

Seismic Response of Structural Components Compared In Different Fault Line Region

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Abstract: The performance of different structural responses against different earthquake ground motion conditions in a G+11 multistorey building is presented in this paper by time history analysis method. The building model is investigated under different ground motions such as Fault normal component and Fault parallel component of the ground motion by dynamic time history analysis method and the analysis is done in the ETAB software. Time histories from different fault types and earthquake magnitudes recorded at various distances from the causative fault are compared and their special features are discussed. The time history of the Uttarkashi earthquake has been applied on the model and Acceleration, Velocity and displacement curves have been drawn for both Fault Normal and Fault Parallel component for Far Fault region and Near Fault region ground motion. The values of acceleration, velocity, displacement have been found in every 0.005 seconds, also the values of Peak Ground Acceleration, Peak Ground Velocity and Peak Ground Displacement has been determined for both components taking the data of two sub stations of Uttarkashi earthquake. A comprehensive review and study of the factors that influence the near-fault ground motions is attempted. The variation and interrelation of the kinematic and dynamic parameters pertaining to the rupture process are examined. The study mainly focuses on the parameters such as displacement variation and response spectrum variation of the near field region and far field region. The subsequent comparison is also done for both the component condition (normal and parallel) for both the regions. The values of PGA, PGV, PGD obtained for fault normal component are higher than the values obtained for the fault parallel component of the ground motion. Discussion regarding the implications of near-source ground motions on the engineering design of long-period structures is presented in an effort to gain insight regarding those features of near-field ground motions that control the dynamic response of such structures. The response spectrum curves are different for each kind of earthquake ground motions, hence it means that the structure have different responses to each kind of earthquake ground motions

KEY WORDS: Fault normal, Fault Parallel, RESPONSE SPECTUM ANALYSIS, ETABS etc.

I. INTRODUCTION

Seismic waves are waves of energy that travel through the Earth's layers, and are an outcome of an earthquake, explosion, or a volcano that imparts low frequency acoustic energy.

The seismicity or seismic action of an area refers to the frequency, type and size of earthquakes practiced over a period of time. Near-fault ground motions are different from ordinary ground motions in that they often contain strong coherent dynamic long period pulses and permanent ground displacements.

A challenging research topic in engineering seismology and earthquake engineering is the characterization of near-fault seismic motions and their effects on the performance of special structures.

At the Earth's surface, earthquakes manifest themselves by trembling and sometimes displacement of the ground. When the epicenter of a large earthquake is situated offshore, the seabed may be displaced adequately to cause a tsunami.

Earthquakes can also trigger landslides, and occasionally volcanic movement.

The probabilistic approach to seismic hazard analysis has an important advantage over the deterministic approach in that it takes into account the degree of activity of the faults that contribute to the hazard, providing explicit estimates of the likelihood of occurrence (or return period) of the hazard level that is specified in the design ground motions.

Earthquakes are measured using remarks from seismometers. The moment magnitude is the most common scale on which earthquakes greater than approximately 5 are reported for the entire globe. The more earthquakes smaller

than magnitude 5 stated by national seismological observatories are measured mostly on the local magnitude scale, also referred to as the Richter magnitude scale. These two scales are numerically similar over their range of legitimacy. Magnitude 3 or lower earthquakes are mostly almost unnoticeable or weak and magnitude 7 and over potentially causes severe damage over larger areas, dependent on their depth.

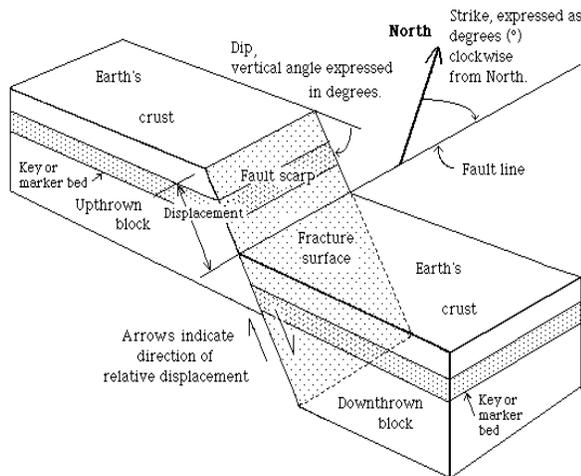


FIG 1: FAULT PLANE SLIP AND FOCUS

There are three main report items existing for time history load cases: Time History Cases, Forcing Function Details, and Forcing Function Summary.

Response spectrum considers the spectrum of a response quantity like acceleration with respect to frequency. This spectrum is used to produce acceleration coefficients for different masses which in turn provide the force.

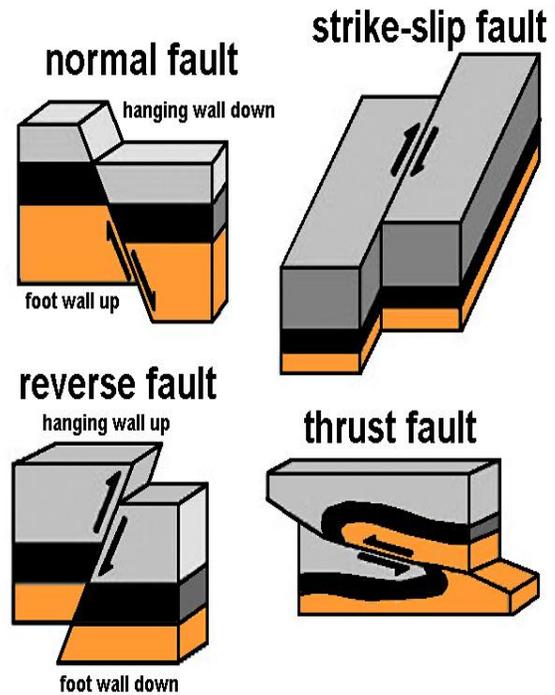


FIG: NORMAL AND REVERSE FAULT

2. BUILDING DESCRIPTION:

In this research we will be taking 4 kinds of earthquakes mentioned below:

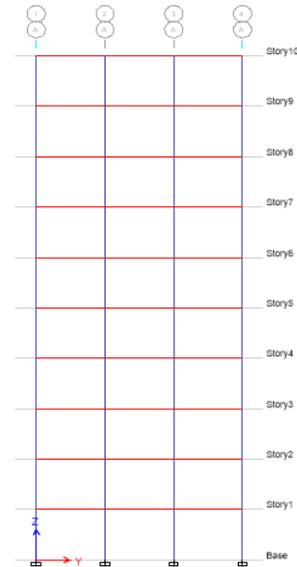
- 1. Far Fault Earthquake**
 - 1a. Fault Parallel component
 - 1b. Fault Normal component
- 2. Near Fault Earthquake**
 - 2a. Fault Parallel component
 - 2b. Fault Normal component

2.1 Material properties:

S no.	Material	Grade
1	CONCRETE(SLAB)	M35
2	REBAR	HYSD-500
3	NO. OF STORY	12(G+11)

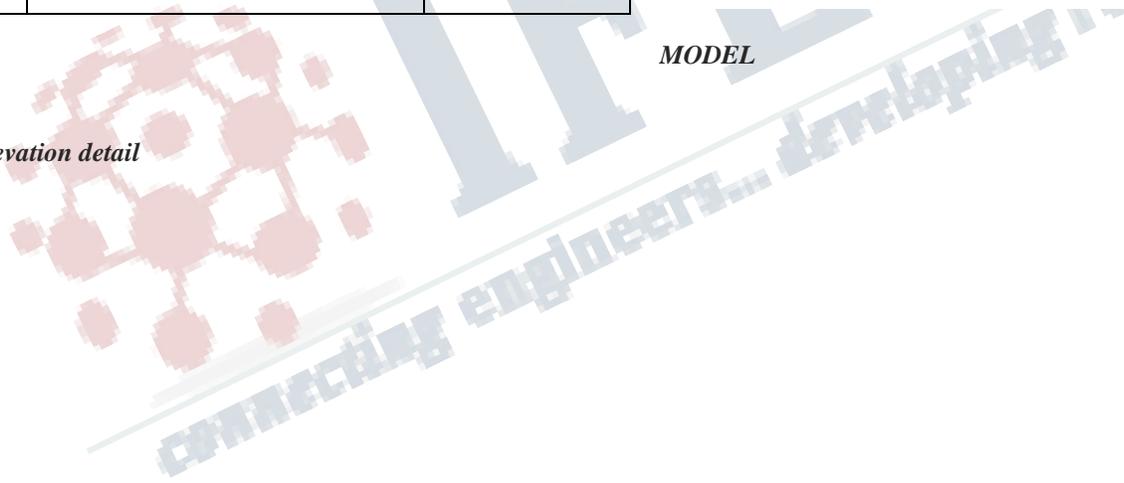
2.2 Seismic data:

S no.	Parameter	Factor
1	SEISMIC ZONE FACTOR	IV
2	TYPE OF SOIL	MEDIUM
3	IMPORTANCE FACTOR	1
4	RESPONSE REDUCTION FACTOR	5
5	TIME PERIOD	PROGRAM CALCULATED



MODEL

Elevation detail



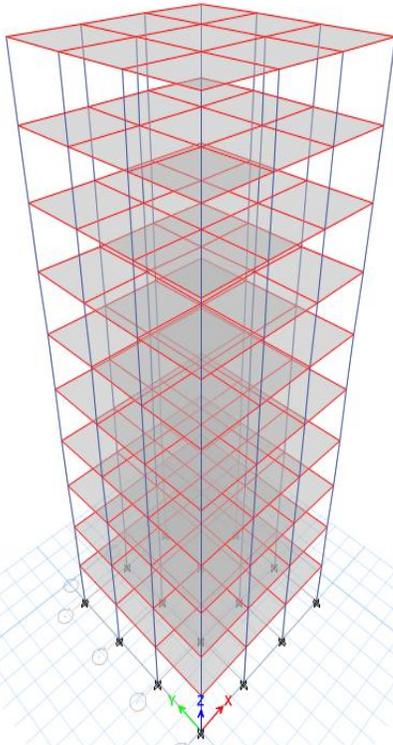


FIG.3: MODEL DESIGNED ON SOFTWARE

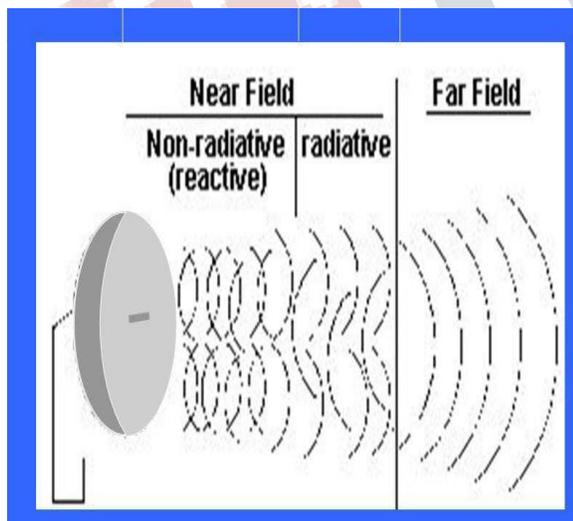


FIG4: RADIATIVE PULSE IN NEAR FIELD AND FARFIELD

3. OBJECTIVE AND SCOPE

1. To study the differences in structural responses against different earthquake ground motions conditions.
2. To compare the associated Response Spectrums for Fault Normal and Fault Parallel components of both kinds of earthquake ground motions.
3. To perform dynamic time history analysis on a structure in model structure by the associated data of time history.
4. To compare the associated peak ground displacement(PGD) for near field earthquake and far field earthquake.

4. EARTHQUAKE AND STATION DETAILS

Uttarkashi 1991-10-19 21:23:15 UTC Magnitude:(Ms=7.0)	STATION: UTTARKASI HYPOCENTRAL DISTANCE:34.1 Km (near field)
Uttarkashi 1991-10-19 21:23:15 UTC Magnitude:(Ms=7.0)	STATION: ALMORA HYPOCENTRAL DISTANCE:153.5 Km (far field)

5. DATA COLLECTION AND INPUT FOR ANALYSIS

Input data for near fault region

- Station: UTTARKASI, India Station Owner: Dept of Earthquake Eng., Indian Inst. of Technology, Roorkee, India
- Station Latitude & Longitude: 30.8000, 78.2200
- HP = High Pass and LP = Low Pass Filters
- Spectra are available for 0.5 - 20% damping.

5.1 Data collection

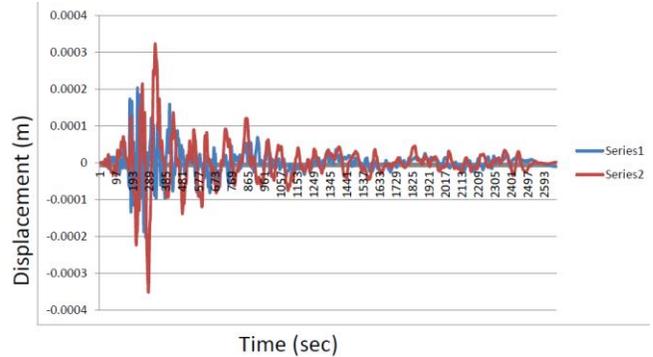
5.1.1 NEAR FAULT LINE

PGA(CM/S/S)	PGV(CM/S)	SPECTRA
-238.00	-25.80	0.5% 1% 2%

		3% 5% 7%
286.00	-15.40	0.5% 1% 2%
		3% 5% 7%

5.1.2 FAR FAULT LINE

PGA(CM/S/S)	PGV(CM/S)	SPECTRA
-26.40	-1.87	0.5% 1% 2%
		3% 5% 7%
-14.00	0.91	0.5% 1% 2% 3% 5% 7%

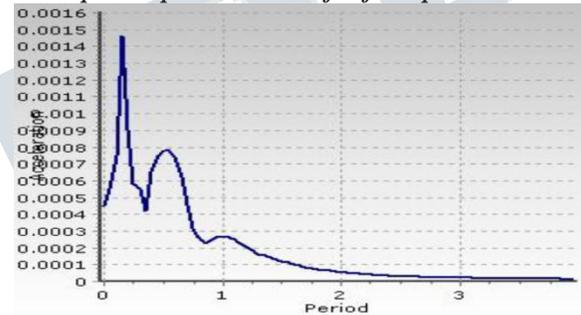


FAR FIELD COMPARISON(PGD)

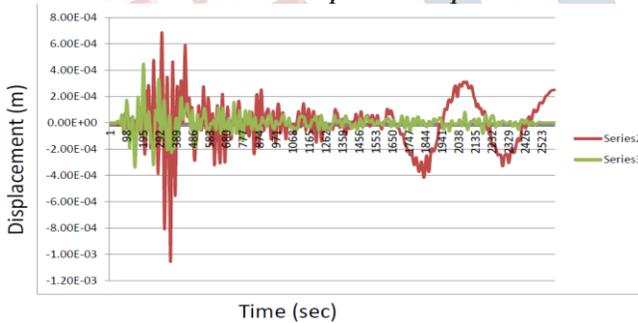
6. RESULT:

Response-spectrum analysis provides vision into dynamic behavior by measuring pseudo-spectral acceleration, velocity, or displacement as a function of structural period for an available time history and level of damping.

6.3 Response spectrum curve for fault parallel



6.1 Fault normal and parallel displacement



NEAR FIELD COMPARISON(PGD)

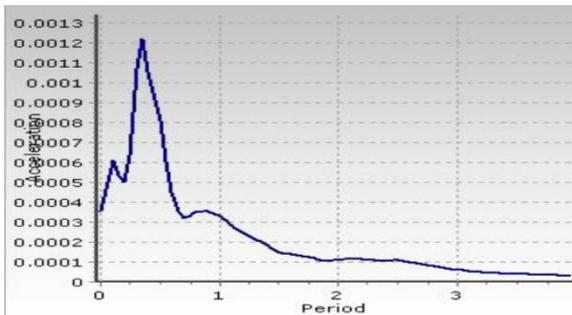
6.4 Response spectrum curve for fault normal



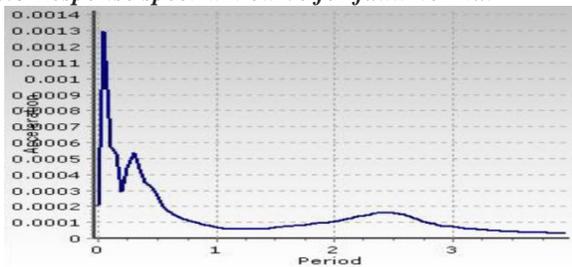
NEAR FIELD RESPONSE CURVES

6.2 Fault normal and parallel displacement

6.5 Response spectrum curve for fault parallel



6.6 Response spectrum curve for fault normal



FAR FIELD RESPONSE CURVES

7.CONCLUSION:

- The values of Peak Ground Displacement, Response spectrum curves obtained for fault normal is higher than fault parallel component for every 0.005 sec time
- The response spectrum curves are different for each kind of earthquake ground motions hence it means that the structure have different responses to each kind of earthquake ground motions.
- The obtained frequencies due to earthquake taken are higher for fault normal component than fault parallel component
- Combined graph for PGD and RSA shows the effect on normal and parallel component on fault plane occurring due to reverse slip producing radiative pulses in near field area.

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