-7.09	28.68	0.02
34	1 SL+X	-1.16	-0.45	-0.02	7.09	28.68	0.02
35	1 SL+X	-1.17	-0.07	0.35	0.21	28.72	0.52
36	1 SL+X	-0.89	-0.07	7.54	-0.03	25.57	0.51

COMPARISON BETWEEN REACTION FOR WIND LOAD IN CONCRETE & STEEL STRUCTURE							
Node	L/C	Horizontal (Fx Mton)		Vertical (Fy Mton)		Moment (Mz MTon-m)	
		Concrete	Steel	Concrete	Steel	Concrete	Steel
1	11 WL+X1	-4.36	-3.17	-28.46	0.41	125.19	13.04
2	11 WL+X1	-5.83	-2.13	-1.09	-3.43	141.63	12.38
3	11 WL+X1	-5.77	-12.05	0.08	-140.35	140.91	0.55
4	11 WL+X1	-5.76	-12.15	-0.08	140.34	140.68	0.54
5	11 WL+X1	-5.79	-1.97	1.09	3.48	140.83	11.98
6	11 WL+X1	-4.44	-1.81	28.46	-0.45	125.47	11.68
7	11 WL+X1	-4.76	-4.62	-29.49	0.72	136.35	15.18
8	11 WL+X1	-6.40	-2.53	-1.91	-6.61	154.65	13.70
9	11 WL+X1	-6.32	-13.56	0.16	-145.63	153.56	0.60
10	11 WL+X1	-6.30	-13.80	-0.17	145.61	153.13	0.59
11	11 WL+X1	-6.33	-2.21	1.91	6.71	153.15	12.92
12	11 WL+X1	-4.90	-2.02	29.49	-0.80	136.82	12.56
13	11 WL+X1	-4.91	-4.75	-30.00	2.06	140.41	15.70
14	11 WL+X1	-6.59	-2.69	-1.93	-12.99	159.20	14.27
15	11 WL+X1	-6.51	-14.51	0.16	-148.39	158.09	0.63
16	11 WL+X1	-6.49	-14.70	-0.16	148.24	157.66	0.62
17	11 WL+X1	-6.52	-2.40	1.94	13.06	157.69	13.57
18	11 WL+X1	-5.05	-2.21	30.00	-1.96	140.89	13.23
19	11 WL+X1	-4.91	-4.76	-30.00	2.80	140.41	15.71
20	11 WL+X1	-6.59	-2.68	-1.93	-12.74	159.20	14.25
21	11 WL+X1	-6.51	-14.47	0.16	-147.87	158.09	0.63
22	11 WL+X1	-6.49	-14.72	-0.16	148.00	157.66	0.62
23	11 WL+X1	-6.52	-2.35	1.94	12.64	157.69	13.45
24	11 WL+X1	-5.05	-2.14	30.00	-2.84	140.89	13.06
25	11 WL+X1	-4.76	-4.61	-29.49	0.72	136.35	15.12
26	11 WL+X1	-6.40	-2.52	-1.91	-6.58	154.65	13.64
27	11 WL+X1	-6.32	-13.47	0.16	-145.02	153.56	0.60
28	11 WL+X1	-6.30	-13.71	-0.17	145.00	153.13	0.59
29	11 WL+X1	-6.33	-2.19	1.91	6.68	153.15	12.84
30	11 WL+X1	-4.90	-2.00	29.49	-0.80	136.82	12.48
31	11 WL+X1	-4.36	-3.16	-28.46	0.41	125.19	13.00
32	11 WL+X1	-5.83	-2.12	-1.09	-3.42	141.63	12.34
33	11 WL+X1	-5.77	-12.00	0.08	-139.91	140.91	0.54
34	11 WL+X1	-5.76	-12.10	-0.08	139.89	140.68	0.54
35	11 WL+X1	-5.79	-1.96	1.09	3.47	140.83	11.94
36	11 WL+X1	-4.44	-1.80	28.46	-0.45	125.47	11.64

8. Discussion & Comparison

COMPARISON BETWEEN CONCRETE & STEEL STRUCTURE			
Sl. No.	**DESDCRIPTION**	**CONCRETE STRUCTURE**	**STEEL STRUCTURE**
1	Size of foundation	4.2 X 4.2 X 0.75 approximate concrete quantity for 1 FDN = 13.25 m^3	3.5 X 3.5 X 0.60 approximate concrete quantity for 1 FDN = 7.35m^3
2	Quantity of material	Total concrete quantity = 2200 m^3 total reinforced bar quantity = 230 TON	Total steel quantity = 830 TON Total concrete quantity = 265 m^3
3	Cost estimate of structure	5.50 CRORE	7.20 CRORE
4	Durability	More durable than steel structure	less durable than concrete structure
5	Safety	High endurance in temperature and fire, hence much safer	Protection in temperature and fire is lesser than concrete
6	Repair	Repair work is easier and cheaper	Repair work is costlier
7	Recycling of material	Recycling of material is not possible except reinforced bar	Recycling of most of the material is possible, hence advantageous

9. Conclusion

- Dead Weight of the Steel framed structure is much lesser than RCC framed structure.
- Bending moment due to Wind force is increased in Steel structure for high rise building. This could have been effect in the costing of the material.
- Bending moment due to Seismic force is reduced in Steel structure for high rise building. This could have been effect in the costing of the material.
- Overall expense is much higher in steel structure than concrete structure in multistoried building.
- Concrete structure is durable & safe with respect to steel structure.

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