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Seismic analysis of G+5 Building Using STAAD Pro

Ningthoujam James Singh[1], Konthoujam Arnold Meitei[2], Gaurav Sharma[3], Vidya Sagar Khanduri[4]

[1,2,3]B. Tech Student, Department of Civil Engineering, Lovely Professional University, Jalandhar, Punjab, India, 144411
[4]Assistant Professor, Lovely Professional University, Jalandhar, Punjab, India, 144411

ABSTRACT

The behavior of the G+5 multi-storey building of regular and irregular design under earthquake is complicated, and a variety of wind loads are assumed to act consecutively with earthquake loads. In this paper a building of G+5 multi story building is studied for earthquake and wind load using STAAD PRO V8i. For performing dynamic analysis, a material having linear static property as assumed. These analyses are carried out by considering different seismic zones, and for each zone, the behavior assesses by taking the medium soil. After doing this study it has come to light that base shear is the greatest at the lowest floor and story shear is the greatest at the top floor and these values increases with the increase in zone factor(varies with the type of soil considered).

Keywords: - dynamic analysis, earthquake, multi-storey building, seismic zones, STAAD PRO.

INTRODUCTION

Using conventional design of manual method of building is time consuming and more possibilities of errors. So, by using STAAD PRO we can get more accurate results consuming less time. This can solve typical Problem like seismic analysis using various load combination to confirm various code like IS 456:2000, 1893:2002, IS875:1897etc. G+7 R.C. framed building was analysis by using STAAD Pro software for seismic load to get seismic responses[2]. Earthquake analysis is a dynamic analysis since earthquake force is dynamic in nature whose acceleration fairly changes with time compared to the structure's natural frequency. The main parameters that were taken into considerations in the present study in the seismic performance of model are story drift, base shear, story deflection and time period. D.R. Deshmukh et. al (2016) concludes that STAAD PRO is a versatile software and has the capability to calculate the reinforcement needed for any concrete section, to find lateral deflection due to earthquake load[6].

METHODOLOGY

Consider (G+5) Storey building located in a region of zone V, the soil conditions are medium stiff soil, entire building is supported on raft foundation, RC frame infill with brick masonry, floors carry live load of 5.062kN/m2 on floors and 4.375kN/m2 on roof, span of building 12m in X and Z direction, Floor to floor height is 3m, size of beam is assumed to be as 0.45X0.45m and size of column as 0.5X0.5m, material assume to be concrete. All the supports are assigned as fixed supports. Calculation of design seismic force by (dynamic) Response spectrum analysis method by using STAADPRO software:-

Run structure wizard and make a bay frame of length × height × width = 12 × 18 ×12.

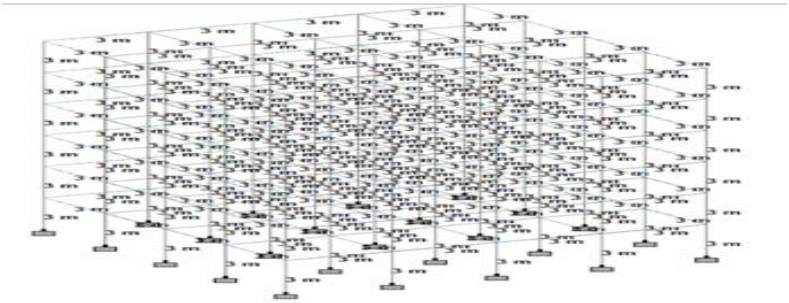

Fig.1: The structural model of the building in staad pro. software.

A. Load Consideration

Self-weight of the members of the structure are applied. Member weight with respect to the concrete strength and size of the member are also considered. Pressure due to the dead load and live load imposed upon the slabs are also calculated and applied.
Beams = (0.45×0.45) mm^2
Columns = (0.5×0.5) mm^2
Slabs = 175 mm
Member load(beams) = 0.45×0.45×25 = 5.0625 kN/mm^2.
Member weight(plate) = 0.175×25 = 4.375 kN/mm^2.

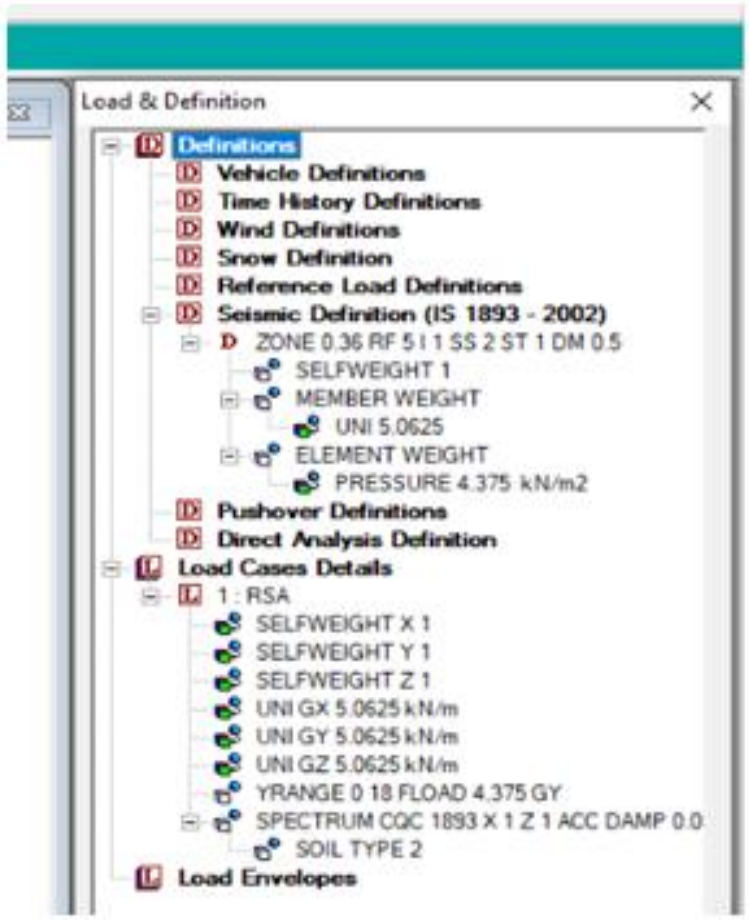

Fig 2: Loads applied on the structure.

Building Configuration	
X Direction	3, 3, 3, 3
Y Direction	3, 3, 3, 3, 3, 3
Z Direction	3,, 3, 3, 3

B. Performing response spectrum analysis

- Go to seismic definitions(IS 1893-2002)
- Make a new seismic load case .
- Select IS1893 2002 and click generate.
- There will show a window similar to the one shown in fig 3 and type the values of the required parameters as shown.
- Click Add.

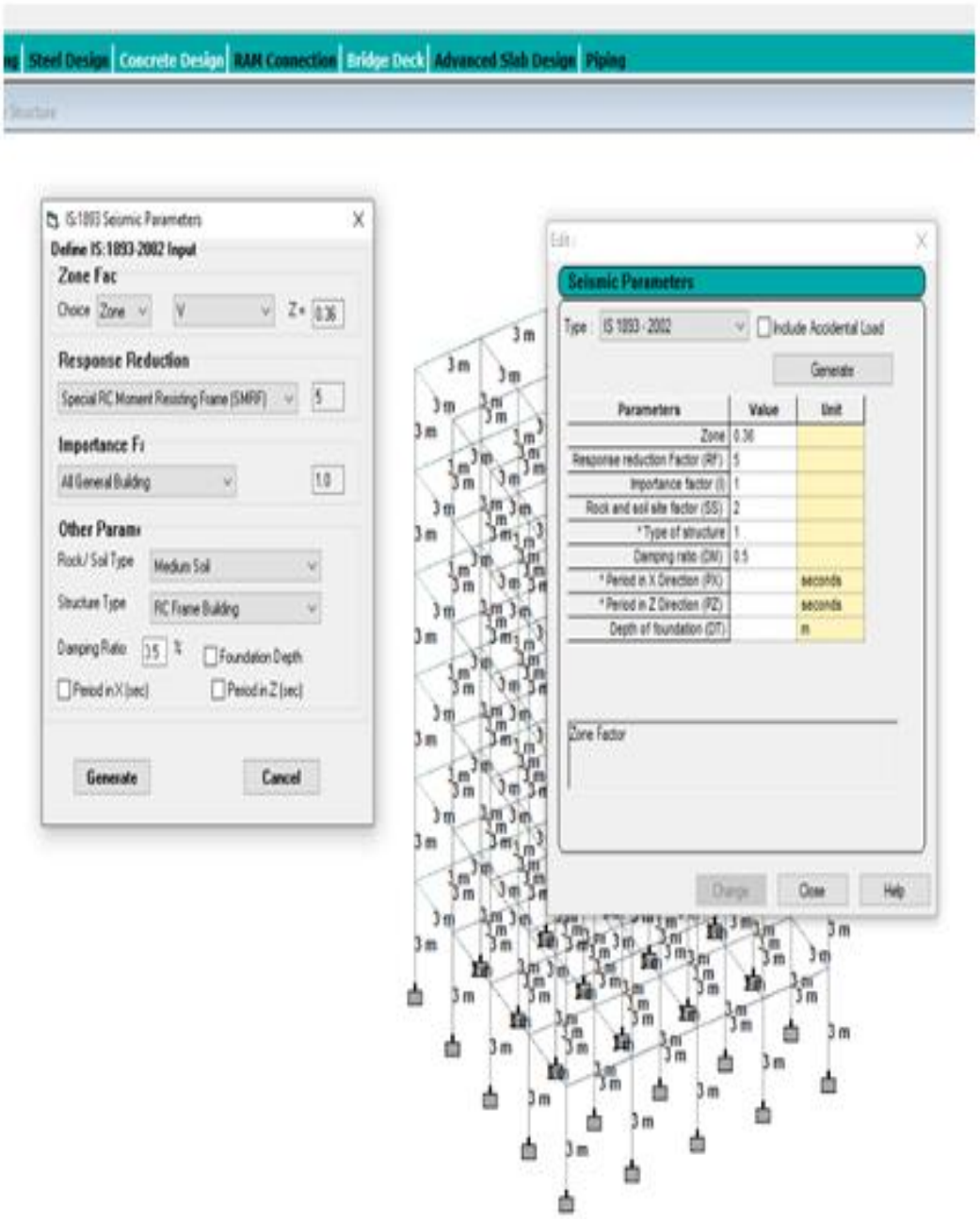

Fig 3 : Seismic load definitions.

C. Seismic Parameter: -

1) Seismic zone V, zone factor Z is 0.36
(Table no. 2 of IS1893:2002 Part-1)
2) Response reduction factor, R is 5
(Table no. 7 of IS1893:2002 Part-1)
3) Importance factor, I is 1.0
(Table no. 6 of IS1893:2002 Part-1)

D. Defining Response Spectrum Load Case: -

- Go to load case details and make a new seismic load case.
- Add self-weight of X Y and Z as 1 respectively.
- Then we will add uniform weight in all dimensions and the floor load in YRANGE.
- Select response spectra.
- Select the required parameters and type the values accordingly and click add as shown in fig 4.

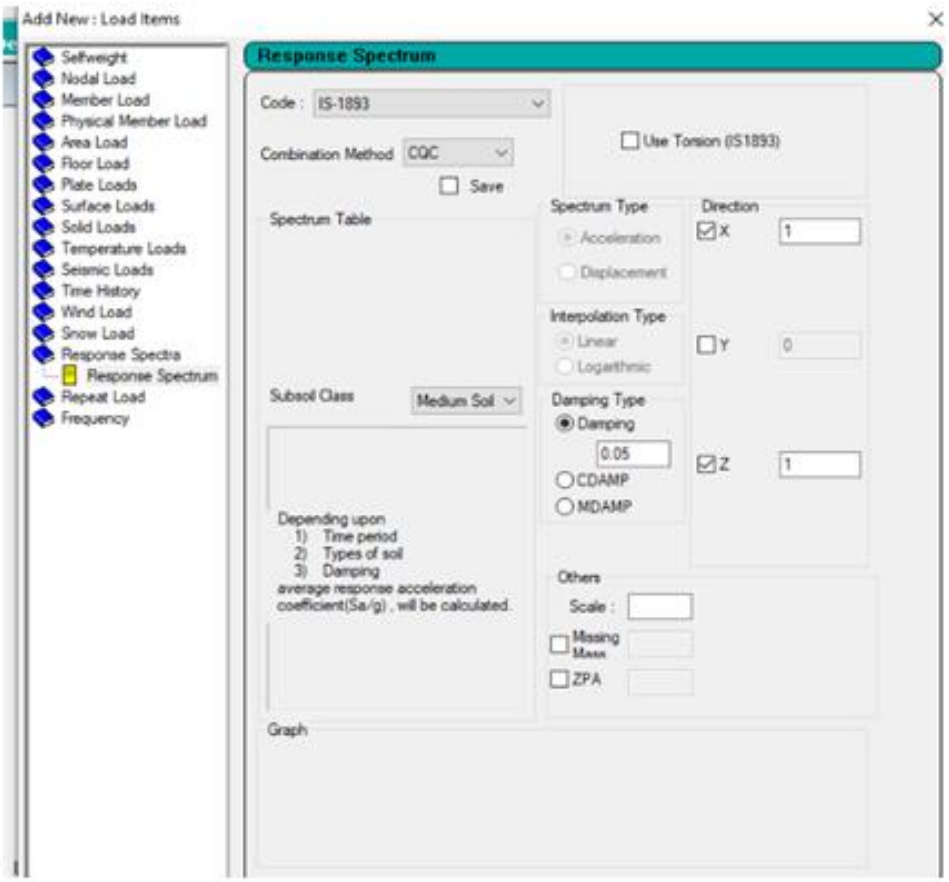

Fig 4: Response spectrum load case

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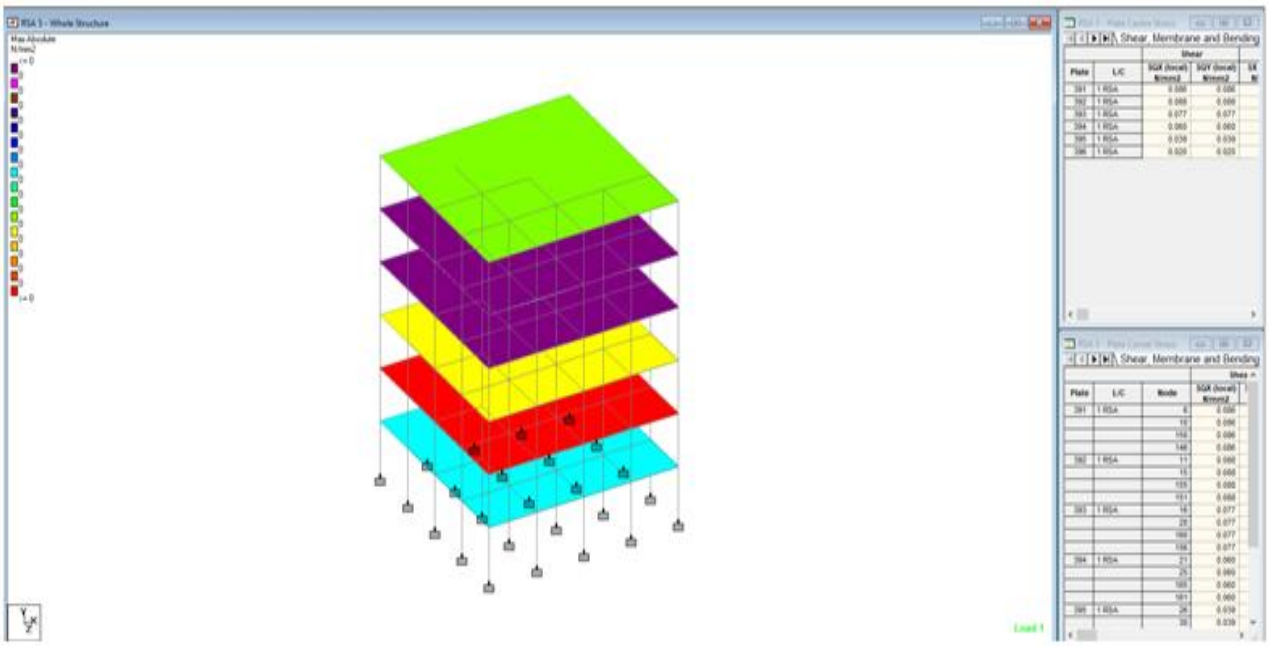
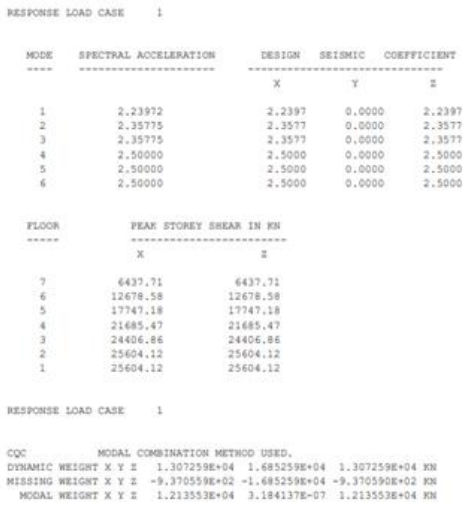
POST PROCESSING MODE: -

After adding all the load cases we will select the materials as concrete and proceed towards analysis/print which will give us the result.

- In post processing mode go to staad output and print the output file.





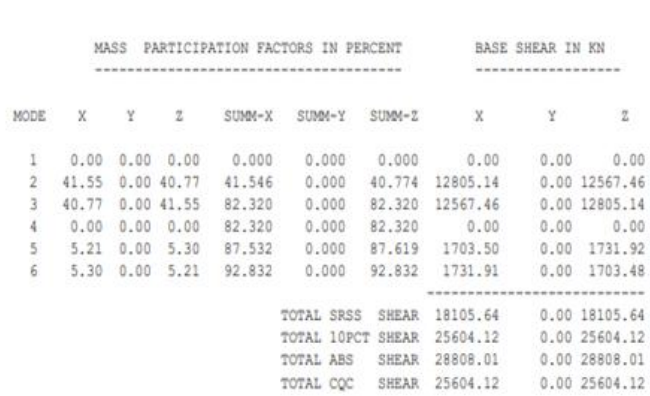
RESPONSE LOAD CASE 1

MODE	SPECTRAL ACCELERATION	DESIGN SEISMIC COEFFICIENT X	Y	Z
1	2.23972	2.2397	0.0000	2.2397
2	2.35775	2.3577	0.0000	2.3577
3	2.35775	2.3577	0.0000	2.3577
4	2.50000	2.5000	0.0000	2.5000
5	2.50000	2.5000	0.0000	2.5000
6	2.50000	2.5000	0.0000	2.5000

FLOOR	PEAK STOREY SHEAR IN KN X	Z
7	6437.71	6437.71
6	12678.58	12678.58
5	17747.18	17747.18
4	21685.47	21685.47
3	24406.86	24406.86
2	25604.12	25604.12
1	25604.12	25604.12

RESPONSE LOAD CASE 1

CQC MODAL COMBINATION METHOD USED.
DYNAMIC WEIGHT X Y Z 1.307259E+04 1.685259E+04 1.307259E+04 KN
MISSING WEIGHT X Y Z -9.370559E+02 -1.685259E+04 -9.370590E+02 KN
MODAL WEIGHT X Y Z 1.213553E+04 3.184137E-07 1.213553E+04 KN



MODE	MASS PARTICIPATION FACTORS IN PERCENT X	Y	Z	SUMM-X	SUMM-Y	SUMM-Z	BASE SHEAR IN KN X	Y	Z
1	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00
2	41.55	0.00	40.77	41.546	0.000	40.774	12805.14	0.00	12567.46
3	40.77	0.00	41.55	82.320	0.000	82.320	12567.46	0.00	12805.14
4	0.00	0.00	0.00	82.320	0.000	82.320	0.00	0.00	0.00
5	5.21	0.00	5.30	87.532	0.000	87.619	1703.50	0.00	1731.92
6	5.30	0.00	5.21	92.832	0.000	92.832	1731.91	0.00	1703.48
					TOTAL SRSS	SHEAR	18105.64	0.00	18105.64
					TOTAL 10PCT	SHEAR	25604.12	0.00	25604.12
					TOTAL ABS	SHEAR	28808.01	0.00	28808.01
					TOTAL CQC	SHEAR	25604.12	0.00	25604.12

Fig 5 : Response Load Case

Fig 6: Participation factors and base shear.

CONCLUSION

The response of (g+5) Storey RCC building under seismic load as per is1893:2002 (part-1) by using software STAAD - PRO has been studied. The model studied above is considered in zone V region. Likewise, all the other seismic zones are also taken under considerations and studied. The following conclusions are drawn according to the study: -

- Base shear value is the greatest at the ground floor.
- Storey shear value is the greatest at the 5^{th} floor.
- As we increased the seismic zones, base shear and story shear increases and the maximum value is at zone V.
- Columns provided continuously from the ground level to the top level also offer less moments and provides more resistance.
- Moments at each nodes and slabs have significant differences and for more safety it is better to design for each and it is more economical.

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