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Comparison Between Wind And Seismic Load On Different Types Of Structures

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ABSTRACT—*It is very important for considering the effects of lateral loads from wind and earthquakes for design of reinforced concrete structures,especially for high-rise buildings.Some cases the effect of earthquake is found more critical than wind effect. It depends on some factors defined by codes. In this study the both effects will be considered and compared according to the Code IS: 875(PART - 3) and IS:-1893-2002(PART-1) and IS:875(PART-1 AND PART-2). A software program is developed to analyze the different types of structures under wind pressure and earthquake effect considering all factors from the codes. Some recommendations are suggested to develop different types of structures with respect to lateral loads.*

KEYWORDS—*Types of structures, Wind pressure,Seismic preassure,Dead Load,Live Load, Zone factor, Load Combination, Importance factor.*

I. INTRODUCTION

My project involves **Effect And Comparission Between Wind And Seismic Loads On Different Types Of Building Structures** [G + 7] using design software STAAD.ProV8i.

The advantages of this software are given below:

1. Easy to use, 2. Provisions of Indian standard codes 3. different natures of solving any types of problems, 4. Perfection of accuracy.STAAD.ProV8i is more effective software for concrete, steel, aluminium and cold-formed steel design, culverts, tunnels, bridges, timber, piles etc. than other softwares. Generally, STAAD.ProV8i used to generate different types of models easily and also analysis and design is completed very significantly.

STAAD.Pro is a general purpose of structural analysis and design program with applications in the commercial buildings, highway structures, industrial structures, chemical plant structures, dams, retaining walls, turbine foundations and other embedded structures, etc. This program hence consists of the following facilities :

1.Beam and column members are represented by lines. Walls, slabs and panel type entities are represented using triangular and quadrilateral finite elements. Solid blocks are represented using brick elements.

2. Analysis engines for performing linear elastic and pdelta analysis, finite element analysis, frequency extraction, and dynamic response (spectrum, time history, steady state, etc.).

3. Design engines for code checking and optimization of steel, aluminum and timber members. Reinforcement calculations for concrete beams, columns, slabs , Design of shear and moment connections for steel members.

4. Result verification and report generation tools for examining displacement diagrams, bending moment and shear force diagrams .

II. LOADS CONSIDERED:

2.1 DEAD LOADS: Dead loads shall be calculated on basis of unit weights which shall be established taking into consideration the materials specified for construction. This consist of walls, partitions, floors, roofs including the weights of all other permanent structures. It may be calculated on the basis of unit weights of materials given in IS 875(part -1).

2.2 IMPOSED LOADS: Imposed loads are produced from the weight of movable partitions of buildings, uniformly distributed and concentrated loads. For structures carring live loads which induced impact and vibration. Imposed loads shall be assumed in accordance with IS 875(part -2).

2.3 <u>WIND LOAD</u>: The IS 875(part -3) deals with wind loads to be considered when designing building , structures and components thereof**.**
Wind load depends upon wind speed and pressure -
a) <u>Basic wind speed (Vb</u><u>)</u>:
IS 875(part-3), fig-1 gives basic wind speed map of India, as applicable to 10m height above mean ground level for different zones of the country.
b) <u>Design Wind Speed (Vz):</u>
The basic wind speed (Vb) for any site shall be obtained and shall be modified to include the following effects of design wind velocity at any height (Vz) for the chosen structure:
a) Risk level;
b) Terrain roughness, height and size of structure; and
c) Local topography.
It can be mathematically expressed as follows:
Vz = Vb * k1 * k2* k3
Vb = design wind speed at any height z in m/s;
K1= probability factor (risk coefficient)
K2 = terrain, height and structure size factor and
K3= topography factor
As per this study,
Vb = 50 m/s, K1=1, k2= 0.85, k3=1

c)**<u>Design Wind Pressure</u> –** The design wind pressure at any height above mean ground level shall be obtained by the fallowing relationship between wind pressure and wind velocity : Pz =0.6 Vz^2
Where,
Pz = Disign wind pressure in N/m^2 at height z , and
Vz = Design wind velocity in m/s at height z

2.4 <u>SEISMIC LOAD</u>: The seismic forces shall be calculated in accordance with IS 1893(part-1). This code deals with assessment of seismic load on various structures and earthquake resistant of design of buildings.
Seismic load depends upon the following criteria:

*a) **<u>Design horizontal acceleration co-efficient (A_h)</u>**: It is a horizontal acceleration co-efficient that shall be used for design of structures.*
$A_h = ZIS_a / 2Rg$
Where, Z= Zone factor
I = Importance factor
R = Response reduction factor
S_a/ g = Avg. response acceleration co-efficient

*b) **<u>Design Lateral Force</u>**:It is the horizontal seismic force prescribed by this standard, that shall be used to design a structure.*

*c) **<u>Design Seismic Base Shear:</u>** The total design lateral force or design seismic base shear (Vb) along shall be determined by the following expression: Vb = Ah W Where, Ah = horizontal acceleration spectrum W = seismic weight of all the floors.*

*d) **<u>Fundamental natural period(T_1):</u>** It is the first longest model time period of vibration.*

*e) **<u>Time History Method:</u>** Time history method of analysis shall be based on an appropriate ground motion and shall be performed using accepted principles of dynamics.*

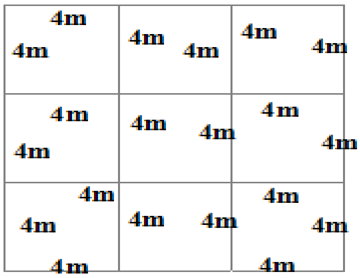
*f) **<u>Response Spectrum Method:</u>**- The representation of the maximum response of idealized single degree fredom systems having certain period and damping during earthquake ground motion.*

III. PHYSICAL PARAMETERS OF BUILDING:-

Length = 3 bays @ 4.0m = 12.0m
Width = 3 bays @ 4 m = 12.0m

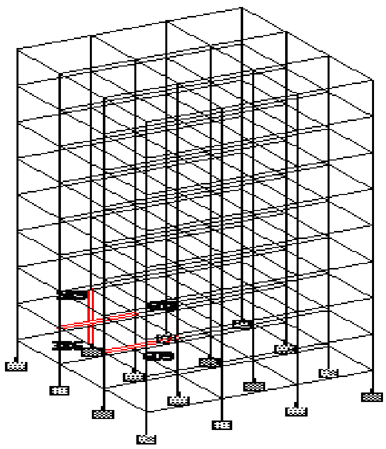
Height = 3m + 6 stories @ 3.0m = 21m (1.0m parapet being non- structural for seismic purposes, is not considered of building frame height)
Live load on the floors is 1kN/m2 & Dead load on the roof
Is 2kN/m2

Grade of concrete and steel used:-
Used M30 concrete and Fe 415 steel.
All columns = 0.40 * 0.40 m ,
All beams = 0.3 * 0.3m ,
All slabs = 0.10 m thick



Plan of the G+7 storey building

IV. TYPES OF STRUCTURES:



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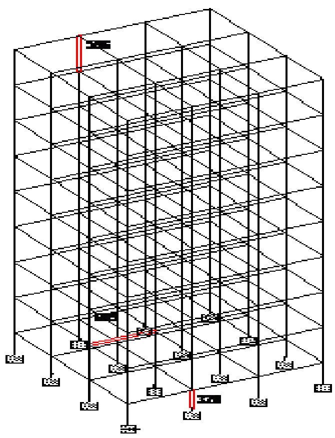
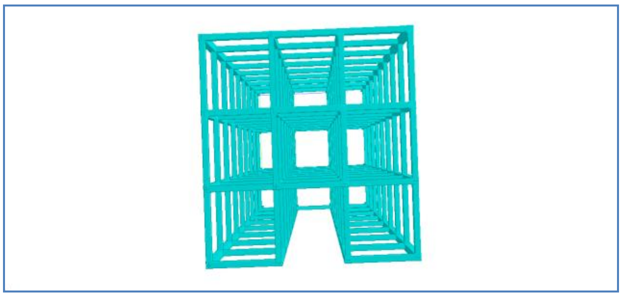
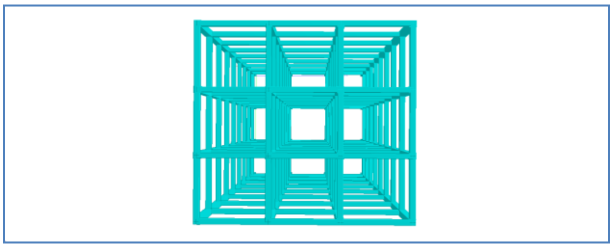
BUILDING TYPE-1(EFFECT OF WIND LOAD)



BUILDING TYPE-1(EFFECT OF SEISMIC LOAD

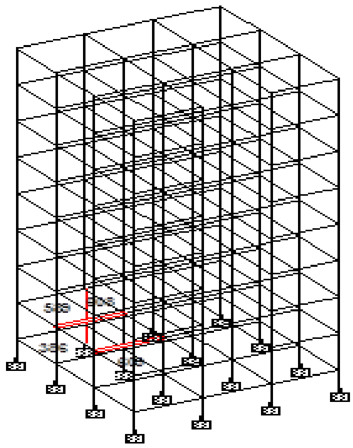
BUILDING TYPE-1

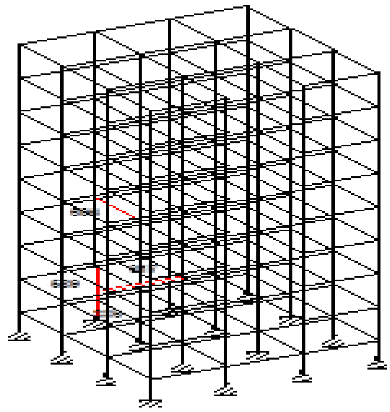




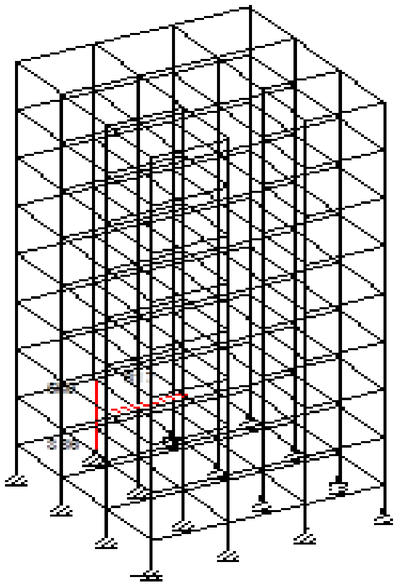
BUILDING TYPE -2

BUILDING TYPE-2 (EFFECT OF WIND LOAD)

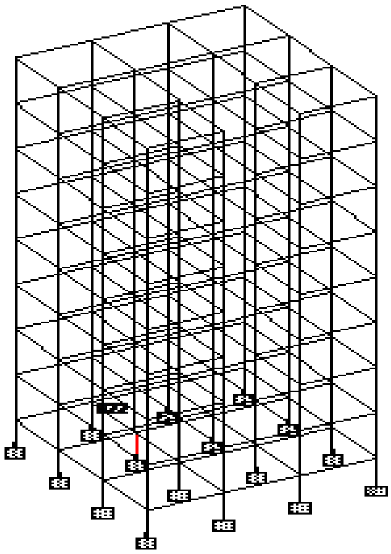




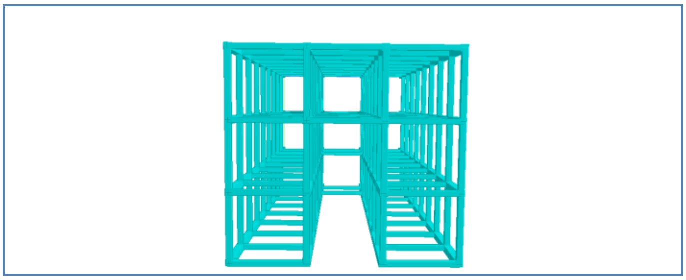
BUILDING TYPE-2(EFFECT OF SEISMIC LOAD)



BUILDING TYPE-3(EFFECT OF WIND LOAD)



BUILDING TYPE -3(EFFECT OF SEISMIC LOAD)



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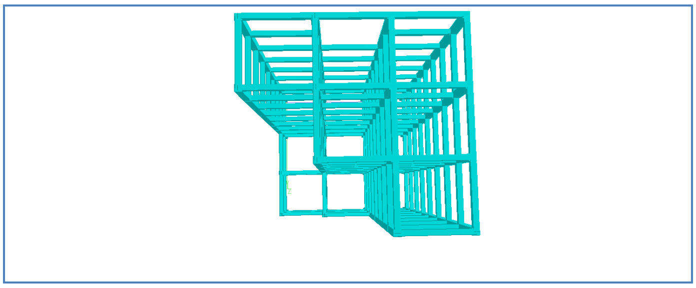
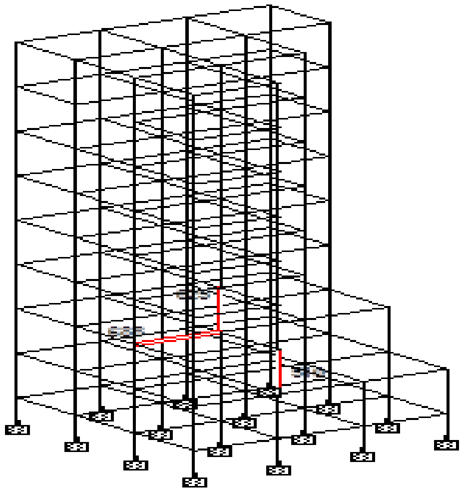


BUILDING TYPE-4



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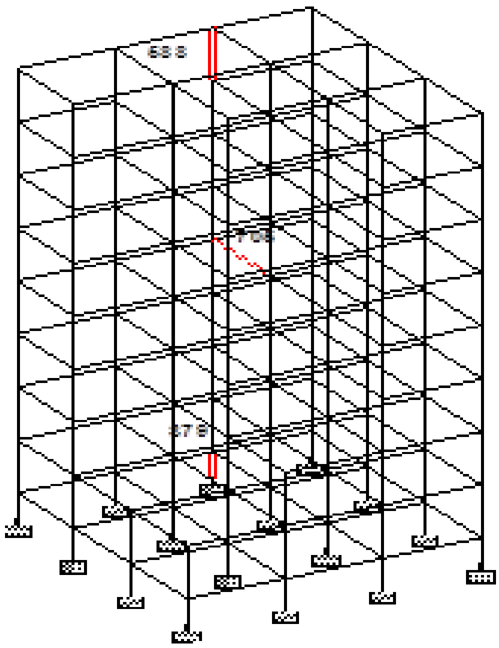
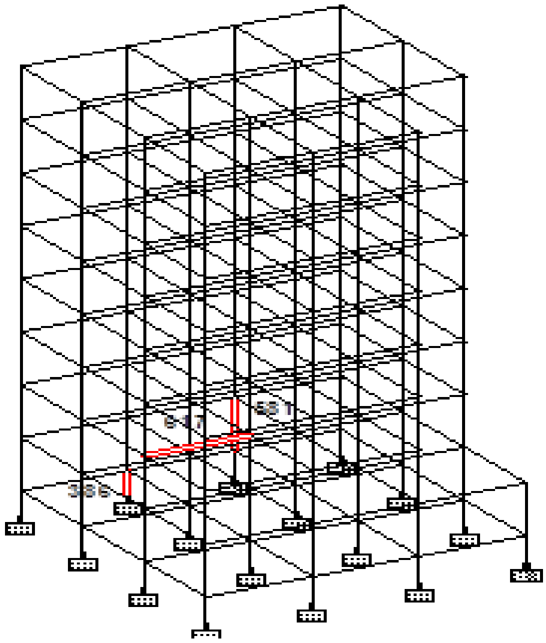


BUILDING TYPE -4(EFFECT OF SEISMIC LOAD)



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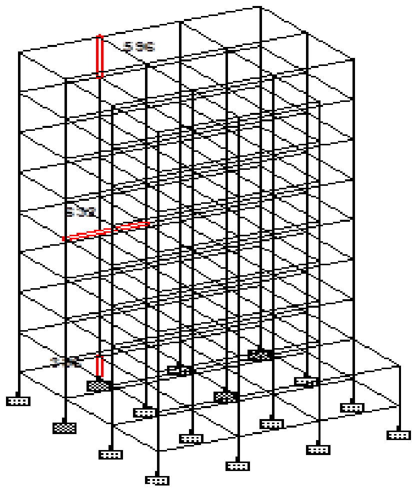
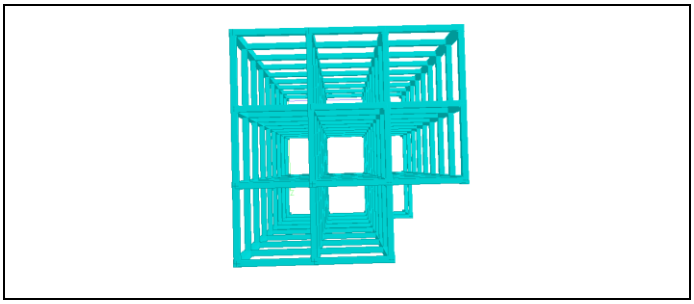
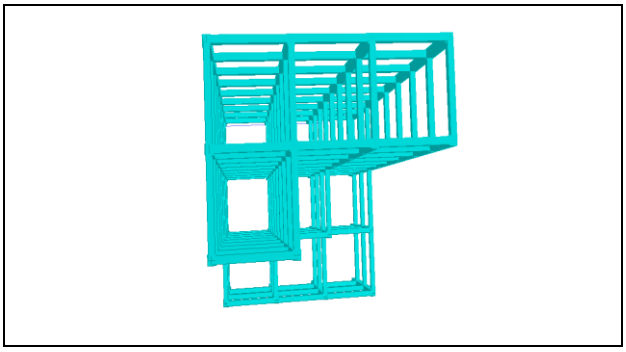


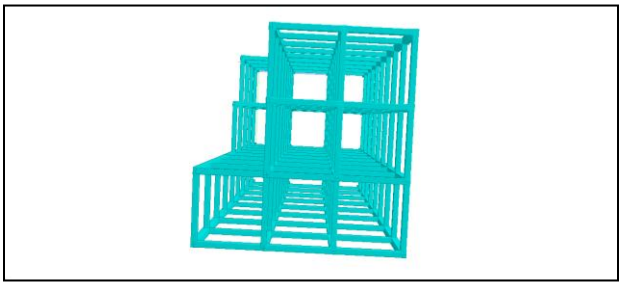
BUILDING TYPE -5(EFFECT OF SEISMIC LOAD



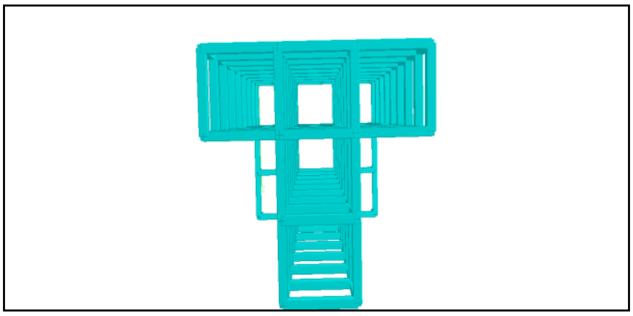
BUILDING TYPE-5



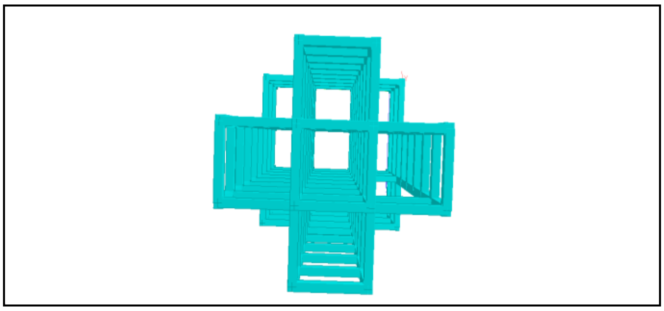
BUILDING TYPE-6



BUILDING TYPE-7



BUILDING TYPE-8



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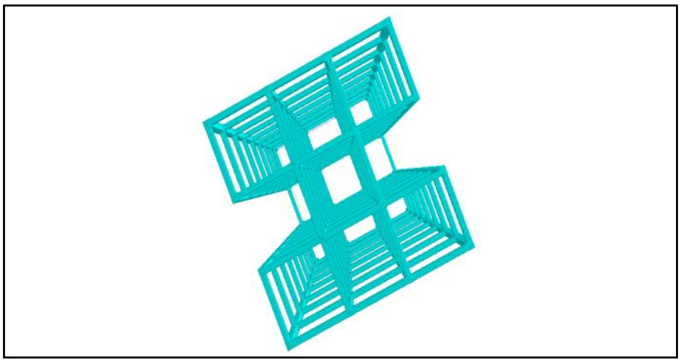
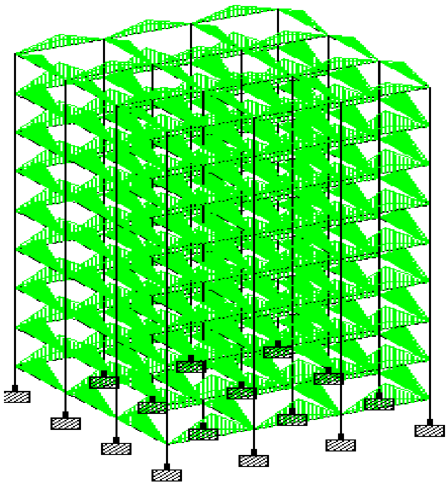
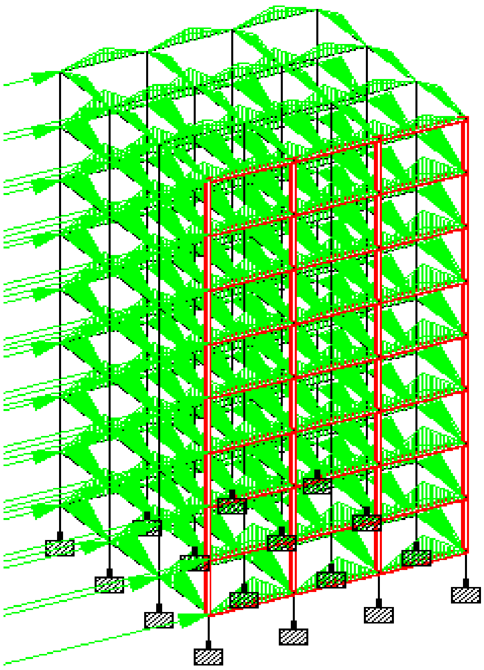


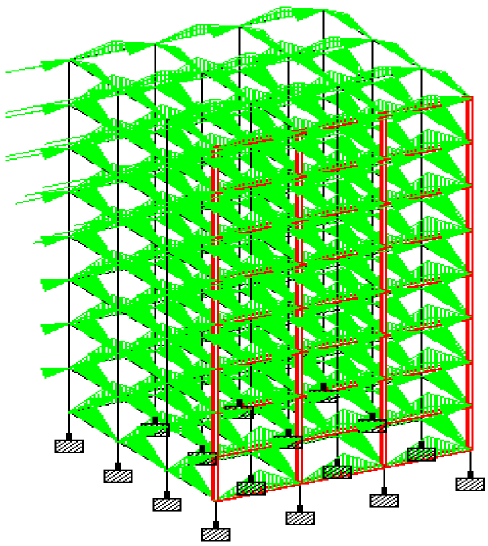
BUILDING TYPE-10

- **LOAD COMBINATION OF DEAD LOAD AND LIVE LOAD**





- **LOAD COMBINATION OF DEAD LOAD AND LIVE LOAD AND WIND LOAD**



- **LOAD COMBINATION OF DEAD LOAD,LIVE LOAD AND SEISMIC LOAD**

4. RESULTS:-

➢ **EFFECT OF WIND LOAD:-**

TABLE -1:-

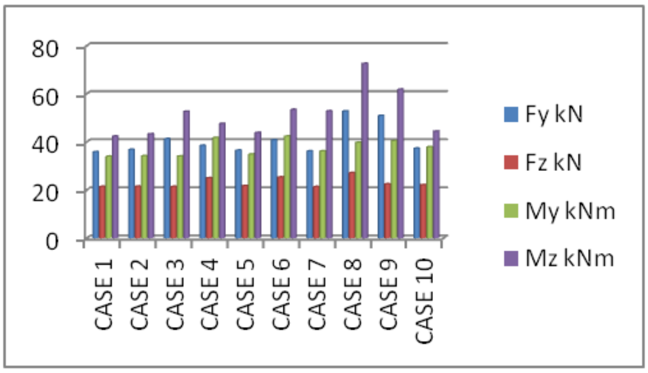
	Fy (kN)	Fz (Kn)	My (kNm)	Mz (kNm
CASE 1	35.77	21.356	33.933	42.293
CASE 2	36.752	21.455	34.125	43.225
CASE 3	41.22	21.34	33.995	52.589
CASE 4	38.452	24.928	41.741	47.573
CASE 5	36.465	21.708	34.83	43.772
CASE 6	40.743	25.303	42.296	53.409
CASE 7	36.157	21.334	36.093	52.759
CASE 8	52.692	27.105	39.693	72.524
CASE 9	50.845	22.41	40.406	61.797
Case10	37.271	22.089	37.85	44.371

TABLE -2:-

BEAM NO.	NODE NO.	STEEL AREA(sqmm)
CASE- 1		
609	274	702.82
386	164	1280
589	164	1280
608	172	706.53
CASE- 2		
609	274	739.19
386	164	1280
589	164	1280
608	172	729.3
CASE-3		
617	278	2070.33
386	164	6004.5
589	164	6004.5

617	278	2070.33
CASE- 4		
688	194	823.77
825	276	1280
510	172	1280
688	194	823.77
CASE-5		
617	185	738.72
386	164	1280
581	157	1280
617	185	738.72
CASE- 6		
705	217	982.64
817	279	1280
567	191	1280
705	283	982.64
CASE- 7		
617	185	716.8
379	157	1280
530	234	1280
467	234	988.05
CASE- 8		
681	271	864.54
845	303	1280
814	275	1280
410	176	882.56
CASE-9		
729	253	864.54
502	171	2400
502	183	2400
808	297	864.54
CASE- 10		
689	275	757.61
814	271	1280
813	267	1280
680	182	760.33

- **LOAD CASE DIAGRAM(EFFECT OF WIND LOAD):-**



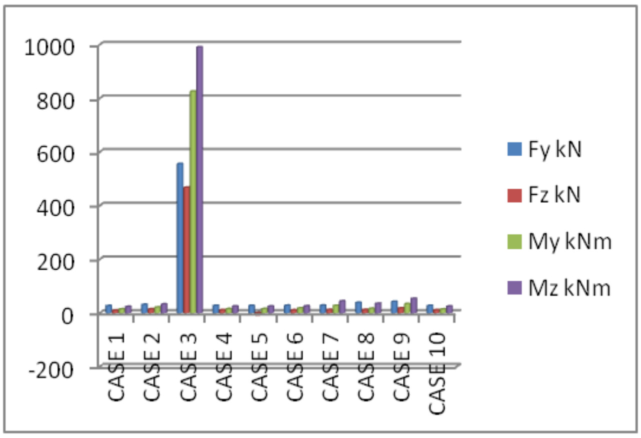
➢ **EFFECTOFSEISMIC LOAD:-**

TABLE:- 1

	Fy kN	Fz kN	My kNm	Mz kNm
CASE 1	26.412	9.137	13.857	23.119
CASE 2	31.118	14.01	20.735	32.421
CASE 3	555.49	467.187	825.135	990.137
CASE 4	27.116	10.584	14.684	24.677
CASE 5	27.138	-10.714	15.039	24.74
CASE 6	27.569	10.209	17.707	25.208
CASE 7	27.665	11.725	27.001	43.718
CASE 8	38.197	11.596	16.015	35.144
CASE 9	42.054	17.371	33.613	53.221
CASE 10	27.087	10.529	13.455	24.321

TABLE :-2

BEAM NO.	NODE NO.	STEEL AREA(sqmm)
CASE- 1		
609	274	702.82
328	30	1280
596	266	1280
609	274	702.82
CASE -2		
617	278	736.32
386	164	1280
589	164	1280
696	206	638.48
CASE- 3		
822	304	4736
CASE -4		
705	217	648.3
379	157	1280
588	265	1280
705	217	648.3
CASE 5		
632	208	584.37
386	164	1280
596	266	1280
632	208	584.37
CASE- 6		
705	283	982.64
386	164	1280
534	187	1280
705	283	982.64
CASE - 7		
633	209	604.9
531	234	1280
530	234	1280
467	234	988.05
CASE- 8		
689	275	864.54
386	164	1280
816	283	1280
462	219	864.54
CASE- 9		
729	253	864.54
866	253	2400
866	253	2400
808	297	864.54
CASE- 10		
689	275	757.61
386	164	1280
589	164	1280
689	275	757.61



- **LOAD CASE DIAGRAM(EFFECT OF SEISMIC LOAD)**

V. CONCLUSION: -

It is concluded form this study that: 1.Wind forces affect any building are as well as the intensity of wind defined by the code according to its the location. 2 For any building, earthquake forces as well as the intensity of earth quake defined by the zone factor through its location, the importance of the building, the structural element, the period coefficient which depends on the dimensions and weight of the building and the soil coefficient. 3. In case of Load cases 5,2 and1, the structures will be more flexible and economical depending upon basic wind speed(50m/s) and zone factor(zone-2). 4. When basic wind speed and zone factor in any region of India will be changed, which structures will be more economy for those cases,that will be further analysed.

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