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A Time History Analysis Method for Studying the Multi-storeyed Building Using STAAD Pro

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Abstract: **Dynamic analysis can be performed by two methods one is response spectrum method and another is time history method. In response spectrum method, the values are taken as per code IS 1893 (part 1) 2002 but in time history method the previous Earthquake data is used. The loads which are used they are as per IS standards. In present study, the time history analysis is to be used because time history analysis is more economical then response spectrum method. Multi-story regular buildings with (G+25) stories have been modelled using software STAAD PRO for seismic zone V in India. And by using time history method for multi-storey building the story displacement and story drift calculated. Time history analysis is also known as non-linear dynamic analysis. A time history is the advanced method of dynamic analysis. The time history analysis method is also capability to incorporate harmonic forcing function which can described by sinusoidal curves with a specified arrival time, frequency, amplitude, and duration.**

Keywords**: Dynamic analysis, response spectrum, time history, STAAD Pro V8i, multistory building.**

I. INTRODUCTION

In the earthquake, prone regions, the chance of failure of building is increase due to act of earthquake. because the various seismic force act on the building when the earthquake come in that region. The building which do not resist these seismic forces they may suffer extensive damage, collapse or break. To improve or save these building the seismic evaluation is required therefore the dynamic and statics analysis is required. Therefore, it is necessary to study the variation in seismic behaviour of multi-storeyed RC building in terms of various responses such as story displacement and story drift. In this paper, a multi-story regular building with 25 stories has been modelled using software STAAD PRO for seismic zone V in India. And calculate the story displacement and story drift. In this paper the time history method is used to determine the story displacement and story drift. The time history method is more economical then response spectrum method.

II. LITERATURE REVIEW

1. Brief Review:

Vinayak B Kulkarni, Mahesh V Tatikonda has studied (2016) studied on time history analysis method using staad pro for multi-storeyed building. Mayuri D. Bhagwat et.al (2014) presented the study on dynamic analysis of G+12 multi-storeyed practiced RCC building considering for Koyna and Bhuj earthquake. Mohd Zain Kangda, Manohar D. Mehare and Vipul R. Meshram (2015) studied the base shear and storey drift by dynamic analysis. Mohit Sharma, Dr Savita Maru (2014) studied Dynamic Analysis of Multi-storeyed Regular Building. Pralobh S. Gaikwad and Kanhaiya K. Tolani (2015) studied on the dynamic analysis of RCC and Steel building with unsymmetrical configuration. For the analysis purpose models of G +9 stories of RCC and Steel with unsymmetrical floor plan was considered. Dr. S.K. Dubey, Prakash Sangamnerkar and Ankit Agrawal (2015) studied multi-story irregular buildings with 20 stories by using software STAAD PRO for seismic zone IV in India. Dr. Deshmukh, et. al (2015) studied G+19 storied building was considered

and applied various loads like wind load, static load, earthquake load and results were studied and compared by manual calculations.

2. *Design parameter:*

Here analysis is being done for - G+25 multi-storey (rigid joint frame) building by computer software using STAAD-Pro by taking preliminary data required as -

1. Type of structure- high rise RC frame structure. 2. No of storey- G+25, twenty-five stories. 3. Seismic Zones-V.

4. Floor height- 4.0m. 5. Building height- 104.00m. 6. Plan size- 24.00 x 24.00m. 7. Total area-576 sqm. 8. Size of columns-0.50m x 0.50 m. 9. Size of beams- 0.30m x 0.60m .10. Self-weight- 1 KN/ m. 11. UDL-4.00 KN/ m. 12. Floor weight-1 KN/ m^2. 13. Material used- Concrete M-25 and Reinforcement Fe-415(HYSD). 14.Earthquake load - As per IS-1893-2002 .15. Type of soil -Medium soil as per IS-1893.16. Ec- $5000\sqrt{fck}$ N/ mm^2 (Ec is modulus of elasticity in $N/mm^{2)}$. 17. Dynamic analysis -Time history analysis method. 18. Software used - STAAD-Pro dynamic analysis by time history analysis.19. Zone factor Z--- as per Is-189-2002 Part -1 for different. Zone as per clause 6.4.2.

3. Model of structure:

In this model the (G+25) story are taken and plan of the building at each floor is 24m by 24m dimension is considered.the floor plan are divided in 8 by 8 bay and distance between each grid is 3m by 3m in figure 1 . and the height of each floor is 4m and the height of building is 104m as shown in figure 2.and the size of coloum is 0.50m x 0.50 m and the size of beam is 0.30m x 0.60m is taken. In this design the self-weight is taken 1 KN/m and the UDL is taken 4KN/m and the floor weight is taken $1KN/m^{2.}$ The floor weight is constant for top to bottom. The objective of this paper is to determine the story displacement and story drift. And in the load case detail for dynamic analysis by time history (DL+LL+TH), (DL+LL-TH). The main objective of this paper is to check and analyse the seismic behaviour of the building. The time history method is the best method to study the dynamic analysis. In this paper the story drift and story displacement calculated in each floor from bottom to top. Also, show the graph between displacement and story height and No of story and story drift.

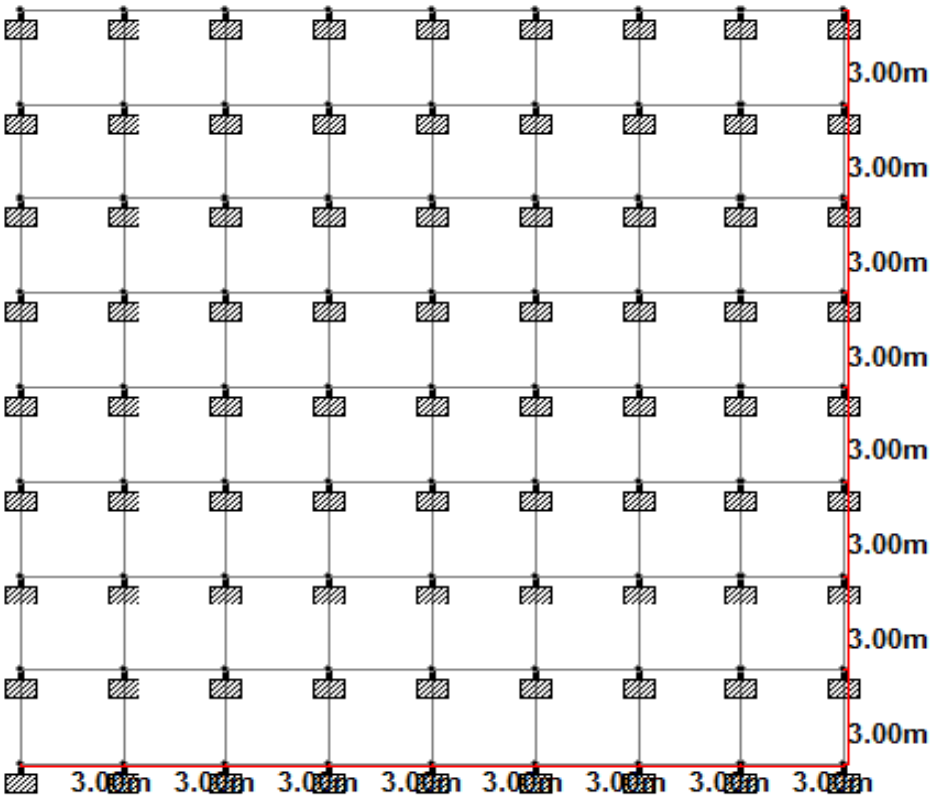

Fig. 1.Typical Floor Plan For All Buildings In STAAD Pro

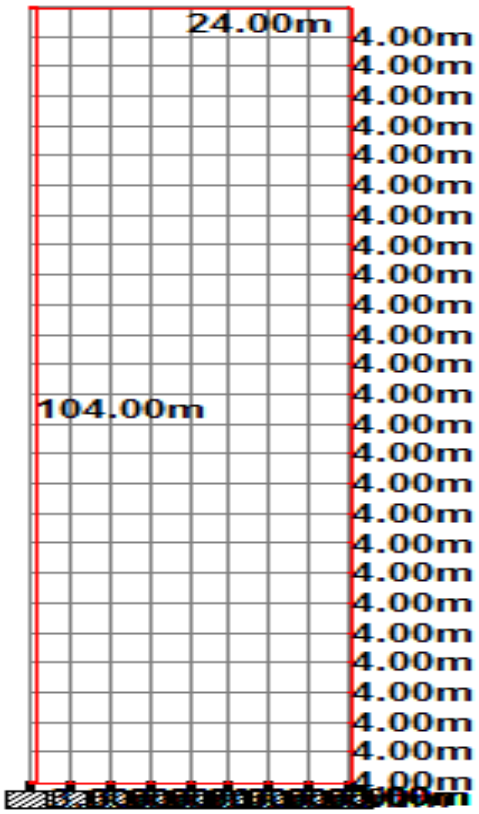

Fig. 2. Elevation of the building model

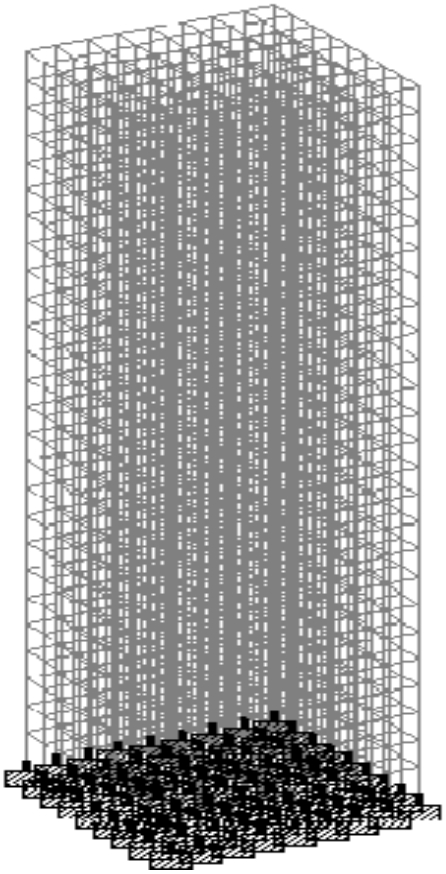

Fig.3. 3D Modal In Saad Pro

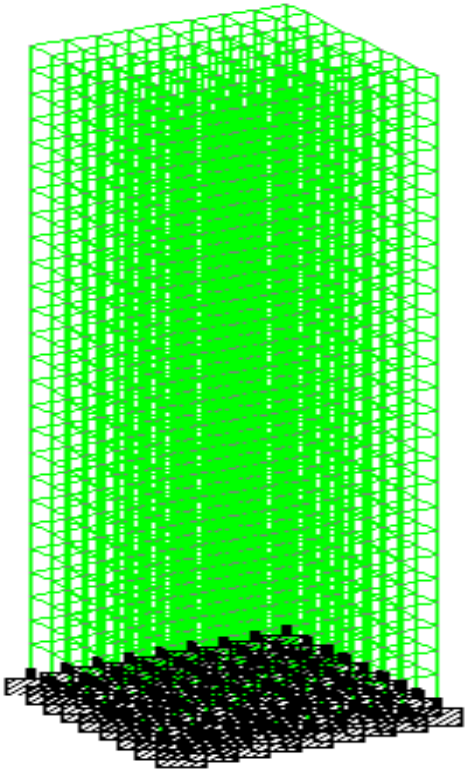

Fig.4. 3D Modal In Staad Pro

4. Method used:

In this paper the multi-storeyed building is to be designed by using time history method in staad pro. Time history method is also known as nonlinear dynamic analysis. This method is time saving method. In time history method, the previous earthquake data is to be carried out and analysis the building. In this paper the story displacement and story drift is calculated by this method the base shear, time and acceleration, time and velocity, time and displacement can also be calculated.

The time history analysis consists in finding a solution of the following equation of the time variable "t":

$$M \times a(t) + C \times v(t) + K \times d(t) = F(t)$$

Where the following initial values are known: d (0) =d_0 and v (0) =v_0, Where: M - Mass matrix - Stiffness matrix = $a \times M + b \times K$ - damping matrix. α - user defined coefficient. β - User defined coefficient. d - Shift vector. v - Velocity vector. a - Acceleration vector. F - Load vector. All expressions containing the (t) parameter are time-dependent.

III. RESULT AND DISCUSSION

Following table shows the story drift values for different story height and the displacement for the No of story in X direction

Table 1: story drift values for different story height in X-direction

STORY HEIGHT (m)	STORY DRIFT (mm) in X-direction
Ground floor	0.000
4	0.372
8	0.355
12	0.340
16	0.325

20	0.308
24	0.294
28	0.278
32	0.264
36	0.248
40	0.234
44	0.219
48	0.204
52	0.190
56	0.175
60	0.161
64	0.147
68	0.133
72	0.118
76	0.104
80	0.090
84	0.076
88	0.062
92	0.048
96	0.034
100	0.019
104	0.006

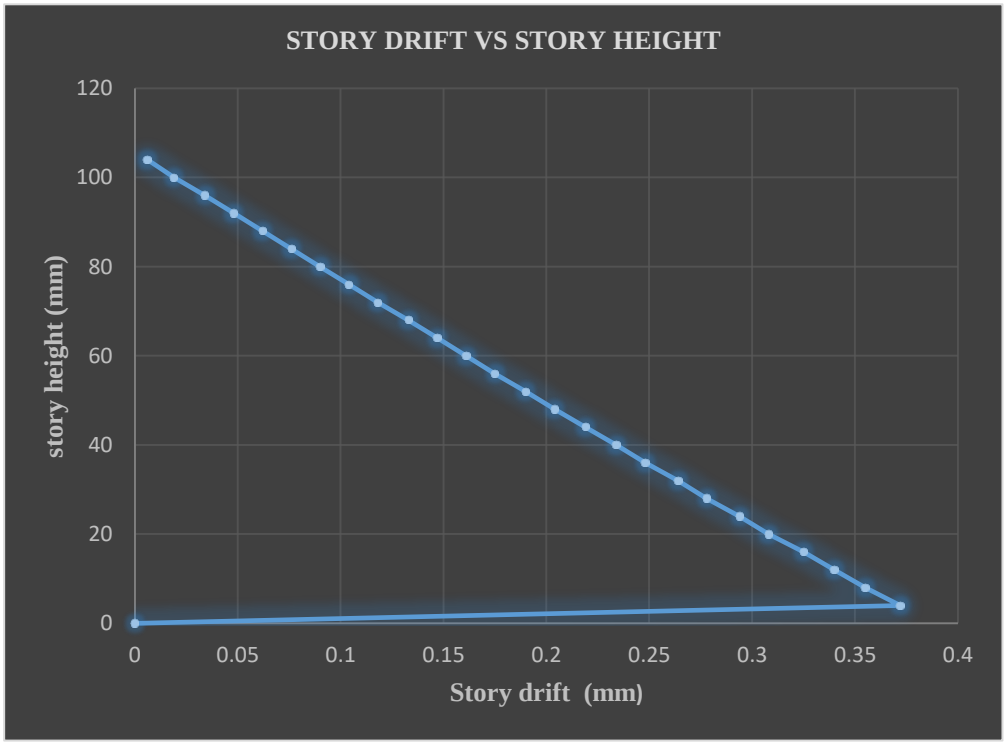

Fig.5. Story Drift In X-Direction And Story Height In Y-Direcion

Table 2 : For No of story and story displacement (mm) in X-direction

No of story	Story displacement (mm) in X-Direction
Ground floor	0.000
1	0.372
2	0.727
3	1.067
4	1.392
5	1.700
6	1.994
7	2.272
8	2.536
9	2.784
10	3.018
11	3.237
12	3.441
13	3.631
14	3.806
15	3.967
16	4.114
17	4.247
18	4.365
19	4.469
20	4.559
21	4.635
22	4.697
23	4.745
24	4.779
25	4.798
26	4.804

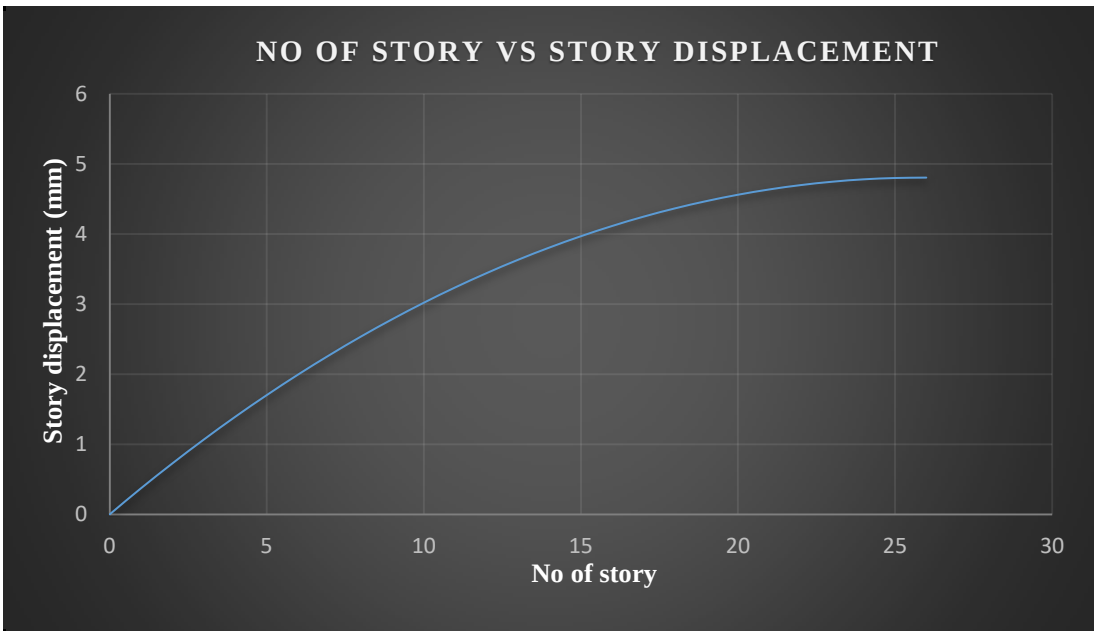

Fig.6: No of Story In X-Direction and Story Displacement In Y-Direction

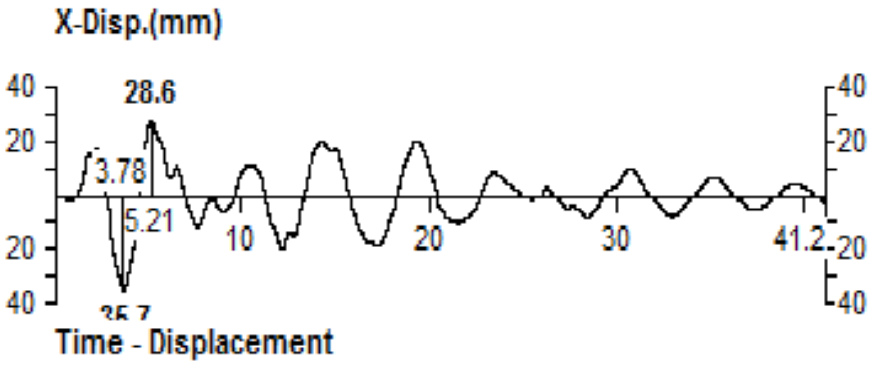

Fig.7. Displacement vs time at 26th floor

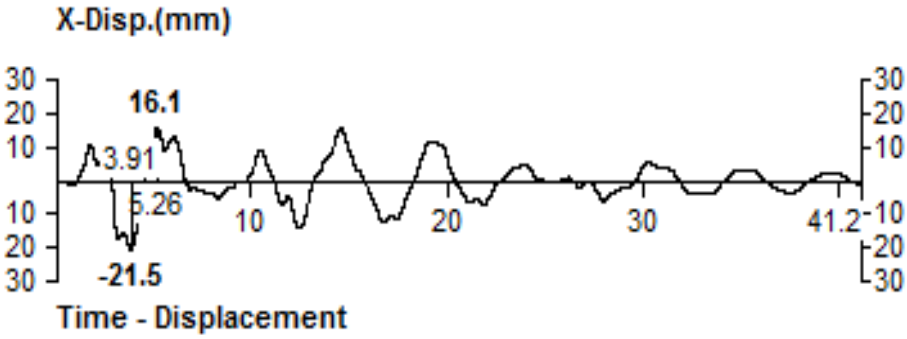

Fig.8. Displacement vs time at 13th floor

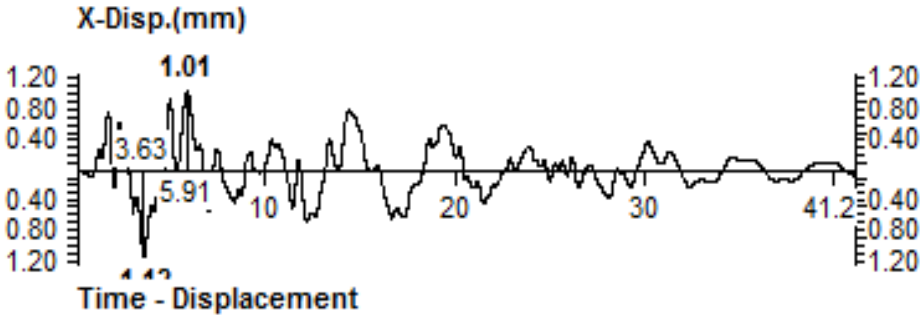

Fig.9. Displacement vs time at ground floor

IV. CONCLUSIONS

In this paper the story displacement and story drift is calculated. The story drift is maximum at first floor and zero at base and minimum at the top of the building. The story drift slightly decrease with increase the story height. And in case of story displacement it is minimum at base and maximum at the top floor. The story displacement is increase with increase number of story. In this paper the displacement and time value and graph is also calculated at base, intermediate and top floor. With increase the story height the value of displacement and time is also increase and the graph between displacement and time is also different at base and 13th floor and 20th floor.

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