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Analysis and Design of High-Rise (G +12) Building Using STAAD Pro

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Abstract: *High rise building is the most frequently used word in all most all construction activities especially in rapidly growing cities in terms of development and population. National Building Code (NBC) defines a high-rise as "All buildings 15 m or above in height (a building more than 4 storeys). The employment opportunities and facilities offered by the developing cities makes people to migrate towards urban areas which create the land scarcity for both Industrial and residential occupants. To satisfy the needs considering the future demand of habitable area and efficient use of land without expanding the boundaries of the cities makes people to choose high rise building it also facilitates with stunning views less noise pollution etc. STAAD is a popular structural analysis application known for analysis, diverse applications of use, Interoperability, and time-saving capabilities. STAAD helps structural engineers perform 3D structural Analysis and design for both steel and concrete structures. It ensures on-time and cost-effective Completion of steel, concrete, timber, aluminium, and cold-formed steel structures and designs, Regard less of complexity. We conclude that in this study we consider plot area 70 m x 24 m of g+12 Building consisting of 72 flats located kesarapalli near vijayawada Located in zone 3. we are going to analyse the high rise building for shear force and bending moments and design of critical sections of slab staircase footing by considering various loads such as with and without wind load, imposed load, dead loads.*

Key Word: *High rise building, wind load, STAAD pro.*

I.INTRODUCTION

Now a days tall or multi-storey buildings has gain very much importance, because in metro cities there is a rapid increase in population with limited land. All people require good accommodations, aesthetic, comfort and safety. Thats the reason for increase in construction of multi-storey buildings.

Structural design of multi-storey buildings is basically worried with safety during ground motion, serviceability what's more, potential for monetary misfortune. Design of structures using Limit State method Design the members are designed for the limiting bending momentand serviceability limits, hence the structures are left with minimum reserve energy. Earthquake will cause more severe effect on tall buildings compare to small buildings. Due to earthquake asymmetrical buildings will damage more than symmetrical buildings. In case of high-rise structures horizontal loads produce develop high lateral displacements which is not desirable for the occupants and the structure itself.

The enormous increase in population and scarcity of land makes the people to move from rural areas to urban paces and construction of multi-storied buildings in small areas is being common now-a-days. Functional designing of the building has become very important and the requirements vary from one building to another. Every Civil Engineer should know the usage of the buildings by contacting the people and basic principles of designing of the R.C.C structures. This is project is intended at Analysing and designing the multi-storey structure using STAAD. PRO V8i and STAAD. ETC. In this project, we adopted limit state method of analysis and design the structural members manually and using STAAD.PRO.V8i and STAAD.ETC. Manually design is done for particular beam, column and slab by using IS456:2000 and loadsare dead load, imposed load and external load considered according to IS 875:1987 (PART III). It is then checked in STAAD.PRO.V8i and STAAD.

Few standard problems also have been solved to show how STAAD. Pro can be used in differentcases. These typical problems have been solved using basic concept of loading, analysis, condition as per IS code. These basic techniques may be found useful for further analysis of problems.

Objectives
1.To analyse the multi-storey high-rise building consists of 12 floors using STAAD Pro.
2.To obtain the results of Maximum shear force and Maximum bending Moment for beams,Maximum axial force for columns and beams.
3.To design the critical structural members of beam, column, slab, footing and staircase usingIS 456-2000 & SP-16.

II.LITERATURE REVIEW

• Ibrahim, et.al (April 2019)1: Design and Analysis of Residential Building(G+4): After analysing the G+4 story residential building structure, conducted that the structure is rate in loading like dead load, live load, wind load and seismic loads. Member dimensions (Beam, column, slab) are assigned by calculating the load type and its quantity applied on it. Auto CAD gives detailed information at the structure members length, height, depth, size and numbers, etc. STADD Pro. has a capability to calculate the program contains number of parameters which are designed as per IS 456: 2000. Beams were designed for flexure, shear and tension and it givesthe detail number, position and spacing breif.

• Dunnala Lakshmi Anuja, et.al (2019)2: Planning, Analysis and Design of Residential Building(G+5) By using STAAD Pro: Frame analysis was by STAAD-Pro. Slab, Beams, Footing and stair-case were design as per the IS Code 456-2000 by LSM. The properties such as share deflection torsion, development length is with the IS code provisions. Design of column and footing were done as per the IS 456-2000 along with the SP-16 design charts. The check likeoneway shear or two-way shear within IS Code provision. Design of slab, beam, column, rectangular footing and staircase are done with limit state method. On comparison with drawing,manual design and the geometrical model using STADD Pro. 3

Mr K. Prabin Kumar, et.al (2018)3: A Study on Design of Multi-Storey Residential Building: They used STADD Pro. to analysis and designing all structure member and calculate quantity of reinforcement needed for concrete section. Various structure action is considered as members such as axial, flexure, shear and tension. Pillar are delineated for axial forces and biaxial ends at the ends. The building was planned as per IS: 456- 2000

• Deevi Krishna Chaitanya, et.al (January, 2017)4: Analysis and Design of a (G+6) Multi-StoreyBuilding Using STAAD Pro: They used static indeterminacy methods to calculate numbers of unknown forces. Distributing known fixed and moments to satisfy the condition of compatibilityby Iteration method. Kanis method was used to distribute moments at sucessire joints in frame and continues beam for stability of members of building structure. They used the designing software STADD Pro. which reduced lot of time in design, gives accuracy.

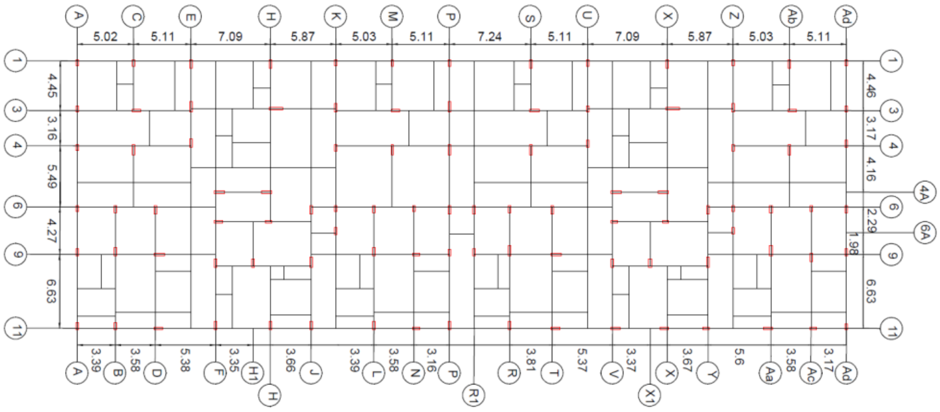
• R. D. deshpande, et.al (June, 2017)5: Analysis, Design and Estimation of Basement+G+2 Residential Building: They found that check for deflection was safe. They carried design and analysis of G+2 residential building by using E-Tabs software with the estimation of building bymethod of center line. They safely designed column using SP-16 checked with interaction formula.

III.DETAILS OF THE PROJECT

1. Type of Building - G+12 HIGH-RISE residential building
2. Number of storey -12 storeys
3. Types of foundation - Pile foundation
4. Height of building - 24 m from G.L
5. Total gross area of the building - 1670 sq.m
6. Column Size - 1200X300 mm,
1000X300 mm,
800X300 mm,
600X300 mm &
500X300 mm
7. Beam Size - 300X630 mm
300X500 mm
8. Interior wall thickness – 230 mm
9. Exterior wall thickness – 300 mm
10. Storey height – 3 m
11. Number of flats per storey – 12
12. Total number of flats –144
13. Name of the building – Hemadurga realtors
14. Location – Kesarapalli, Vijayawada

Plan:

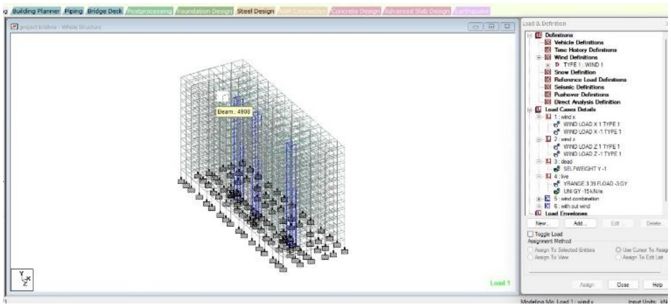
Beam Column Layout:

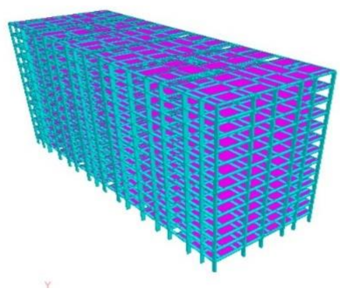


IV.ANALYSIS AND DESIGN USING STAAD PRO

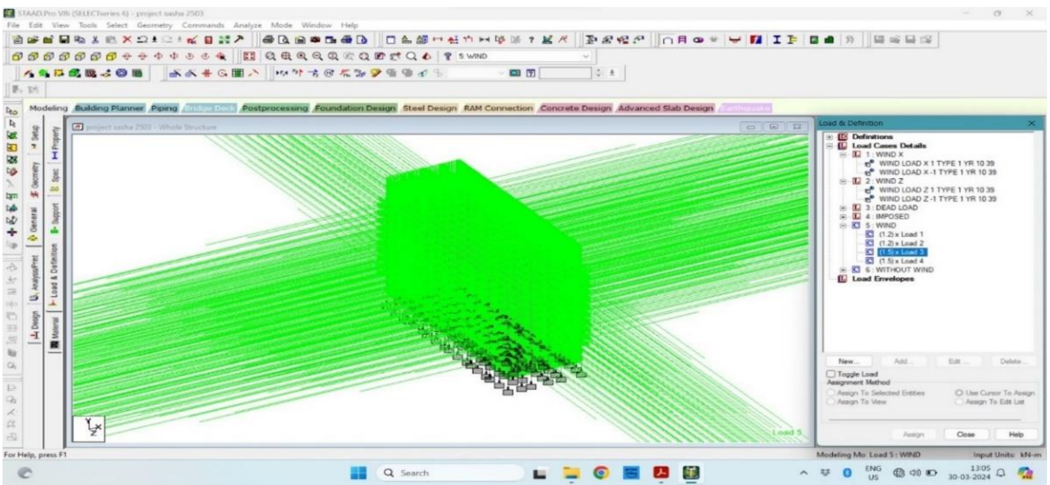
The Following Are the Major Steps for Obtaining Results for Staad Pro

Step 1: Creation of Panel



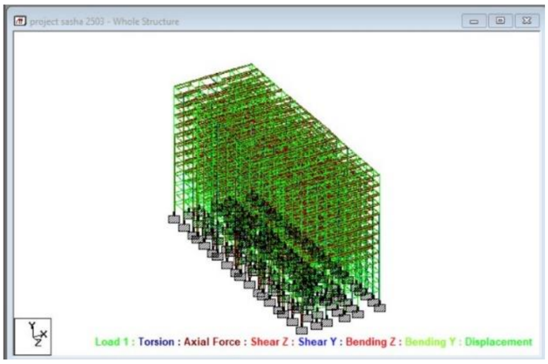


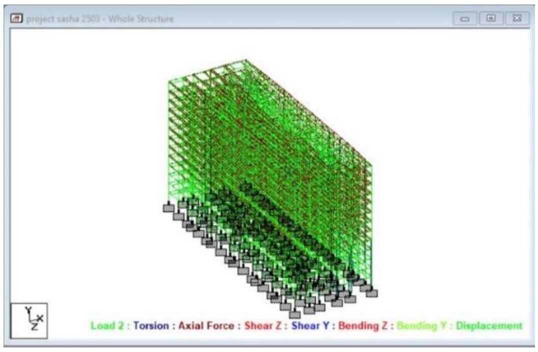
Step 2: Assigning Support
Step 3: Assigning Loads & Combinations

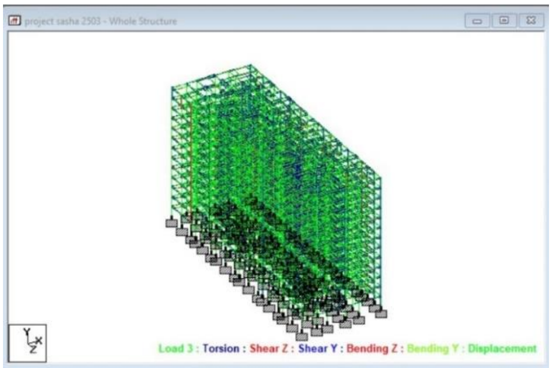


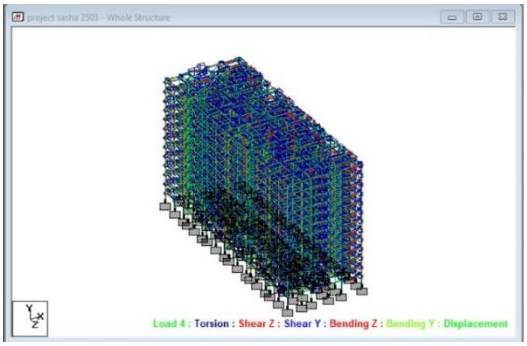
Dead Load: 9 KN/M, Live Load: 18 Kn/M
Wind Load: 2 KN/M At The Top Of The Building

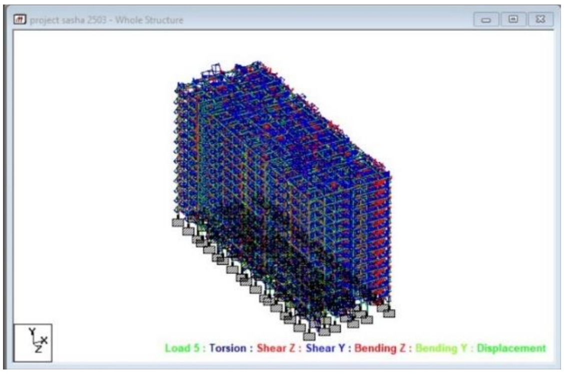
V.ANALYSIS RESULTS

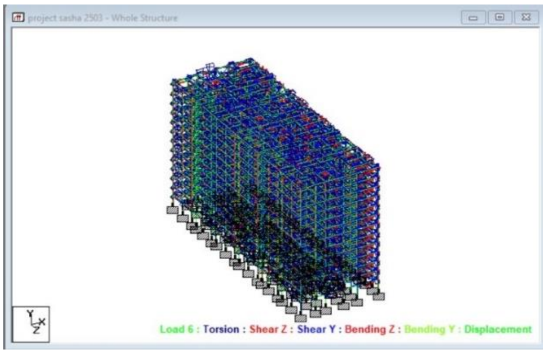












Beam Maximum Moments:

Table No. 1: Beam Maximum Bending Moments

L/C	Beam	Node A	Length (m)		d (m)	Max My (kNm)	d (m)	Max Mz (kNm)
5:WIND	347	2	3.000	Max +ve	3.000	41.538		
				Max -ve	0.000	-19.822	3.000	-3.808
	348	3	3.000	Max +ve	3.000	6.638	3.000	24.326
				Max -ve	0.000	-4.917	0.000	-15.674
	349	4	3.000	Max +ve	3.000	33.665	3.000	19.292
				Max -ve	0.000	-13.998	0.000	-12.481
	350	5	3.000	Max +ve	3.000	14.212	0.000	4.027
				Max -ve	0.000	-4.423	3.000	-14.061
	351	6	3.000	Max +ve	3.000	7.436	3.000	30.977
				Max -ve			0.000	-17.980
	352	7	3.000	Max +ve	3.000	14.403	0.000	17.034
				Max -ve	0.000	-7.906	3.000	-39.295
	353	8	3.000	Max +ve	0.000	9.981	3.000	16.237
				Max -ve	3.000	-22.230	0.000	-10.643
	354	11	3.000	Max +ve	0.000	2.473		

				Max -ve	3.000	-4.959	3.000	-22.891
	355	12	3.000	Max +ve	0.000	16.243	3.000	69.242
				Max -ve	3.000	-22.931	0.000	-40.226
	356	16	3.000	Max +ve	3.000	14.613		
				Max -ve	0.000	-5.294	3.000	-3.085
	357	17	3.000	Max +ve	0.000	13.540	3.000	31.821
				Max -ve	3.000	-11.110	0.000	-18.058
	358	18	3.000	Max +ve	3.000	2.182	0.000	38.164
				Max -ve	0.000	-1.440	3.000	-97.001
	359	27	3.000	Max +ve	0.000	16.670		
				Max -ve	3.000	-35.212	0.000	-2.557
	360	28	3.000	Max +ve	0.000	17.023	3.000	22.243
				Max -ve	3.000	-31.580	0.000	-13.876
	361	35	3.000	Max +ve	0.000	6.536		
				Max -ve	3.000	-11.946	3.000	-11.576
	362	36	3.000	Max +ve	0.000	15.992	3.000	40.458
				Max -ve	3.000	-2.239	0.000	-22.998
	363	37	3.000	Max +ve	0.000	0.720	0.000	43.779
				Max -ve	3.000	-2.234	3.000	-129.576
	364	43	3.000	Max +ve	0.000	8.651	0.000	3.555
				Max -ve	3.000	-14.143	3.000	-12.261
	365	52	3.000	Max +ve	3.000	23.322	3.000	3.208
				Max -ve	0.000	-10.667	0.000	-3.997
	366	97	3.000	Max +ve	0.000	12.476	3.000	14.406
				Max -ve	3.000	-15.070	0.000	-10.654
	367	101	3.000	Max +ve	3.000	77.721	3.000	20.897
				Max -ve	0.000	-21.172	0.000	-14.319
	368	104	3.000	Max +ve	3.000	4.929	0.000	15.596
				Max -ve	0.000	-2.704	3.000	-55.479
	369	116	3.000	Max +ve	3.000	30.253	3.000	19.073
				Max -ve	0.000	-15.247	0.000	-12.631
	370	118	3.000	Max +ve	3.000	26.064	3.000	34.142
				Max -ve	0.000	-12.655	0.000	-87.948

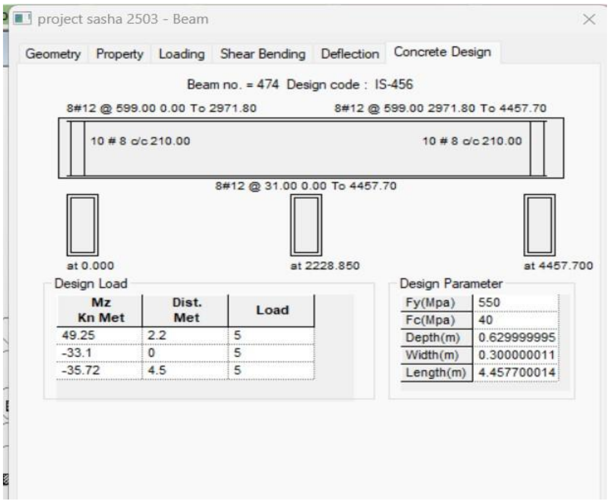
Beam Maximum Shear Forces:

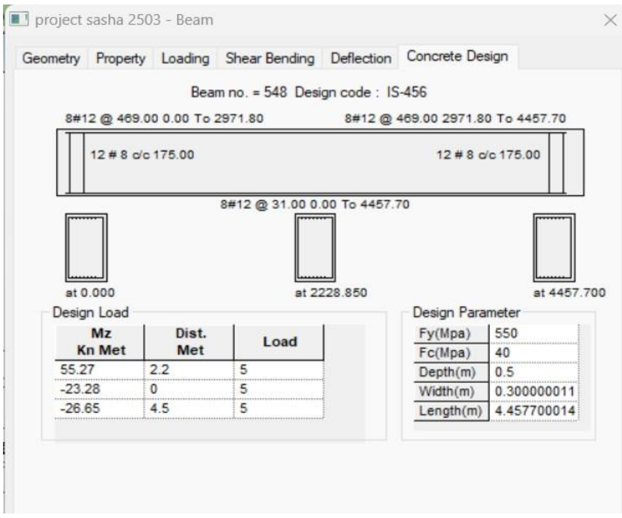
Table No.2: Beam Maximum Shear Force

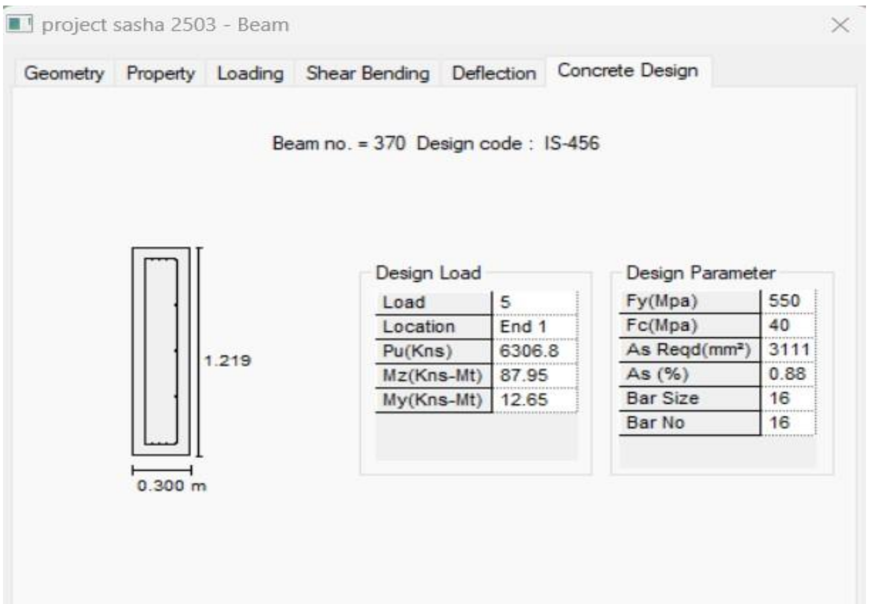
L/C	Beam	Node A	Length (m)		d (m)	Max Fz (kN)	d (m)	Max Fy (kN)
5:WIND	347	2	3.000	Max +ve	0.000	20.453	0.000	0.992
				Max -ve				
	348	3	3.000	Max +ve	0.000	3.852		
				Max -ve			0.000	-13.333
	349	4	3.000	Max +ve	0.000	15.887		
				Max -ve			0.000	-10.591
	350	5	3.000	Max +ve	0.000	6.212	0.000	6.029
				Max -ve				
	351	6	3.000	Max +ve	0.000	2.161		
				Max -ve			0.000	-16.319
	352	7	3.000	Max +ve	0.000	7.437	0.000	18.776
				Max -ve				
	353	8	3.000	Max +ve				
				Max -ve	0.000	-10.737	0.000	-8.960
	354	11	3.000	Max +ve			0.000	3.413
				Max -ve	0.000	-2.477		
	355	12	3.000	Max +ve				
				Max -ve	0.000	-13.058	0.000	-36.489

	356	16	3.000	Max +ve	0.000	6.636	0.000	0.929
				Max -ve				
	357	17	3.000	Max +ve				
				Max -ve	0.000	-8.217	0.000	-16.626
	358	18	3.000	Max +ve	0.000	1.207	0.000	45.055
				Max -ve				
	359	27	3.000	Max +ve				
				Max -ve	0.000	-17.294	0.000	-0.030
	360	28	3.000	Max +ve				
				Max -ve	0.000	-16.201	0.000	-12.040
	361	35	3.000	Max +ve			0.000	2.638
				Max -ve	0.000	-6.161		
	362	36	3.000	Max +ve				
				Max -ve	0.000	-6.077	0.000	-21.152

Design Details
Beams &Columns Design Summary







VI.COMPARISION

			STAAD PRO DESIGN			MANUAL DESIGN			
S. No	**MEMBER TYPE**	**SIZE OF MEMBER mm**	**ϕ OF BAR mm**	**No. OF BARS**	**A_{st} mm^2**	**ϕ OF BAR mm**	**No. OF BARS**	**A_{st} mm^2**	**%**
1	COLUMN	1200x300	12	20	3770	20	12	3600	5
2		900x300	12	16	2415	20	9	2700	-11
3		760x300	12	12	1360	20	9	2280	-40
4		600x300	12	12	1360	16	10	1800	-25
5		530x300	12	12	1360	16	8	1590	-15
6	BEAM	300x630	8	12	900			810	12
7		300x500	8	12	900			810	12
8	SLAB	5000x4600			1065			839	25
9	STAIR CASE	1200x4740			864			1240	-40

Note:
\+ sign indicates **STAAD PRO VALUE > MANUAL VALUE**
\- sign indicates **STAAD PRO VALUE < MANUAL VALUE**

VII.CONCLUSIONS

1. By Using STADD Pro., analysis and design of multistorey building is easier and quickprocess than manual process.
2. Proposed size of the beam and column can be safely used in the structure.
3. The structure is safe in shear bending and deflection.
4. There is no hazardous effect on the structure due to wind load on the structure.
5. The proposed structure is stable and structurally defined using various loads and combination.
6. The deflection value is more in WL (Wind Load) condition.
7. The area of steel reinforcement A_{st} various from -40% to 25%.
8. To know the behavior of the structure by applying various loads like dead load, liveload, wind load and seismic load by using staad.pro. And also find out the Shear forces,displacement, bending and reactions of structure.
9. By using staad pro, we performed dynamic analysis. So that, the results obtained in Staad prois more effective as compared to analysis and design performed by theoretical method.

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