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"Seismic Comparison of OMRF & SMRF Structural System on Zone II"

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Abstract - *In recent increase in the rate of earthquake every year & thereby increasing loss of life & property has led to necessity of comparing the methods of analyzing & designing of building structure. The selection of a building configuration is one of the most important aspects of overall design in its role to provide seismic protection that may impose severe limitations on the structure. In India, the zones are divided according to the rate of magnitude of earthquake. Indian codes divided the entire country into four seismic zone (II, III, IV, V) depending on the seismic risk. The study of the building structure according to the zone was done by the classifying into two methods i.e. Ordinary RC Moment Resisting Frame (OMRF) structures & Special RC Moment Resisting Frame (SMRF) structures.*

Key Words: *Base shear, Earthquake loads, Wind load*

1. INTRODUCTION

Some of the largest earthquakes of the world have occurred in India & the earthquake engineering development in the country started rather early. After, the 1987 earthquake in Assam a new earthquake resistant type of housing was developed, which is still prevalent in northeast India. The Baluchistan earthquakes of 1030s led to evolution of a map of the first seismic zone, the innovative earthquake resistant construction. The institutional development started in the late 1950s & earthquake engineering concepts have been applied to many major projects in high seismic regions in the country. Extensive damage during moderate earthquakes indicates that despite such early gains, earthquake risk in the country has been increasing frighteningly.

2. LITERATURE

Dipak M. Kolekar, Mukund M. Pawar. "Study of Base Shear, Storey Shear and Moment Multi-storey Building for Different Seismic Zones." In the present paper, author studied of the variation in base shear, storey shear and base moment for different seismic zones. In present study earthquake load is applied on G+3, G+5, G+7, G+9 storey buildings for two different plan areas and different seismic zones. They conclude that whenever we increase the number of storey the base shear, storey shear and base moment get increased.

Ravikant Singh, M. C. Paliwal. "Study of Behavior Parameters of the Building with Variations in Story and Number of Bays." In the present paper the behavior parameter of the bare frame buildings is studied. The author studied in this paper SMRF buildings with same number bays and different number of storeys was compared. The pushover curve was plotted and the author found that the ductility and the magnitude of base shear that can be resisted, increases with increase in the number of storeys. They observed that all the SMRF buildings considered have almost the same value of initial slope in the pushover curve.

J. Bhattacharjee. "Study of OMRF & SMRF Structures for Different Earthquake Zones of India" In these papers authors were done the study of building by classifying them by two methods i.e. Ordinary RC moment resisting Frame Structure (OMRF) and Special RC moment Resisting Frame (SMRF). In these paper two comparison has been done. The first comparison in between OMRF and SMRF structure & Second comparison is the behavior of the building structure in different earthquake zone of India. They were used STAAD Pro software for designing the structure for four earthquake zones. In this paper, the variation in the structure was done while designing, considering OMRF and SMRF structures. For that purpose, fixed dimension of beams and columns taken to co-relate variation in displacement of OMRF and SMRF structure.

G.V.S. Siva Prasad, S. Adiseshu. "A comparative Study of OMRF & SMRF Structural System for Tall & High Rise Building Subjected to Seismic Load" In this paper, the author studied the seismic behavior of the structure i.e. Special Moment Resisting Frame (SMRF) & Ordinary Moment Resisting Frame (OMRF). They analyzed the G+10, G+15, G+20 storied in staadpro software. In this paper structure was studied under seismic zone by using IS standards for zone ii. system for a tall & high raise structures SMRF structures was studied. The lateral loads, dead loads, live load is taken for the design of structures as per IS standards for Zone II. In this paper, they conclude SMRF gives safer than OMRF. In both systems the SMRF gives a more safety to designers to design the structure, and it is little cost effective to the builders who construct the tall and high rise building.

Sheovinay Rai, Rajiv Banerjee, Tabish Izhar, (December 2015), conducted the study on 'A Comparative Study of OMRF & SMRF Structural System

Using Different Software's' this is carried out to examine the seismic behavior of the structure having various structural formation like OMRF (Ordinary Moment Resisting Frame), SMRF (Special Moment Resisting Frame) using different software i.e. Staad Pro & Etabs. In the view of results & observation obtained by the analysis of the considered building structure, the SMRF structural system is more efficient than OMRF structural system in earthquake design because for a particular seismic zone, design base shear, average displacement & story drift for SMRF is 40% lower than that of OMRF.

Amit Kumar Yadav, Prof. Anubhav Rai, (February 2017) '**A** seismic comparative study of OMRF & SMRF structural system for regular & irregular building' in this paper, they analyzed the OMRF (Ordinary Moment Resisting Frame) & SMRF (Special Moment Resisting Frame) with all seismic zone considering all various regular & irregular structures in software. They analyzed all the structures in the Staad pro software. They compare the bending moment, shear force, displacement & base shear of various structure in various zones. It is observed that SMRF with regular and irregular frame is better than OMRF with regular and irregular frame because it reduces various parameter likes bending moment, shear force, displacement and storey displacement. It also clears that SMRF is a moment resisting frame specially detailed to provide ductile behavior due to with size of section and area of reinforcement can be reduced. The analysis is very useful from a structural point of view because SMRF gives more security to the designer to design the structure, and it is cost effective for the builder.

Swapnil J. Bhusari, Ashish S. Moon and Anupam S. Hirapure (2017). "Seismic Behavior of Ordinary and Special Moment Resisting Frame" In this paper, they studied the behavior of the SMRF and OMRF structure by using the software STAAD PRO, and also compared both the system. In this work they took the G+10 RCC structure is analyzed. They compared the axial loads, shear forces, bending moments, drift and torsion of the building by using the staad pro for the modeling, and the analysis of the building. The result of this study that the SMRF system of ductile design is best for the analysis and design of earthquake resisting structure.

Mukesh Rai, M.C. Paliwal (2017). "A Comparison of OMRF Braced and SMRF RC Frame Considering Earthquake Loading" In this study Special Moment Resisting Frame and Ordinary Moment Resisting Frame with bracing are considering as structural frame and comparison are made for seismic load. In this paper, they analyzed the regular and irregular structure and compared both the structure. They analyzed the structure in the staad pro software. In this paper, compared the bending moment, shear force & displacement. They observed the SMRF is more efficient than OMRF braced type frame & SMRF reduces moment means reduces area of steel. Also, SMRF reduces the shear forces means reduce shear reinforcement.

Dr Valsson Varghese Yogesh Ramakant Borkar (2013). "Comparative Study of S.M.R.F. Building Over O.M.R.F. Building with Seismic and Wind Effect." In this paper, author studied the special moment resisting frame (ductile detailing) and ordinary moment resisting frame should be considered as a structural frame and compared for seismic load and wind load. They analyzed the OMRF and SMRF structure and the structure detailing. They were studied the provision of IS 1893-2002 (part 1) for earthquake and IS 13920 -1993 for ductile detailing. He concluded the forces of OMRF structure are comparatively much higher than that of the SMRF structure. It is more safe to design a ductile detailing structure than the non- ductile detailing structure. The quantity of steel found more in case of SMRF than that of OMRF.

Tena- Colunga et. al. (2008). Conducted a study on 22 regular mid rise RC-SMRF buildings to fulfill the requirements of MFDC (Mexico Federal District Code) and concluded that uses of secondary beams to reduce the slab thickness will result in increase in seismic behavior of SMRF.

Mohhammad AlHamaydeh (December 2011), "Seismic Design Factor for RC Special Moment Resisting Frames in Dubai, UAE" In This study authors investigates the seismic design factors for three reinforced framed buildings with G+ 4, G+16 and G+32 stories in Dubai, UAE utilizing nonlinear analysis. In this paper author designed the buildings according to the response spectrum process defined in 2009, International Building Code (IBC'09). They can be concluded that the level of inelasticity in the response of RC frame structures in the UAE, and consequently the factors to be used in seismic design, significantly depend on the level of the considered design ground motion. The result of the nonlinear time history analysis showed an increase in the inelastic drift, C_d, R and R_d Factors in the range of 2 to 4 times. The $\Omega_\circ$ factors on the other hand, showed a nominal 30% increase.

3. CONCLUSIONS

The above research paper gives the following conclusion.

The ductility of SMRF building is more than the OMRF building, the reason being the heavy confinement the concrete due to splicing and uses of a number of stirrups as ductile reinforcement. Comparing base shear capacity of OMRF building is 7 to 28% more than that SMRF building. So, it is necessary to increase strength and stiffness of building to withstand seismic load.

It is safer to design a ductile detailing structure than the non- ductile detailing structure. The quantity of steel found more in case of SMRF than that of OMRF.

The SMRF is more efficient than OMRF braced type frame & SMRF reduces moment means reduces area of steel. Also, SMRF reduces the shear forces means reduce shear reinforcement.

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