Seismic Analysis of Multi Storied Building for SMRF and SMRF with Shear Wall by using Static and Dynamic Methods

Akshay Agrawal[1], Vinita Gavanang[2], Shilpa Gaikwad[3], Shruti Patare[4], Pravina Mithe[5], Pallavi Sonavane[6]
Department of Civil Engineering, Dr. D.Y. Patil Institute of Engineering and Technology, Pimpri Pune. 18

Abstract
Frequency of occurrence of earthquake has increased recently causing severe damage to human life and property. Hence need of accurate seismic analysis of structures arises. There are static and dynamic methods of seismic analysis such as Seismic Co-efficient method and Response Spectrum method. In this paper these methods are applied for seismic analysis of G+19 building for SMRF and SMRF with shear wall system. Comparative study these earthquake resisting system and methods is carried out and presented here.

Keywords — *Seismic analysis, seismic co-efficient method, response spectrum method, SMRF, SMRF with Shear Wall*

I. INTRODUCTION

In an event of a major earthquake, 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. The multi storey R.C. buildings are being designed and constructed and for which seismic analysis is an important aspect. Various countries have come up with codes for seismic analysis and design. IS1893:2002 is the seismic analysis code for India. IS 1893:2002 discusses about the static and dynamic seismic analysis, of which Seismic Coefficient Method (SCM) is the static method and Response Spectrum Method (RSM) is dynamic method. Frame with ductile detailing as per IS13920:1993 are called as Special Moment Resisting Frame and Shear Wall is another effective technique to resist seismic force. In the present study G+19 building is considered and analysed for two different types of frame (SMRF and SMRF with shear wall) by both, the methods viz SCM and RSM.

The study of related literature has showed that shear wall is economical and effective in high rise building and providing them at adequate locations substantially reduces the displacements due to earthquake[5].Seismic coefficient method is not sufficient for high rise irregular building as it is conservative as compared to response spectra method[1]. More accurate results can be obtained for buildings by the modal analysis method, using modified design response spectra for inelastic analysis[3]. Storey moments are high in seismic coefficient method as compare to response spectrum method[2]. The performance of SMRF is quiet good as compare to OMRF in resisting earthquake forces[4].

A. Seismic analysis

In order to calculate equivalent forces on structure, the predominant horizontal (lateral)forces are computed by various methods, SCM, that is static method which is easy to apply as compare to the RSM which is Dynamic method. For assessing the accuracy of these two methods, a comparative study for G+19 building has been carried out in this work. The methods and result are discuss in next section.

B. Seismic coefficient method

The total design lateral force or seismic base shear (V_B) along any direction is determine by the expression $V_B = A_h W$ where W is seismic weight of building and $Ah = \frac{ZIS_a}{2Rg}$,the design Base Shear is to be distributed as $Qi = V_B \frac{W_i h_i^2}{\sum_{j=1}^{n} W_j h_j^2}$

C. Response Spectrum Method

Dynamic analysis shall be performed to obtain the design seismic forces and its distribution along the height of the building at different level, for the buildings those greater than 40m in height in Zones IV and V, and those greater than 90m in height in Zones II and III. The peak lateral force (Q_{ik}) at floor i in Mode k is given by $Q_{ik} = A_{ik} \emptyset_{ik} P_k W_i$ Where $A_{hk} = \frac{ZIS_a}{2Rg}$ and the peak shear force (V_{ik}) acting in storey i in mode k is given by $Vik = \sum_{j=i+1}^{n} Q_{ik}$

II. ANALYSIS OF STRUCTURE

The G+19 building as shown in fig 1 is analyzed by both seismic coefficient method and response spectrum method for zone V for different frame system. The seismic coefficient method is carried out by spread sheet and response spectrum method with the help of STAAD PRO software. The results obtained are studied and compared to derive following conclusion.

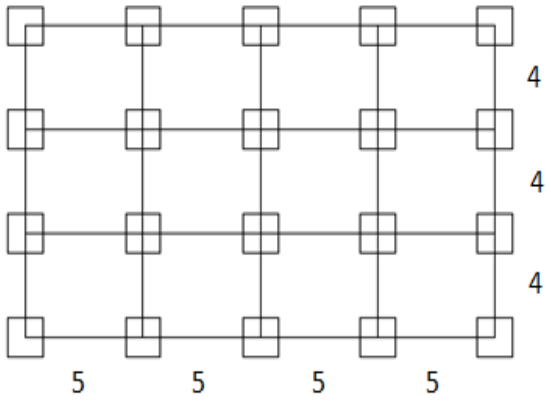

Figure 1 Plan

III. RESULTS AND DISCUSSION

After applying both the seismic analysis methods and behavior of frames the lateral forces on each storey are presented in tabular form.

Table 1. Lateral force distribution for SMRF and SMRF with shear wall by SCM and RSM

Storey No	Lateral forces by Seismic Coefficient Method		Lateral forces by Response Spectrum Method	
	SMRF kN	Shear wall with SMRF kN	SMRF kN	Shear wall with SMRF kN
20	345.38	432.73	623.42	710.92
19	668.19	881.28	653.92	811.42
18	599.71	790.95	478.26	642.74
17	534.92	705.51	355.63	528.57
16	473.84	624.95	266.41	454.36
15	416.46	549.27	202.09	400.72
14	362.79	478.48	160.59	359.55
13	312.81	412.56	135.97	327.3
12	266.54	351.53	125.19	300.52
11	223.96	295.39	125.6	278.73
10	185.09	244.12	132.78	264.14
9	149.93	197.74	146.45	257.9
8	118.46	156.24	164.65	258.68
7	90.70	119.62	181.54	262.28
6	66.63	87.88	193.13	261.69
5	46.27	61.03	193.89	249.81
4	29.62	39.06	178.04	221.81
3	16.66	21.97	144.33	173.81
2	7.40	9.76	92.1	106.04
1	1.85	2.44	31.81	35.51

The Base Shear for SMRF by SCM and RSM were found to be 4917.206 kN and 4585.8 kN respectively. Whereas for Shear wall with SMRF base shear by SCM and RSM were 6462.515kN and 6906.5kN respectively.

Comparison of SMRF and SMRF with Shear Wall

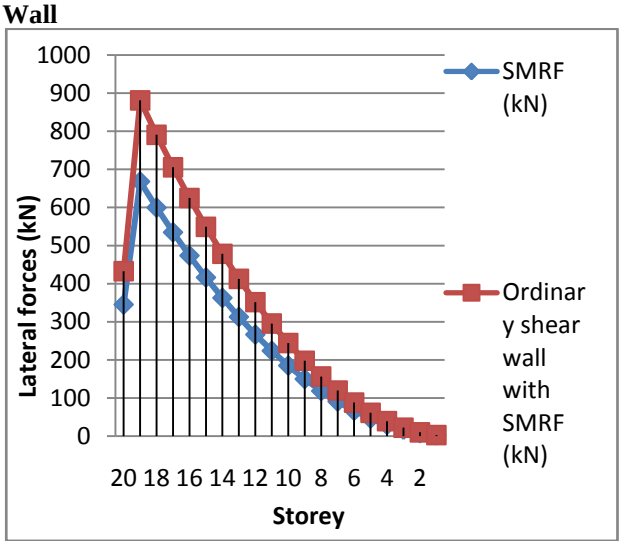

Figure 1. Static analysis

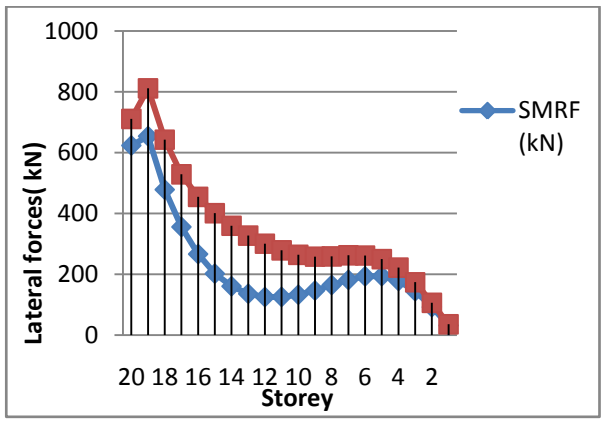

Figure 2. Dynamic analysis

From the above Figures(1&2) it can be seen that the lateral forces in SMRF are lesser as compare to Shear Wall with SMRF, also SCM shows higher and conservative values of lateral forces. SCM has a linear distribution of lateral forces

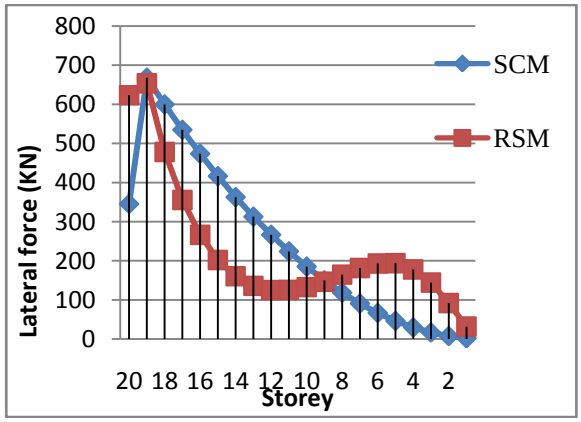

Figure 3. SMRF

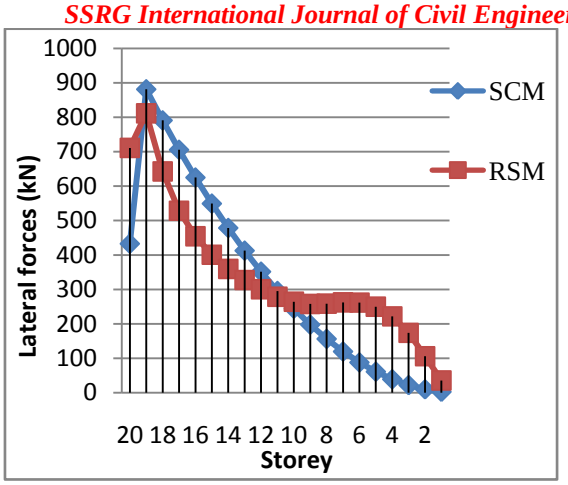

Figure 4 .SMRF with Shear wall

The above Figures(3&4) show that the distribution of lateral forces is linear in SCM and it gives more conservative and higher values than RSM.

IV. CONCLUSION

As discussed earlier seismic analysis has a prime importance and it should be carried out more precisely. Among the two methods (RSM and SCM), SCM is a approximate approach as it take seismic load as static and RSM is more accurate as it consider dynamic nature of seismic load. However SCM is easy to apply as compare to RSM.

Comparative study has shown that SCM show linear distribution of base shear whereas RSM shows non linear in fact in RSM Base Shear at lower storey is higher than SCM. For the mid stories(10-14) RSM shows almost linear relation and again rises.

Also comparative study of SMRF and SMRF with shear wall

has showed that the lateral forces in SMRF with Shear wall are more than SMRF. This may be due to extra loads of Shear wall.

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