Scientific Journal of Impact Factor (SJIF): 5.71
e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 02, February -2018

Comparative study for Seismic Analysis of building using different software

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Abstract - *This paper concern on the seismic analysis of G+12 building which is subjected to live, dead, seismic load as per IS codes. Earthquake occurred in any structure shows that if the structures are not designed for earthquake loads then it may lead to the complete collapse of the structures. To ensure safety against lateral forces that will act on multi-storied building hence, there is need to study of seismic analysis to design earthquake resistance structures. In this paper Base shear, time period and storey displacement is evaluated by using STAAD and Etabs software and the results are compared with IS1893 and this paper building is analyzed for zone IV. The study includes the modeling of building having plan areas 20mx20m and the height of storey is 3m.These analysis are carried out by considering zone IV with medium soil and using SMRF type building The results obtained for base shear and other design parameters obtained from STAAD and Etabs software were compared and matched with IS1893:2002*

Keyword *— Base shear, storey displacement, special moment resisting frame, static analysis Etabs, STAAD Pro.*

I INTRODUCTION

When earthquakes occur, a buildings undergoes dynamic motion. This is because the building is subjected to inertia forces that act in opposite direction to the acceleration of earthquake excitations. During earthquake there is a release of elastic energy by sudden slip on a fault and resulting ground shaking. So apart from gravity loads, the structure will experience dominant lateral forces of considerable magnitude during earthquake shaking. It is essential to estimate and specify these lateral forces on the structure in order to design the structure to resist an earthquake. The ductility of a structure is the most important factors affecting its seismic performance and it has been clearly observed that the well designed and detailed reinforced structures behave well during earthquakes and the gap between the actual and design lateral force is narrowed down by providing ductility in the structure.

When earthquake occur, most of the buildings are likely to get damaged or collapse and lead to very severe disaster. It is very difficult to cope up with such a disaster, so there is a need to design buildings so that they can resist these lateral forces and building do not fail during a event of earthquake.

Today there are many software in the market. Many design company's use different software for their project design purpose. So, this paper mainly deals with the comparative analysis of the results obtained from the analysis of a multi storey building structure when analyzed manually and using ETABS and Staad Pro software separately.

The study aims to determine and compare the seismic forces on buildings computed as per the IS: 1893 The seismic forces, computed by IS: 1893-2002 are found to be slightly lesser than what software has calculated, the difference is very small.

Analysis was done with response spectrum method. The effect of frame, was studied under the earthquake loading. The results are studied for both the software and the main parameters considered in this study to compare the seismic performance of different models are storey drift, base shear, story deflection and time period.

II MODELLING

STAAD and Etabs are some powerful design software that are currently being used by many organization for analysis and design of various structures. The structure was subjected to self-weight, dead load, live load values considering by the specifications of IS 875 part-1 and part-2. A RCC G+12 building with floor height 3 m subjected to earthquake lading in IV has been considered. In this regard STAAD Pro V8i and Etabs software has been considered as tool to perform analysis. Effect of earthquake is studied in both the software.. The Seismic load calculations of Static and Dynamic analysis were done following IS 1893-2002 part-1. For analysis of our building we followed following steps :

i. Geometric Modeling
ii. Sectional Properties and Material Properties
iii. Supports : Boundary Conditions
iv. Loads & Load combinations (Dynamic)
v. Analysis Specification and Design command

For the analysis of multi storied building following dimensions are considered which are elaborated below. In the current study main goal is to compare the results of Staad Pro and Etabs, dimension of building are given in Table 1.

No. of bays along X direction	5
No. of bays along X direction	5
Bay Length along X direction	5
Bay Length along X direction	5
Concrete grade used	M30
Columns	.750 x .750m
Beams	.300 X .450m
Slab Thickness	150mm
Live Load	3 kN/m3
Zone	iV
Soil Conditions	Medium Soil
Damping Ratio	5%

Table1 Specifications of frame

Plan Area	Structure	Member Properties	Size B x D (mm)
20m x20 m	G+12	Beams Columns Slab	300x450 750 x 750 Thickness=150mm

Table 2 Geometrical and Section properties for 20m x20m plan

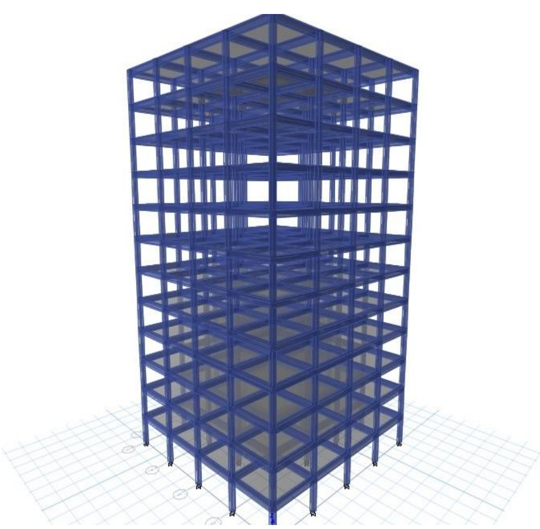

Fig.1 ETABS 3D MODEL

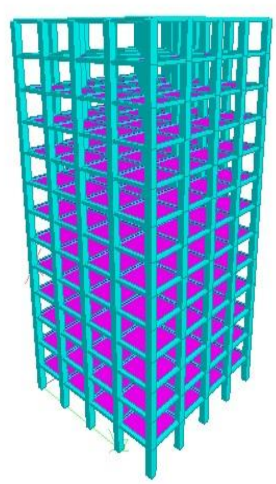

fig.2 STAAD PRO 3D MODEL

Load combination used in analysis

Combination	1	1.5(DL+LL)
Combination	2	1.5(DL+EQX+)
`Combination	3	1.5(DL+EQX-)
Combination	4	1.5(DL+EQZ+)
Combination	5	1.5(DL+EQZ-)
Combination	6	1.2(DL+LL+EQX+)
Combination	7	1.2(DL+LL+EQX-)
Combination	8	1.2(DL+LL+EQZ+)
Combination	9	1.2(DL+LL+EQZ-)
Combination	10	0.9DL+1.5EQX+
Combination	11	0.9DL+1.5EQX-
Combination	12	0.9DL+1.5EQZ+
Combination	13	0.9DL+1.5EQZ-

Table3 Load Combinations

Seismic Load Parameters	Value
1. Zone factor	0.24
2. Response Reduction factor	5
3. Importance Factor	1
4. Type of soil strata	2 (Medium)
5. Damping	5%

Table 4 Seismic Load Parameters

III SEISMIC ANALYSIS and RESULTS

After assigning sectional properties, support conditions, static and dynamic loading along with combination of loading following results are tabulated and compared. Table 5 shows the comparison of design horizontal seismic coefficient for different buildings where T is fundamental natural period, h is the total height of building measured from the base of building and d is the base dimension of the building measured in the direction in which seismic force is considered. Seismic force is considered in only one direction so all the calculations are in +ve X direction
Ah is calculated by IS 1893:2002 , STAAD Pro and Etabs are same and the values match . Table 6 shows the comparison of base shear by STAAD, Etabs and IS 1893:2002. It is important to note that that table 6 shows a sample calculation of weight actually. The load calculations are also discussed.

IV Load Calculations:

Dead load:

Slab Weight Calculation

Thickness of slab=0.150m Density of concrete= 25kN/m^3

Self Weight of slab= Density of concrete x Thickness of slab
= 25x0.150
= 3.75kN/m^2

Floor Finish at floor level = 1.5 kN/m^2

Total Slab Weight at floor level= 5.25 kN/m^2

Wall load calculation:

Width of the outer wall=230mm

Width of the inner wall=115mm

Beam size=300x450mm

Height of floor =3m

Wall Weight (outer) = Thickness of wall x Height of wallx Density of brick wall

= 0.23 x (3-0.45) x 20

= 7.65kN/m

Wall Weight (inner) = Thickness of wall x Height of wall x Density of brick wall

= 0.115 x (3-0.45) x 20

= 5.865kN/m

Weight of parapet wall = 0.15 x 1 x 20
= 3kN/m

1) Live load:

Floor load:

Live Load Intensity specified (Public building) = 4 kN/m^2 Live Load at roof level =1.5 kN/m^2

After comparison of weight calculations in table 7, Table 8 shows the comparison of storey shear of G+12 building . Moreover table 12, 13, 14 and 15 shows the comparison of storey drift G+12 building respectively. In the next section conclusions are discussed.

Time (sec) as per IS 1893:2002	Time (sec) STAAD	Time (sec) Etabs	Sa/g IS 1893:2002	Sa/g STAAD	Sa/g Etabs	A_h as per IS 1893:2002	A_h STAAD	A_h Etabs
0.820	0.821	0.820	1.658	1.658	1.685	0.04044	0.04040	0.04046

Table 5 Comparison of Design horizontal seismic coefficient Ah

Weight as per IS 1893:2002	Weight of structure STAAD (kN)	Weight of structure STAAD (kN)	Base Shear as per IS 1893:2002	Base Shear STAAD (kN)	Base Shear Etabs (kN)
72450.25	75432.31	80011.63	2929.888	3050.48	3237.27

Table 6 Comparison of Base Shear

Floo r	Storey Shear By Staad (KN)	Storey Shear by Etabs (KN)
Twelfth	489.35	508.9
Eleventh	430.03	465.12
Tenth	402.30	423.24
Ninth Floor	350.25	380.23
Eight Floor	309.00	316.12
Seventh Floor	265.32	280.36
Sixth Floor	230.46	240.32
Fifth Floor	180.46	198.36
Fourth Floor	130.65	136.42
Third Floor	106.25	110.64
Second Floor	80.65	84.63
First Floor	45.26	49.34
Ground Floor	25.26	26.34
Plinth level	5.24	7.25
Base shear	3050.4 8	3237.2 7

Table7 Comparison of storey shear G+12 Building

Floor	Storey Drift by staad (mm)	Storey Drift by Etabs (mm)
Twelfth	51.92	59.52
Eleventh	48.51	54.36
Tenth	46.61	50.25
Ninth	41.14	46.89
Eight	38.11	41.23
Seventh	37.55	39.76
Sixth	33.53	35.92
Fifth	24.17	27.56
Fourth	20.56	23.75
Third	15.78	18.76
Second	12.36	15.46
First	8.64	11.39
Ground	4.19	5.13
Plinth level	0	0

Table 8 Comparison of Storey drift G+12 building

V CONCLUSIONS

The main purpose of this study is to analyses building by STAAD and Etabs static analysis has been carried out to know time period , natural frequency , deformations, displacements and floor responses . The building is tested for various load combinations.

The base shear, lateral forces at each storey along with the storey drift are tabulated and compared.

The major conclusions drawn from the present study are as follows:

1. It can be observed that the design seismic coefficient parameters such as fundamental natural period and spectral acceleration coefficient calculated by IS 1893:2002 match by STAAD and ETABS software.
2. The design horizontal seismic coefficient obtained by STAAD and Etabs also matches with code.
3. The base shear obtained for the models varies a little.
4. The weight of building is calculated manually and by software are different.

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