International Refereed Journal of Engineering and Science (IRJES)
ISSN (Online) 2319-183X, (Print) 2319-1821
Volume 7, Issue 7 Ver. I (Jul 2018), PP.46-51

Performance Analysis Of OMRF Braced Frame And SMRF Frame Under Seismic Condition

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ABSTRACT- *Earthquake is very dangerous and calamitous phenomenon occurring due to the movement of the tectonic plates of earth. Therefore it is sagacious to do the seismic anatomization and delineation to intercept structures versus any calamity. In this analytical study Performance analysis of both OMRF frame and SMRF frame was performed under seismic loading condition of different zones of India. From different study it was observed that various parameters like earthquake magnitude, propinquity to epicenter, and the confined geological situation, which impinge on the seismic wave promulgation. Maximum displacement and shear stresses developed were found to be major output parameters. SMRF performed much better than other form of OMRF frame. Three different configurations of high rise buildings were also studied. Stepped Building was observed to attain better configuration form as compared to other configuration.*

KEYWORDS: *OMRF, SMRF, high rise building, Earthquake, bracing*

Date of Submission:12-11-2018 Date of acceptance: 26-11-2018

I. INTRODUCTION

Earthquake is very dangerous and calamitous phenomenon occurring due to the movement of the tectonic plates of earth. It is assumed to be one of the most dangerous and disastrous phenomena occurring in nature. Therefore it is sagacious to do the seismic anatomization and delineation to intercept structures versus any calamity. From different study it was observed that various parameters like earthquake magnitude, propinquity to epicenter, and the confined geological situation, which impinge on the seismic wave promulgation. Thus it can be understood that the performance of the structure was dependant on the establishment and representation of factors such as lateral forces exhibited by the earthquake was the primary factor for destruction of the structure under earthquake [1-2].

Frame structures are the structures having the combination of beam, column and slab to resist the lateral and gravity loads. These structures are usually used to overcome the large moments developing due to the applied loading. One of the best advantages of frame structures is their ease in construction. It is very east to teach the labor at the construction site. Frame structures can be constructed rapidly. Economy is also very important factor in the design of building systems. Frame structures have economical designs. In frames structures, span lengths are usually restricted to 40 ft when normal reinforced concrete. Otherwise spans with a length greater than that can cause lateral deflections.

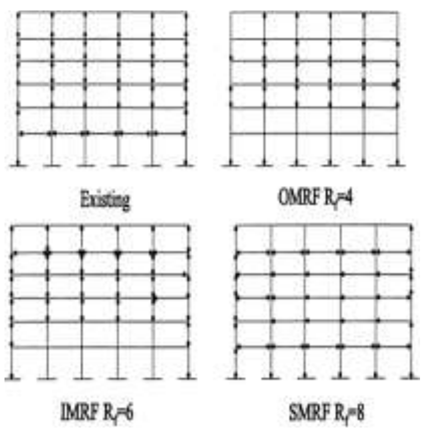

Fig.1. SMRF and OMRF building frame [3]

It was established that there are basically two types of frame structures which were essentially being used for design of the structure namely Special moment resisting frame and Ordinary moment resisting frame.

Special moment resisting frame was termed as a class of moment resisting frame with special proportioning and detailing necessities, which are very essential in resisting tough earthquake trembling by means of extensive inelastic manners. These frames were necessarily stated up when they provide essential perks for enhancing the reaction distinctiveness of these frames in the assessment of extensive normal and active moment acting on the structure.

II. METHODOLOGY

Three different high rise building namely normal building, single step high rise building and stepped high rise building were modeled using E-Tabs software. Different building structures separately were subjected to high intensity and classic earthquakes i.e seismic loads of different zones of India. Seismic loads of different zones were represented in tabular form with its time acceleration graph. Such values were used as boundary conditions to provide loading condition on the structure which is taken for the respective analysis. It was observed that the three different building combinations with either SMRF or OMRF configuration were modeled which was further applied with proper boundary conditions. It was observed that seismic analysis was performed considering that the foot of the building was firmly placed in ground therefore end connections of the buildings were fixed. Gravity loads also was found to play a very significant role in the seismic analysis of the building.

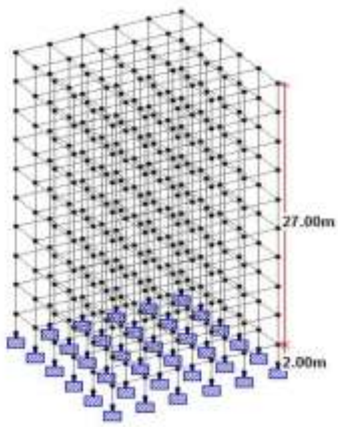

Fig.2. Isometric view of 10 storey high rise structure

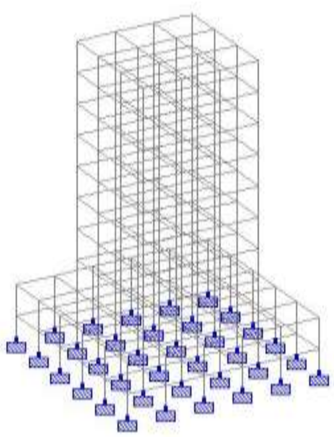

Fig.3. Isometric view of 10 storey single step high rise structure

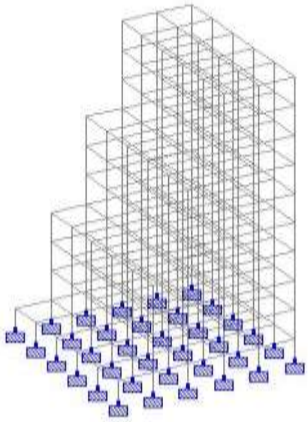

Fig.4. Isometric view of 10 storey stepped high rise structure

One of the most important methods during pre-processing of a simulation work is to provide the boundary conditions. In the boundary conditions for a frame system bottom faces of the column was considered to be fixed. Bonded contacts were provided between all the faces of columns of frame which are connected to each other. No separation was allowed between the joints of the structure that the loads can be transferred to the whole structure perfectly. Gravity load was given to the structure to consider the effects of inertia and gravitational force of the building while seismic analysis. Seismic analysis was performed as an explicit dynamic analysis. Loads to the building frame were provided in the form of time- acceleration history plot for different earthquake zones.

III. RESULTS AND DISCUSSION

It was observed that buildings start to perform highly non-linearly on the application of highly dynamic seismic loads. Structural non-linearity occurs in the high rise buildings whatever may be the shape of building. Under seismic loads of structure due to various zones of earthquake non-linearity behavior of the structure almost remains the same only the magnitude of the deformation varies.

It was observed that for tall or high rise building seismic analysis has to be performed by dynamic modes then only accurate results were possible while for small building even static seismic analysis could give us better results.

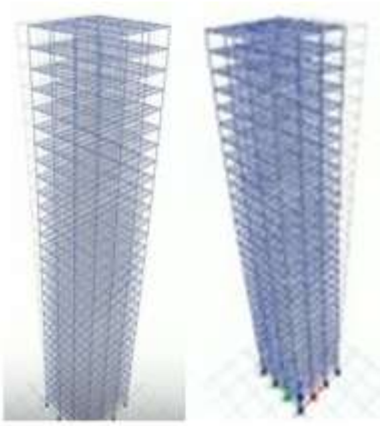

Fig.5. Modes of deformation

Fig. 5 shows the modes of deformation of the structure when subjected to highly unstable seismic loads. It was observed that structure undergoes a to and fro motion in the horizontal direction with time while the magnitude of the displacement was directly proportional to the intensity of the earthquake. It was clearly visible that the structure (of any shape) has higher deformation in zone V as compared to zone III and zone IV.

It was observed from fig. 6 that bending moment of stepped frame tends to have maximum bending moment on comparison to other two types of structure. Stepped frame therefore starts to behave more unstable on exposure to high dynamic seismic loads, while other two types of frames remain more stable. It was also observed from the figure that OMRF braced building have subsequently more bending moment as compared to SMRF braced building frame. Maximum bending moment for normal, single step, stepped frame was 137.24, 141.47 and 130.85 N-mm for OMRF while it was 100, 110.49 and 118.73 N-mm respectively for SMRF. It was the outcome of all three different types of buildings. SMRF building was observed to be highly efficient and earthquake resisting structure as compared to that of OMRF building.

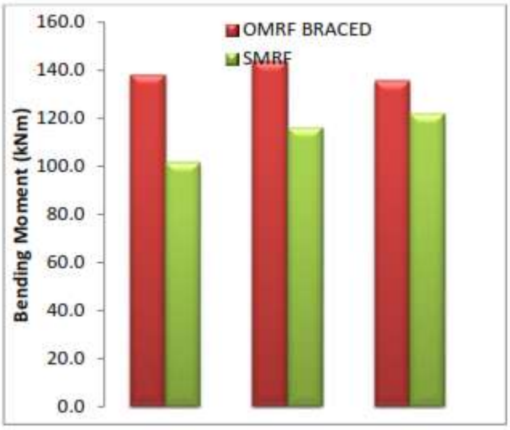

Fig.6. Bending moment of framed structures in Zone III

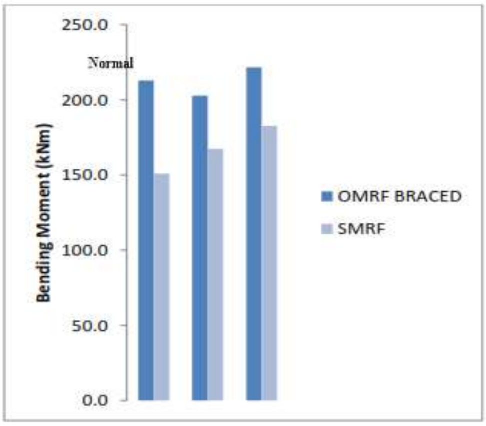

Fig.7. Bending moment of framed structures in Zone IV

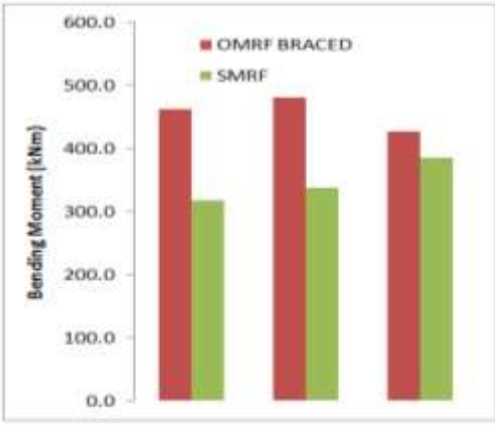

Fig.8. Bending moment of framed structures in Zone V

When the magnitude of the seismic loads applied were as per that of time acceleration graph of zone IV. All three different types of the structure normal, single step and stepped building was subjected to same earthquake load as per zone IV according to IS codes. It was evident that stepped frame tends to have maximum shear force on comparison to other two types of structure.

It was observed from fig. 9 that maximum shear force of stepped frame tends to have maximum shear force on comparison to other two types of structure. Stepped frame therefore starts to behave more unstable on exposure to high dynamic seismic loads, while other two types of frames remain more stable. It was also observed from the figure that OMRF braced building have subsequently more maximum shear force as compared to SMRF braced building frame. It was the outcome of all three different types of buildings. SMRF building was observed to be highly efficient and earthquake resisting structure as compared to that of OMRF building.

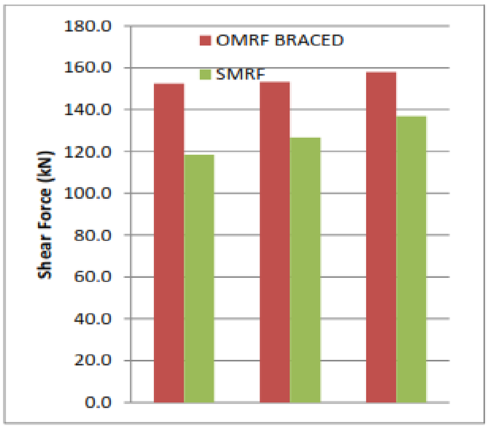

Fig. 9. Shear Force of Framed structures in Zone IV

When the magnitude of the seismic loads applied were as per that of time acceleration graph of zone III. All three different types of the structure normal, single step and stepped building were subjected to same earthquake load as per zone III according to IS codes. It was evident that stepped frame tends to have maximum displacement on comparison to other two types of structure.

It was observed from Table 1.and 2 that maximum displacement of stepped frame tends to have maximum value of nodal displacement in both x and z direction on comparison to other two types of structure. Stepped frame therefore starts to behave more unstable on exposure to high dynamic seismic loads, while other two types of frames remain more stable. It was also observed from the figure that OMRF braced building have subsequently more maximum displacement as compared to SMRF braced building frame. It was the outcome of all three different types of buildings. SMRF building was observed to be highly efficient and earthquake resisting structure as compared to that of OMRF building.

Table 1 Nodal displacement in x direction

MAXIMUM NODAL DISPLACEMENT (mm) IN ZONE III			
RF	TYPE OF STRUCTURE IN X DIRECTION		
	Normal	Single step	Stepped
OMRF BRACED	63.104	69.992	70.091
SMRF	51.821	52.346	58.542

Table 2 Nodal displacement in z direction

MAXIMUM NODAL DISPLACEMENT (mm) IN ZONE III			
RF	TYPE OF STRUCTURE IN X DIRECTION		
	Normal	Single step	Stepped
OMRF BRACED	63.104	64.928	70.091
SMRF	51.521	54.015	58.542

IV. CONCLUSIONS

Following are the conclusions made from this analytical study:

- SMRF structures were most efficient structures under seismic loading as the seismic load resistance of SMRF structures was very high.
- Stepped configuration used in the study was found to be most affected by seismic loading in zone III and zone IV.
- Single step configuration used in the study was found to be most affected by seismic loading in zone V as single configuration has least 145 N-mm bending moment and has least shear stress affected zone against same loading.
- Normal configuration used in the study has highest seismic load resistance.
- Stepped configuration was found to have maximum bending moment in zone III and zone IV. Maximum bending moment for normal, single step, stepped frame was 137.24, 141.47 and 130.85 N-mm for OMRF while it was 100, 110.49 and 118.73 N-mm respectively for SMRF for zone IV.
- Stepped configuration was found to have maximum shear force in zone III and zone IV.

- Stepped configuration was found to have maximum displacement in x and z direction in zone III and zone IV. Maximum nodal displacement for SMRF in normal single step and stepped condition were 124.31, 129.574 and 140.468 mm respectively while OMRF braced configuration will undergo 151.346, 155.676 and 168.128 mm for Normal, single step and stepped configuration respectively in zone IV.

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Shantilal Patel "Performance Analysis Of OMRF Braced Frame And SMRF Frame Under Seismic Condition "International Refereed Journal of Engineering and Science (IRJES), vol. 07, no. 07, 2018, pp. 46-51