ABSTRACT

Near fault earthquake record are rich in high frequencies that effects structures for far fault earthquake record lower frequencies is not effects highly in structure. The objective of the study is to be investigating the effect of near-fault and far fault earthquake motion on the response of RC moment resisting regular and irregular structure considering Near and Far situated fault zones. Linear time history analysis G+10 building has carried out for two structures. The effects of Near and Far faults zones were evaluated for G+10 Two structure the ordinary moment resisting frame system was considered for two building as a lateral load-resisting system. For two building time, history analysis was performed under two example earthquake motion Uattarkashi (Almora and Bhatwari) magnitude 6.8 Mw. The peak acceleration v/s time response spectra of the two horizontal components of the two records for Near source earthquake records @ a distance 21.7 km Bhatwari and Far source earthquake records @ a distance 153.5 km of Almora records are taken in virtual data centre of India earthquake records COSMOS Virtual Data Center - Strong Motion Center. For two building and earthquake record, the analysis was carried out for both

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conditions and compared with fixed base results for all analysis both Near-field and Far-field earthquake were considered. The mainly evaluated parameter were storey drift, storey displacement and storey force, period vibration results based on linear time history analysis considering two structures. The comparative study of four parameters considers the graphs and curves shows higher and lower values higher values show that the earthquake effect of building and damages is more.

Keywords: Regular and irregular structures; RC moment resisting structures; near and far fault earthquake.

1. INTRODUCTION

In the RC moment resisting framed regular and irregular structures. The Regularity in elevation is a particular condition by distributed along with the height of mass stiffness and strength, compare to irregular structure earthquake damages lesser than that of the regular structure. The irregular structure shows an unfavourable seismic behaviour characterized by the concentration of plastic demand in a limited number of the section that the reason early collapse under seismic motion.

Fig. 1. Map showing the Seismic zones in India
Fig. 2. The earthquake data representation from Almora, India

Fig. 3. The earthquake data representation from Bhatwari, India
Near-fault earthquake (NFE) records are rich in higher frequencies because the short travel distance of the seismic waves wouldn’t allow much time for the high-frequency content to be damped out of the record. In addition, in the forward directivity zone, Near-fault earthquake records may contain large amplitude velocity pulse of long duration. All the buildings in seismic zones need to be designed so that they can withstand the major seismic effect. Ghobarah [1] response of structures to near-fault ground motion”. It is advisable to make the structure simple so that the structure is ‘Quake Safe’. India has a history of devastating earthquakes. The foremost reason for the high frequency and intensity of the earthquakes is that the Indian plate is driving into Asia at a rate of roughly 47 mm/year. Geographical statistics of India show that almost 54% of the land is liable to earthquakes [3-10].

The latest version of seismic zoning map of India given within the earthquake resistant design code of India [IS 1893 (Part 1) [2]] gives four levels of seismicity for India in terms of zone factors. In other words, the earthquake zoning map of India divides India into 4 seismic zones (Zone 2, 3, 4 and 5) in contrast to its previous version, that consisted of five or six zones for the country. According to the present zoning map, Zone 5 expects the highest level of seismicity whereas Zone 2 is related to the all-time low level of seismicity.

1.1 Ground Motion Selections

Two sets of two-component ground motion records are selected for this study. They are the Almora record in the 20 October 1991, Uttarkashi earthquake (Mw = 6.8) and Bhatwari records in the 20 October 1991, Uttarkashi earthquake (Mw=6.8).The peak acceleration response spectra of the two horizontal components of the two records shown in Figs. 12, 13 near sources earthquake records at a distance 21.7 Km Bhatwari and far sources earthquake records @ a distance 153.5 Km of Almora. Near-fault earthquake Bhatwari 1808 Acceleration data points (in m/s/s) at .020 sec records are taken. Far fault earthquake Almora 1067 Acceleration data points (in m/s/s) at.020 sec records are taken in the virtual data centre of India earthquake records COSMOS Virtual Data Center - Strong Motion Center.
2. METHODOLOGY

The methodology followed to evaluate the behaviour of near and Far to Fault Zone. The building considers for an analysis RC moment resisting irregular and regular commercial building with a height of 33.5 meter with an area of 1113.706 sqmt. The building consists of basement and G+10 Stories. The building consists of RC irregular and regular structural system. Linear static Time History analysis and designs are carried out for bare frame in ETABS 15.2.0 in different response of the structure to near and far response of earthquake records. The near and far earthquake acceleration v/s time records taken into in virtual data centre of India earthquake records COSMOS Virtual Data.
Center - Strong Motion Center. All the supports were modelled as fixed Supports.

3. RESULTS AND DISCUSSION

The storey drift, storey displacement, base shear and period vibration of four parameters are discussed for RC regular and RC irregular building plan. The effects of the storey drift, storey displacement at storey along near and far of X and Y directions of two building are discussed. The effect of base shear and period vibration two building are also discussed.

![Fig. 7. Regular and irregular storey drift near fault earthquake records in Y–direction](image1)

![Fig. 8. Regular and irregular storey drift near fault earthquake records in Y–direction](image2)

3.1 Storey Drift

From the data represented in Figs. 7 to 14 shows the storey drift for regular structure in X & Y directions. When the models are subjected to Lateral load analysis, the storey drifts in the X direction for a building situated near to the fault shows highest values in the seventh storey are 0.004451 and 0.00446 in regular and irregular building respectively and building situated far to the fault zone shows in X-direction 0.00033 in the eighth storey of regular 0.000399 in the seventh storey in irregular building and in Y- direction 0.000344 eight storeys of regular 0.00038 in the second storey in an irregular building. The Drift in Near building structure is more than the Far building structure in irregular, This is because of total lateral load acting on each floor of the building in the near building is greater than far building. If the building situated near to fault zone effect of the earthquake will be more, and the effect of an earthquake is lesser when the building is situated far from the fault zone. 7.11.1 of IS 1893 (Part – 1): 2002 prescribes the limitation on storey drift design lateral force, with a partial load factor of 1.0, shall not exceed 0.004 the storey height.

![Fig. 9. Regular and Irregular storey drift far fault earthquake records in X – direction](image3)

![Fig. 10. Regular and irregular storey drift far fault earthquake records in Y–direction](image4)
4. STOREY DISPLACEMENT

From the data represented in Figs. 15 to 22 shows the storey displacement for regular structure in X & Y directions. When the models are subjected to Lateral load analysis, the storey displacement in X and Y direction for a building situated near & far to the fault show highest values at the top of the building and lesser displacement at the bottom of the building. Storey displacement in near to the fault zone in X and Y direction of the regular and irregular building shows highest displacement at HR ROOM are 92.426, 02.867, 121.993 and 105.81 respectively. Regular building exhibits more displacement than the Irregular building in X and Y direction in Near to the fault zone. Storey displacement in far to the fault zone in X and Y direction of the regular and irregular building shows highest displacement at HR ROOM are 7.922, 9.171, 7.402 and 8.802 respectively, irregular building exhibits more displacement than the regular building in X and Y direction in Far to fault zone. The Displacement in Near building structure is more than the Far building structure. This is because of total lateral load acting on each floor of the building in the near building is greater than far building. If the building situated near to fault zone effect of the earthquake will be more and effect earthquake is
lesser when the building is situated far from the fault zone. Hence more care as to be taken in the design construction processes for those buildings situated near to the fault. Storey displacement of the storey relative to the base.

Fig. 15. Regular and irregular storey displacement near fault earthquake records in X–direction

Fig. 16. Regular and irregular storey displacement near fault earthquake records in Y–direction

Fig. 17. Regular and irregular storey displacement far fault earthquake records X–direction

Fig. 18. Regular and irregular storey displacement far fault earthquake records Y–direction

Regular Building Storey Displacement

Fig. 19. Storey displacement near and far earthquake records in X – direction

Fig. 20. Storey displacement near and far fault earthquake records in Y - direction
Irregular Building Storey Displacement

5. STOREY FORCE

From the data represented in Figs. 23 to 30 shows the storey force for regular structure in X and Y directions. When the models are subjected to Lateral load analysis, the storey force in X & Y direction for building situated near & far to the fault shows highest values at the bottom of the building and lesser force at the top of the building. Storey force in near to the fault zone in X and Y-direction of the regular and irregular building shows the highest force at PLINTH level are 27732.2586, 25573.508, 30988.9641 and 19387.6268 respectively. Regular building exhibits more storey force than the irregular building in X and Y direction in Near to the fault zone. Storey force in far to the fault zone in X and Y-direction of the regular and irregular building shows highest storey force at PLINTH level are 2047.1138, 1835.0584, 2913.3935 and 1980.1614 respectively. Building exhibits more force than the irregular building in X and Y direction in Far to the fault zone. The Force in Near building structure is more than the Far building structure. This is because of total lateral load acting on each floor of the building in the near building is greater than far building. If the building situated near to fault zone effect of the earthquake will be more, and effect earthquake is lesser when the building is situated far from the fault zone. Hence more care as to be taken in the design construction processes for those buildings situated near to the fault.
Fig. 25. Regular and irregular storey force far fault earthquake records in X – direction

Fig. 26. Regular and irregular storey force far fault earthquake records in Y – direction

Regular Building Storey Force

Fig. 27. Storey force near and far fault earthquake records in X – direction

Fig. 28. Storey force near and far fault earthquake records in Y – direction

Irregular building storey force

Fig. 29. Storey force near and far fault earthquake records in X – direction

Fig. 30. Storey force near and far fault earthquake records in Y – direction
6. PERIOD VIBRATION

Fundamental Natural Period is the time taken by the structure to come back in equilibrium position after a unit lateral force applied to the system.

From the data represented in Fig. 31 shows Period vibration: Period vibration for the regular structure it is observed that frequency and Eigen values are gradually increased for increased on mode number. Frequency, Circular Frequency, Eigen value in the regular building are 7.218, 45.3546 and 2057.0402 and similarly in the irregular building are 7.187, 45.1595, 2039.38 from the above values regular building exhibits higher stiffness than the irregular building.

7. CONCLUSION

In the Behaviour of RC regular and irregular structure, the near field fault zone effect is higher than the far field fault zone. From the Study of four parameters such as of storey drift, storey displacement and storey force, period vibration compression with the graphs and results table shows that in near and far x and y-direction near-fault earthquake effect is higher and far fault earthquake effect is lesser. The storey drifts in both structures subjected to the lateral load in x & y-direction for a building situated near and far show lesser drift values at top and bottom of the building and at the middle of building drift is increasing in compared to top and bottom. The storey displacement of the structure subjected lateral load analysis in x & y-direction for a building situated near & far to the fault shows the highest displacement @ top of the building and gradually decreasing to bottom of the building. The storey force in x & y-direction for building near & far to the fault values shows highest values @ the bottom of the building and lesser values @ the top of the building and the bottom building effect is higher and top of building effect is lesser. The regular and irregular building period vibration of higher values in a regular building and irregular building lower values. The period vibration for the higher value of regular building vibration higher and stiffer compared to irregular building lesser. Regular and Irregular RC building structure storey drift, storey displacement, storey force x & y direction near earthquake fault values higher and far fault earthquake values lower. The near-fault earthquake effect more than the far fault earthquake. From the study, Regular and Irregular structure graphs curves show that the regular structure curve change in values gradually in comparison with irregular structure. Earthquake effects in irregular structure damages more than the regular structure. Effects on the structure by Near faults zones is more than the far faults zones. Hence more care as to be taken in the design and construction processes for those buildings situated near to faults zone and Far fault zone earthquake the effects will be lesser. Hence lesser care can be taken extra care for design construction processes.

COMPETING INTERESTS

Authors have declared that no competing interests exist.
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