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Research Article

EVALUATING MAIN PARAMETERS EFFECTS OF NEAR-FIELD EARTHQUAKES ON THE BEHAVIOR OF CONCRETE STRUCTURES WITH MOMENT FRAME SYSTEM

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ABSTRACT

Amplitude and frequency content are two important features of earthquakes that are different for near and far-fault earthquakes and in most of the standards, the effects of near-field earthquakes in loading are not considered. Therefore, study and comparison of these effects on structures is necessary. In this paper, structural operation against near and far fault earthquakes for two near sites and two far sites is investigated. For this purpose and in order to achieve an operation point of a structural model with six staircases with a mean lateral bending frame resistant system seismic hazard information is analyzed with regards to special plan spectrums of 2 different sites using near and far faults. An evaluation of the effects due to near and far fault earthquakes based on the Iran's standard 2800 ranges on operation point and the comparison of operation effects of near and far fault spectrums with Iran's standard are results of this research work. After the presentation of results obtained from time history analyses, some suggestions are proposed for design correction based on the regulations in near -field earthquakes.

Keywords: Near-field earthquakes, moment frames, affect, behavior, Accelerogram compatibility with structural mechanism spectrum.

INTRODUCTION

Concerning recent advancements, the researchers have investigated different effects of earthquakes both near and far from the fault. After the 1966 earthquake in Park field California and the 1971 earthquake in Pacoima-Son Fernando, near -field earthquakes were defined by Bolt (1975) [5]. Whereas the effect of near -field earthquakes was known before the importance of this topic in structures design was not known well. This was the case until catastrophic earthquakes such as Northridge-USA (1994), Kobe-Japan (1995), Ezmit-Turkey (1999), Chichi-Taiwan (1999) occurred [11]. These earthquakes presented useful information about properties and the effects of near -field earthquakes on structures and opened the way for more study on near -field earthquakes and their effects. Bam earthquake of Iran in 2003 attracted the attention of many engineers to these earthquakes. The properties of near -field earthquakes depend directly on seismic source mechanism, fault failure direction toward the site and fault slip direction. The most important distinguishing near -field vibrations properties produce pulses that occur because of persisted displacements and directivity effects. These types of motion pulses consist of one or more distinct pulses in the time history of acceleration, velocity and displacement, and usually in the time history of velocity. These properties in mapping near -field earthquakes are completely different from properties and characteristics of far -field maps. Notwithstanding information about the mentioned difference and because of information shortage until recent decades, not many studies have been carried out on properties of near -field earthquakes and their influences on structures. Notwithstanding significant studies about forward directivity effects and persistent displacement on the structures, studies that have been conducted with regards near -field earthquake effects on concrete frames are negligible. With regard to a great number of these structures in different zones of a seismic country such as Iran, t behavior evaluation in these earthquakes and the comparison results obtained from far -field earthquakes would be important.

In this study and evaluation of different behaviors of concrete frames affected by near and far-field fault earthquakes, a nonlinear dynamic analysis affected by near and far fault records is used. For this purpose, after introducing near -field fault earthquakes and their basic characteristics for modeling SAP 2000 software was used. Values of displacement and relative displacement, bending moment, basic shear axial force and forming that are needed for corresponding near fault records have comprised with far from fault records values and then the obtained results have been discussed and interpreted.

NEAR -FIELD EARTHQUAKES PROPERTIES AND LITERATURE REVIEW

Near -field earthquakes are points in the earth whose distance from the center of an earthquake is less than a specific level. Some researchers consider this distance 50 Km and some others 15 Km [5]. With specifying some near fault earthquakes properties in 1957, the most important studies have been carried out in that time by Bolt [5], Hotson and Holster [10] and Bertero et al. [4]. Holster and Hotson found that near -field earthquakes contain critical energy pulses. Despite this, earthquakes have little magnitude or small amplitude, though they have high destructive potential. These types of earthquakes that are occurring near an active fault have long period pulse maps with one or more pick velocity. This subject prompts an impulse stimulation in near -field earthquakes because of the short distance between fracture locations (wave production resource) and its receiving location. There is no time for damping high frequencies, so the time history of their acceleration contains high frequencies [8]. It should be mentioned that these types of earthquakes have three different horizontal components perpendicular to the fault. The biggest influence on structures, their response and the effect of this component is more than the horizontal component parallel to the fault and perpendicular to earth level [22]. This will elude to some different behaviors of structures during an earthquake. All in all these earthquakes have some properties such as a time history of pulse with a long period of pulses, large ratio of maximum velocity to maximum acceleration of earth (v_{PG} /a_{PG}) and sometimes a large continual deformation of the earth [20]. These properties are created because of numerous phenomena effects near the seismic source, which are explained later.

Directivity effect

When fault failure develops toward the site and slip direction of a fault is toward that direction, forward directivity phenomenon occurs. When front failure propagates focus toward the site and because the fault failure rate is close to shear rate waves of the earthquake, the waves that are released due to consecutive slips of different fault zones near its fault; a flood of moving waves starts to collect at the front. These waves reach to side as a strong shock frequently. This shock could be identified as a strong pulse of motion perpendicular to slip and in the beginning of a map. So, during a short persistence period, pulses with large amplitude and mean to long periods are some of forward directivity condition characteristics. Directivity phenomenon occurs in streak-slip and dip-slip faults. In the streak e-slip faults mechanism radial shear displacement distribution on the fault occurs, the motion pulse is perpendicular to slip direction, and in dip-slip fault the forward directivity condition for the sta-

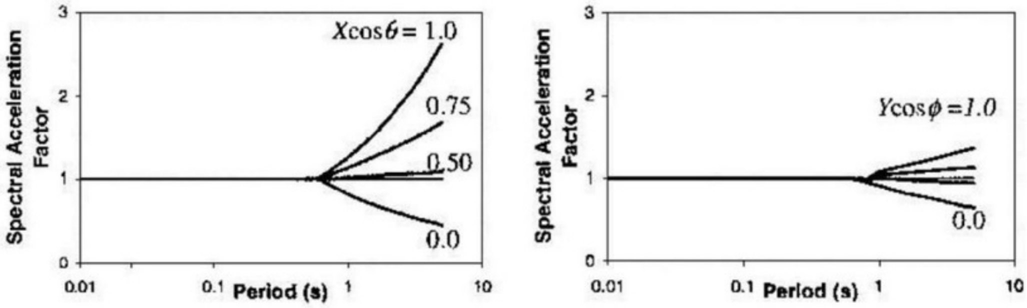

Fig. 1. Directivity effect coefficient in acceleration response spectrum (Somerville, 1997) [20]

tions that are on the upper surface of fault are made [21]. Fault propagation toward the site with a rate near to v_r=0.8v_e results in the most energy produced by the fault and in a large pulse reach to one side or the other this pulse appears at the beginning of the time study. In other words, if we assumed that each part of the fault length is falling in a specific time range, from the rupture of each fault part. Some waves are sent toward the side and if the side is in the direction that the fault is moving along, these waves come together in the side location and produce a large pulse. We can conclude to reduce the time period that the waves of rupture reach to side. But if the side is in the opposite direction of fault development the opposite of this condition occurs, therefore that the waves apart each other and reach to side after some time. The direction has neutral directivity is a condition that away or close of rupture propagation toward the site is not recognizable. In this condition the directivity has not a special effect on the -field amplitude and time history period of earthquake [15]. Somerville [20] that considered the effect of directivity in the earthquake response spectrum, especially acceleration response spectrum, presented a procedure that can be used for design. In this procedure he assumed that the directivity effect can be expressed by two parameters: angle and length ratio. Directivity coefficient in acceleration spectrum can be obtained from following figure. Somerville in his calculations found that the directivity effect begins from period of 0.6 s in spectrum.

When the earthquakes are created by forward directivity, the structures are exposed by damage that this matter expresses one of main properties of near -field earthquakes [1]. Some studies show that near earthquakes records can be classified in two classes: with and without pulse, that sometimes pulse phenomenon in history of acceleration, velocity or displacement is one of properties that can distinct near -field earthquake from far-field earthquake [18].

Generally many researchers [21, 6] believe that the condition that results to forward directivity effect can be summarized in following two points:

- fault failure is toward the site or the angle between failure propagation along and the site is small.
- fault failure rate is close to shear wave rate of site.

Also directivity effect can changes the energy distribution in time called special energy density. So this density can be one of main parameters in the identification of the earthquakes which are affected from directivity effect [14]. Finally the most important properties which are affected from directivity effect that are found in the investigation of many researchers as effective parameters on response and behavior of structures are as follows:

- accumulation of energy in a short time range that result to pulse motion, and that high amplitude pulse shape and short persistence interval in time history of earthquake map [16, 13].
- directivity effect results that in near -field earthquakes (v_{eg} /a_{PG}) ratio is larger and (d_{PG}/ v_{PG}) is smaller than far -field earthquakes. Above ratios directly affect T_e period (the period that distinct the acceleration-sensitive and velocity-sensitive zones in the response spectrum), and T_d (the period that distinct the velocity-sensitive and displacement-sensitive zones in the response spectrum) and conclude that the velocity-sensitive zones become narrower and acceleration-sensitive and displacement-sensitive zones become wider [7]. In Figure 2.a. the response spectrum of some near -field maps and far -field maps of Taft have been plotted that shows the following expressions.

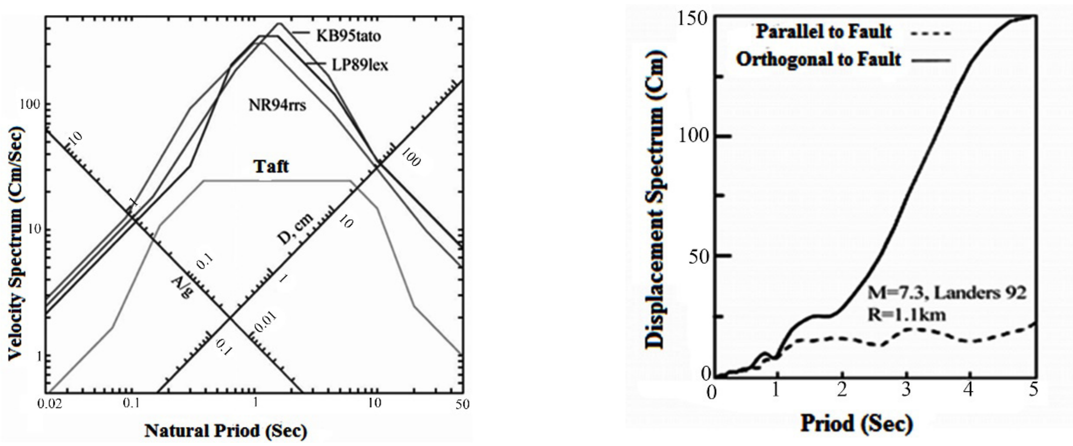

Fig. 2. a) Smoothed response spectrum of perpendicular to fault coefficient of three near -field maps with far -field map of Taft [15], b) displacement response spectrum of Livsern map [8]

- because of radial distribution of fault shear displacement, the directivity effect in the direction perpendicular to fault is more specific and maximum velocity values in perpendicular to fault components are significantly larger than parallel to fault components [3, 19]. Also the response spectrum for perpendicular to fault motion is larger than parallel to fault motions in high and mean periods [8, 18]. In Figure 2.b. the directivity pulse in perpendicular to fault component, Livsern map is seen. Also the displacement response spectrum of perpendicular to fault component of this map is so larger in high periods.

Persist displacement effect

Properties of other recorded near -field maps of recent earthquakes such as 1999 earthquake of Turkey and Taiwan, is persist displacement resulted from earth rupture in zones near a fault that occur in a multi second time range of slip and in the slip direction of fault and are independent from dynamic displacement due to directivity pulse of earth failure. Therefore this will affect the components that are in the slip direction of fault (parallel to fault slip in strike-slip earthquakes and in the slope direction in the dip-slip earthquakes. For dip-direction earthquakes persist displacement effect and directivity effect are in the same direction and persist displacement of earth is at the same time with maximum dynamic displacement approximately that it is needed to consider them as coincided loads. This load crosses at same time have a widely potential for damage [4]. For example as can be seen in Figure 3 a persist displacement about two meter occured in the Yarimka station in Kojayli earthquake.

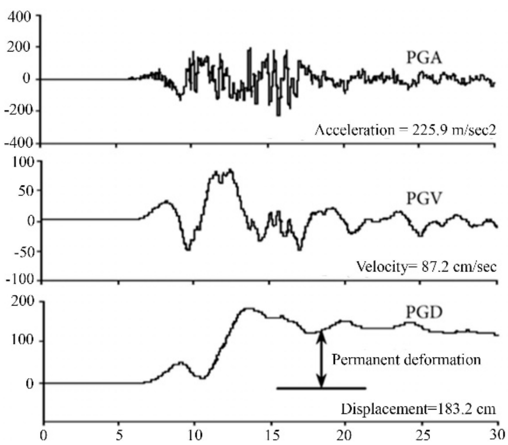

Fig. 3. East west component of Yarimka map in Kojayli earthquake [6]

Hanging Wall effect

Hanging wall effect can occur in a dip-slip. As it can be seen in Figure 4 one of the first reasons of arising this effect could be more closing the sides located in the hanging wall part fault surface rather than the site located in the collapsed wall in the same distance from fault ($R_1 > R_2$) [10]. Hanging wall effect can have following properties and problems in near -field earthquakes:

- larger amplitude and less attenuation are seen in sever movement parameters of earth in hanging wall rather than collapsed wall in the same distance [14].
- this effect has the significant influences on acceleration response spectrum in short period [16].

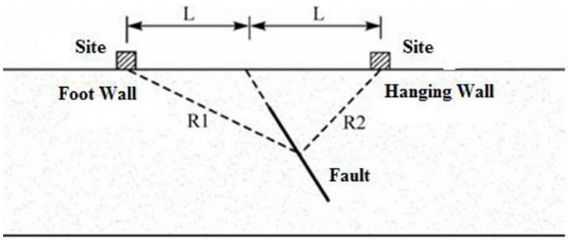

Fig. 4. Hanging wall effects diagram [10]

- not considering the hanging wall effect in experimental models of earth movement parameters which have been used in models, can create large errors in prediction of near -field earthquakes and evaluation of probable seismic hazard [13].

Vertical component effect

In many researchers point of view the main properties resulting from vertical component effect in near -field earthquake rather than far -field earthquake are as follows:

- Maximum vertical acceleration to maximum horizontal acceleration ratio (a_{PV}/a_{PH}) in near -field earthquake is more rather than far -field earthquake. In many conditions this ratio is more than 2.3 that are considered in regulations usually. It should be mentioned that increase of the mentioned ratio in smooth soils are more than other sides [7, 3].
- Vertical to horizontal response spectrum ratio (S_V/S_H) depends on structure period and distance between structure and rupture surface. For short periods vertical to horizontal response spectrum ratio for near fault sides exceed from usual value which is 2.3, but for long period 2.3 ratio is so conservative [19].

THE EFFECT OF NEAR-FIELD EARTHQUAKE ON THE ONE DEGREE OF FREEDOM STRUCTURES AND STRUCTURAL FRAMES

After 1971 earthquake of Sun Fernando behavior of Olivio hospital against large pulse motion near the seismic source investigated by some researchers and showed that this structure because of a severe pulse exposed with a wide damage that they identified this severe pulse as one of properties of near -field earthquakes [2]. Hall et al. [9] applied wave propagation theory for investigation of integrated shear structure response. They believe that the damage potential of near -field earthquakes depend on displacement value in earth because of velocity pulses. Ivan [12] used the same elastic shear structure for obtaining "relative displacement spectrum" as measurement criteria for seismic need of multi-degrees of freedom structures exposed to near -field earthquakes pulse-like. They should that even for elastic structures, near -field effects cannot be calculated by multiplying the regulation basic shear coefficient by a coefficient as near -field effect factor.

Different studies have been done in order to reduce the effect of near fault earthquake effect by application modification of structures which are exposed to near -field earthquakes. Hall et al. [9] and Makris and Chung [17] studied seismic separators applications by different mechanism of lost energy for maintenance and security of structures against near -field earthquakes. Whereas the interesting results were obtained, but large deformation needs imposed by sever pulses of near -field earthquakes produced many problems. Anderson and Bertero [4] evaluated the application of some long concrete and still frames which were reinforced with bracing systems or resistant shear walls and conclude that when the long period structures exposed with severe pulse-like earthquakes, usual reinforcements methods such as increase of hardness or resistance of system by adding shear walls is not effective. The reason of this matter is that hardness improvement reduces the system period and displaces it to upper spectral acceleration.

All in all the most important near -field earthquakes have the following effects on the structures behaviors:

- As was mentioned before near -field earthquake have larger (v_{PG}/a_{PG}) ratio rather than far-field earthquakes that result that zone-sensitive acceleration spectrum response become wider and apparent hardness increases in most of structures and also basic shear in short period structures increases [18].
- Large amplitude in long periods of displacement response spectrum result to enlarging the displacement response in the long period structure [2].
- For multi-degree of freedom structures, when the structure period is so larger than usual period of velocity pulses, usage of principal frequency of structure will not be adequate for structure response specification [13].
- Nonlinear response needs of near -field earthquakes are larger than far -field earthquakes.

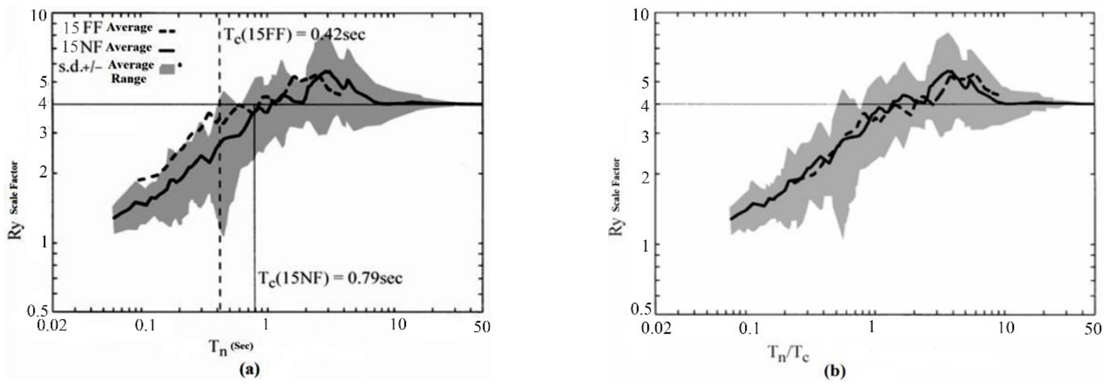

Fig. 5. Resistant reduction coefficient variation versus, a) T_n, b) T_n/T_c-b for average of 15 near -field and far -field earthquakes [15]

Sometimes using some methods such as root mean square (SRSS) and some of average values (SAV) for prediction of structures nonlinear response may conclude to non-conservative results. So the only design response spectrum modification in structures seismic design regulations for considering the effects of near -field earthquake in not adequate because they cannot consider increase of non-elastic response.

- In the structures with the same forming ability, near -field earthquake have less reduction resistance coefficient rather than far-field earthquake. Whereas reduction resistant coefficient spectrum shapes for both type of earthquake in corresponding spectrum zones are the same. This matter is because of the differences in T_c (the period that separates the acceleration-sensitive zone from velocity-sensitive zone) in near-field earthquakes rather than far -field earthquakes [15, 9]. As can be seen in Figure 5 resistant reduction coefficient in smaller period is meaning fully less than T_c near-field earthquakes. Figure 5-shows that near -field earthquakes apply larger resistance needs two structures. The reason of this matter is differences between T_c periods of two earthquakes types. By plotting this coefficients versus normalized period to period T_c the difference between this coefficient in two group of earthquake will be removed approximately (Figure 5-b).

MODELING AND ANALYSIS

Analysis and introduction of structural model

In this study a six stairs structural model has been investigated two dimensionally or mean lateral bending frame resistant system (frame has been shown in Figure 6-a). The heights between stairs has average of 2.7 m roof slab from each side is 2 m and the same beams in all stairs and all columns except some columns that have wider

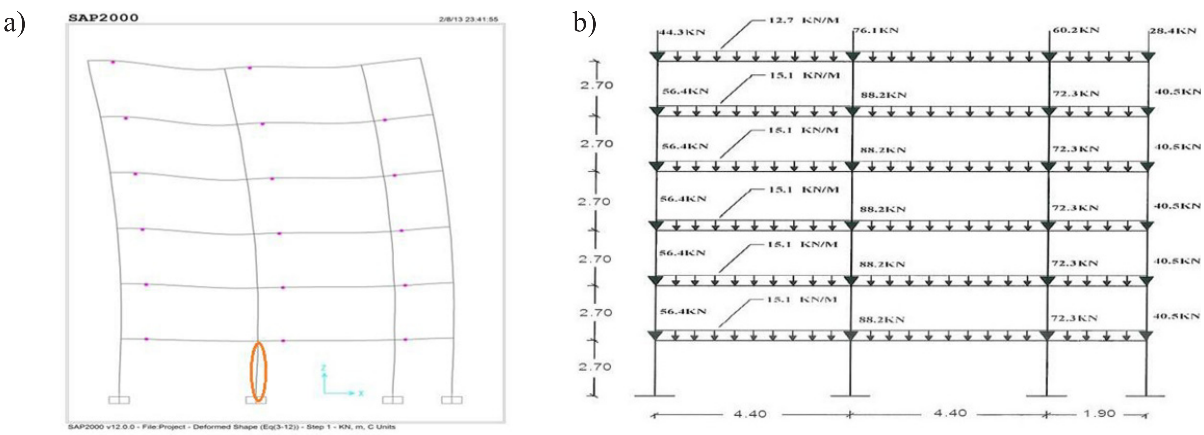

Fig. 6. a) The investigated frame of this study, b) final step in pushover analysis of studied frame and specification of critical column

Table 1. Acceleration map characteristics of near and far faults used in this study

Near Fault

PGA(g)	R(km)	Magnitude	Soil	Station	Event	EQ NO.
0.7	-	6.6	III	Bam	Bam, Iran, 2003	1
0.2046	72.2	6.93	III	CDMG 58224	Loma Prieta, 1989	2

Far Fault

PGA(g)	R(km)	Magnitude	Soil	Station	Event	EQ NO.
0.1595	49.97	7.37	III	Qazvin	Manjil, Iran, 1990	1
0.1014	82.32	6.69	III	CDMG 13122	Northridge, 1994	2

internal space, have the same properties along the structure. The considered material for concrete C16/20 has been modeled. For doing the considered analysis in SAP2000 software and nonlinear static analysis (pushover) for specifying critical column has been used. in earthquake loading based on 2800 standard, the considered frame in the width with so much relative risk or design basic acceleration A=0.35 g has been considered. The investigated frame is a mean concrete frame with coefficients: R=7, T=0.565, B=S+1=2.75, I=1.2, C=ABI/R=0.165. Also based on the obtained documents the soil type in both near fault and far fault stations is from type III soil. Also in Figure 6-b the final step in pushover analysis and critical column has been specified. It should be mentioned that acceleration maps characteristics which have been used in this study are presented in Table 1.

In order to use different records in dynamic analysis of linear time history and comparison possibility of obtained results, the used records should be equal. Therefore the used different records have been equaled according to PGA=0.35 g after doing time history analysis using near and far fault records, the result of axial force, shear force and bending moment of critical column has been presented as a comparison of some graph as follow. In Figures 7 and 8 real and scaled acceleration time graphs of two near -field earthquake faults (Bam 2003 and Loma Prieta 1989) and two far -field earthquake faults (Manjil 1990 and Northridge 1994) have been shown.

In Figures 9 to 12 the furrier amplitude-frequency, power amplitude-frequency, acceleration-period and displacement time curves for near -field Bam and Loma Prieta earthquakes and far -field Manjil and Northridge earthquakes have been illustrated, respectively. Great pulses in the beginning of near-field earthquakes records show a huge kinetic energy release in a short time that is because of fault fracture. This pulse energy can be seen clearly that shows high ductility need for

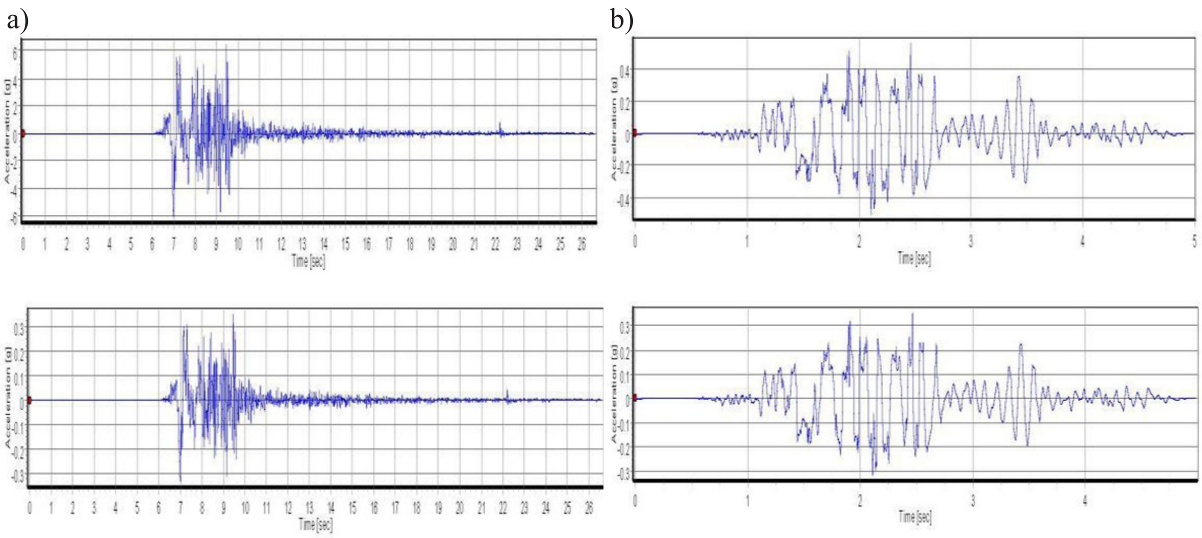

Fig. 7. Real and scaled acceleration time graphs of two near-field earthquake faults (Bam 2003 and Loma Prieta 1989)

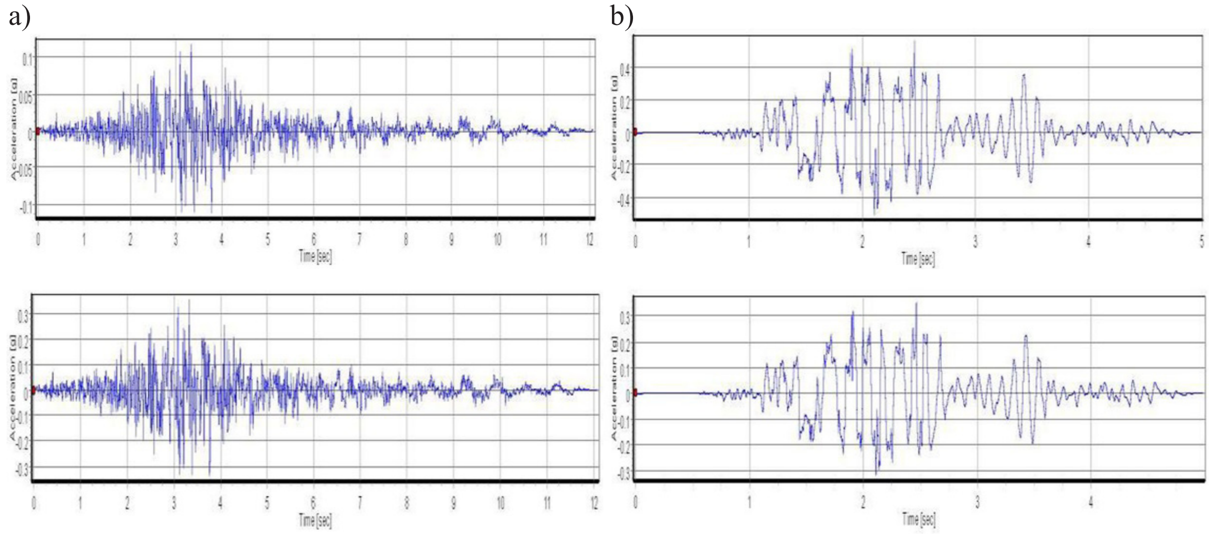

Fig. 8. Real and scaled acceleration time graphs of two far -field earthquake faults (Manjil 1990 and Northridge 1994)

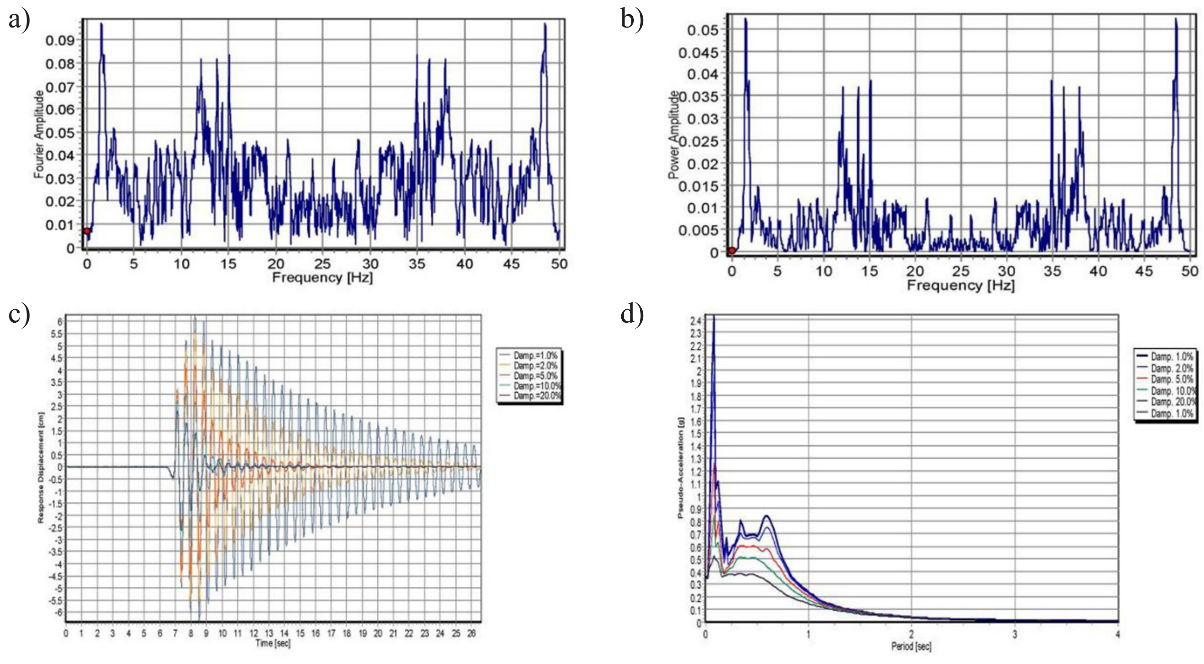

Fig. 9. a) Furrier amplitude-frequency, b) power amplitude-frequency, c) acceleration-period, d) displacement-time curves in Bam earthquake

the structures and also the column which are located in near fault zone. But this matter cannot be seen in far-field earthquake's records. About this matter it should be mentioned that in near -field earthquake there is a need to high ductility in upper stairs of high period structures that this matter is against what was believed before (the predicted result for far-field earthquakes). It means when the earthquake intensity is high level, not only there is no need to reinforcement of lower stairs of structure but also in the case of near fault earthquakes upper stairs of structures should be reinforced.

Time history result analysis

In Figures 13 to 16 the result of time history analysis in earthquake on the studied frame with displacement-time, bending moment-time, basic shear-time and axial force-time curves affected by two near-field earthquakes, Bam and Loma

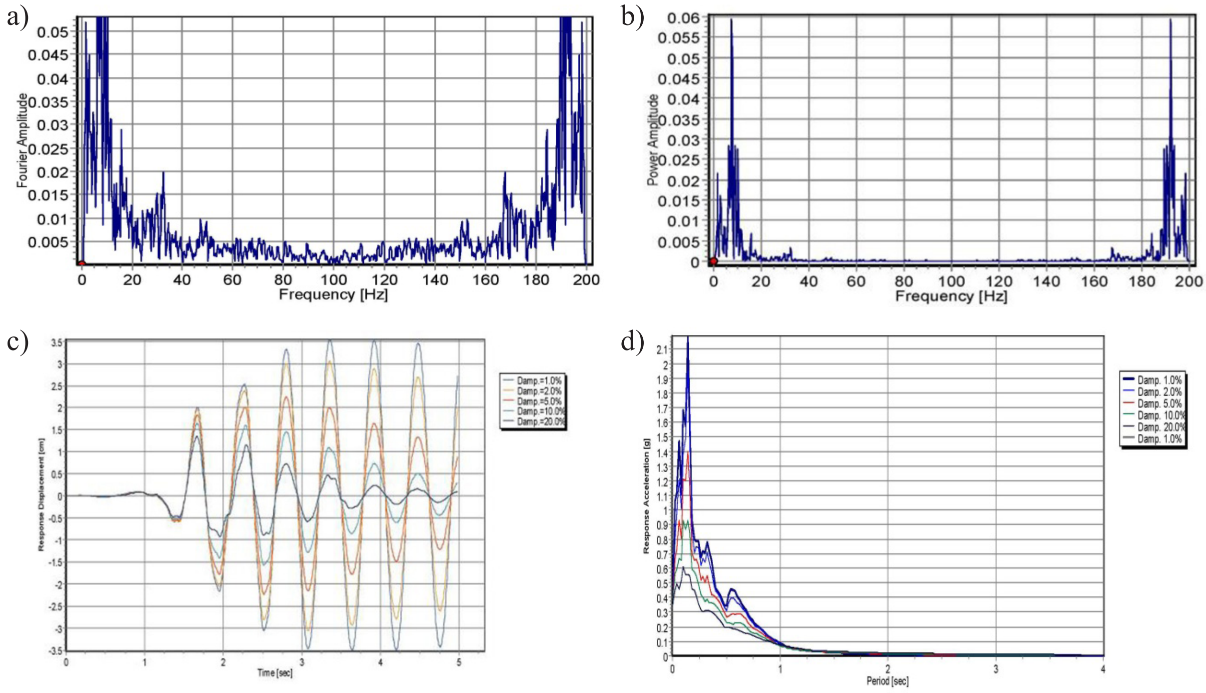

Fig. 10. a) Furrier amplitude-frequency, b) power amplitude-frequency, c) acceleration-period, d) displacement-time curves in Loma Prieta earthquake

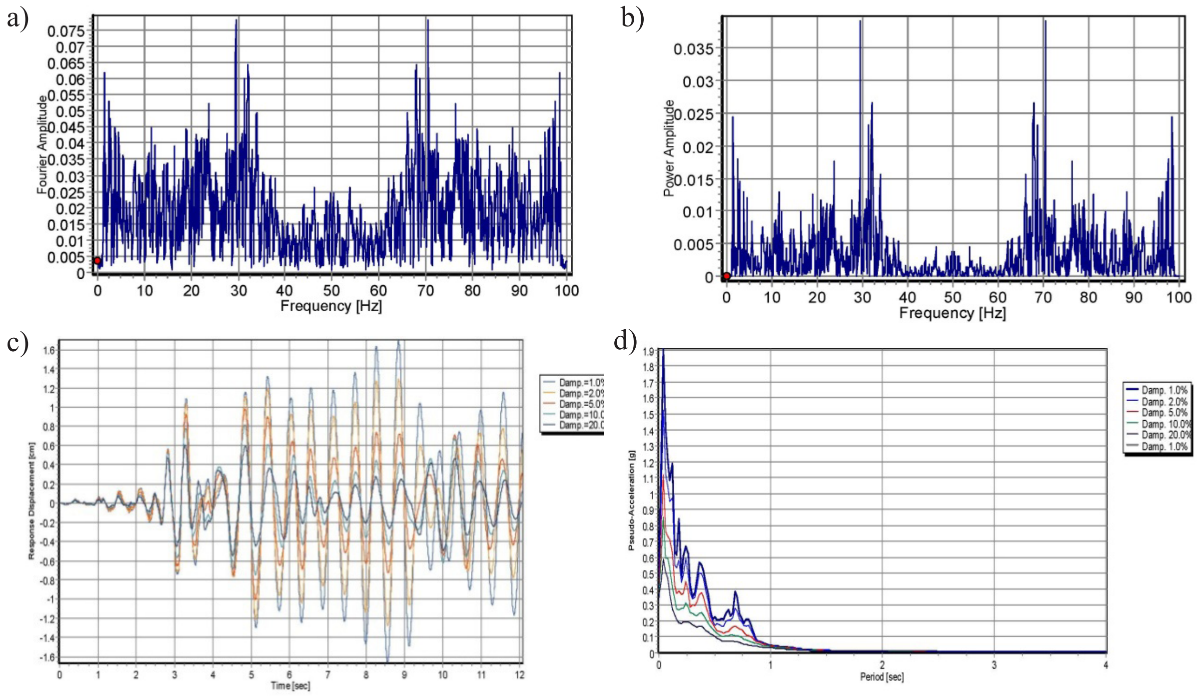

Fig. 11. a) Furrier amplitude-frequency, b) power amplitude-frequency, c) acceleration-period, d) displacement-time curves in Manjil earthquake

Prieta, and also two far-field earthquake, Manjil and Northridge have been shown. Meanwhile the maximum values of different effective parameters in design affected by different earthquakes have been comprised in Table 2. As can be seen from following Figures and time history analysis result comparison table for different earthquakes, maximum displacement values obtained for near -field

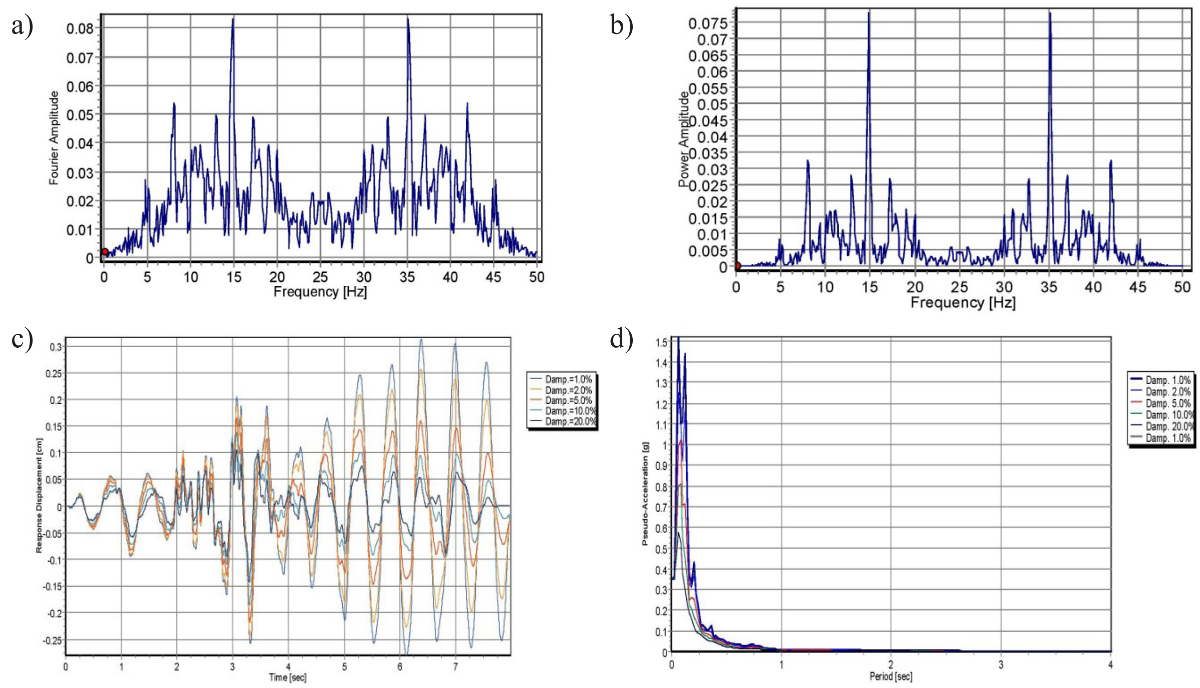

Fig. 12. a) Furrier amplitude-frequency, b) power amplitude-frequency, c) acceleration-period, d) displacement-time curves in Northridge earthquake

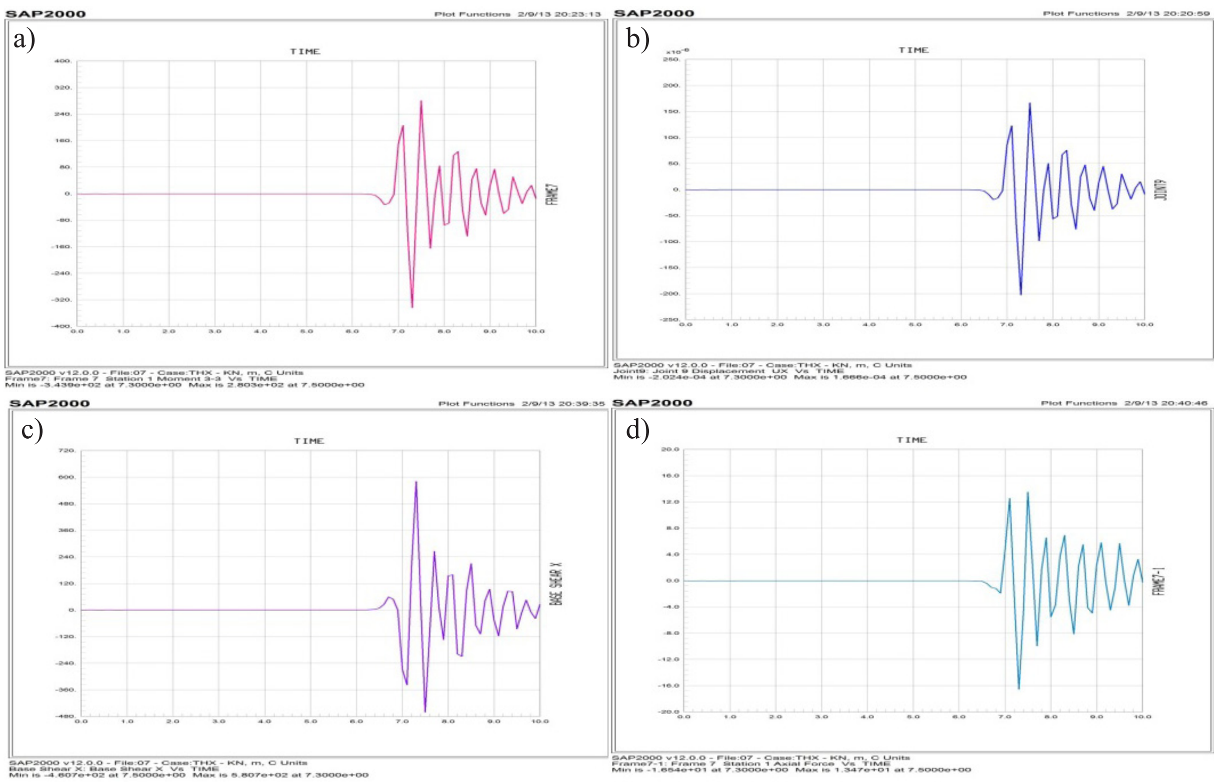

Fig. 13. Displacement-time, bending moment-time, basic shear-time and axial force-time, curves in Bam earthquake

earthquakes on the critical columns is more than far -field earthquakes. The obtained result for displacement show that the displacement value and also the necessary time for the vibration depend on axial force value. In the column, near field earthquake loading this is affected by their axial force value influence

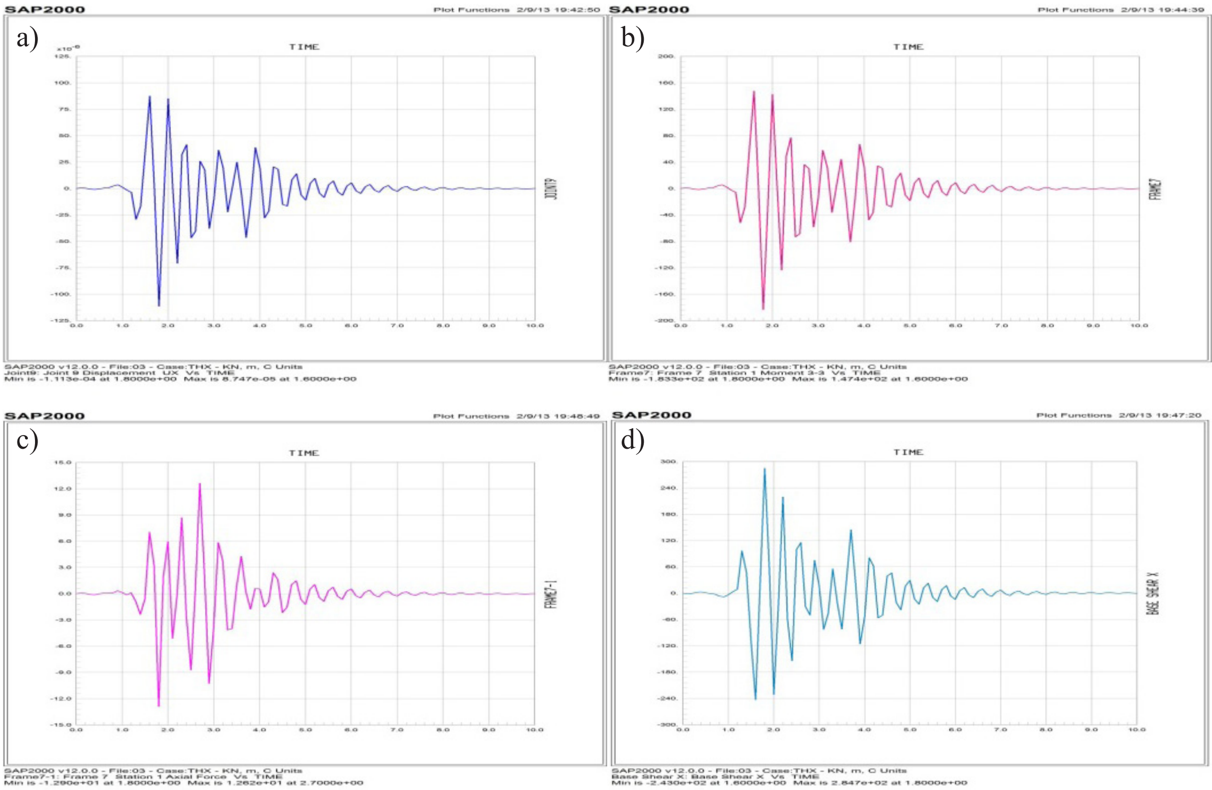

Fig. 14. Displacement-time, bending moment-time, basic shear-time and axial force-time, curves in Loma Prieta earthquake

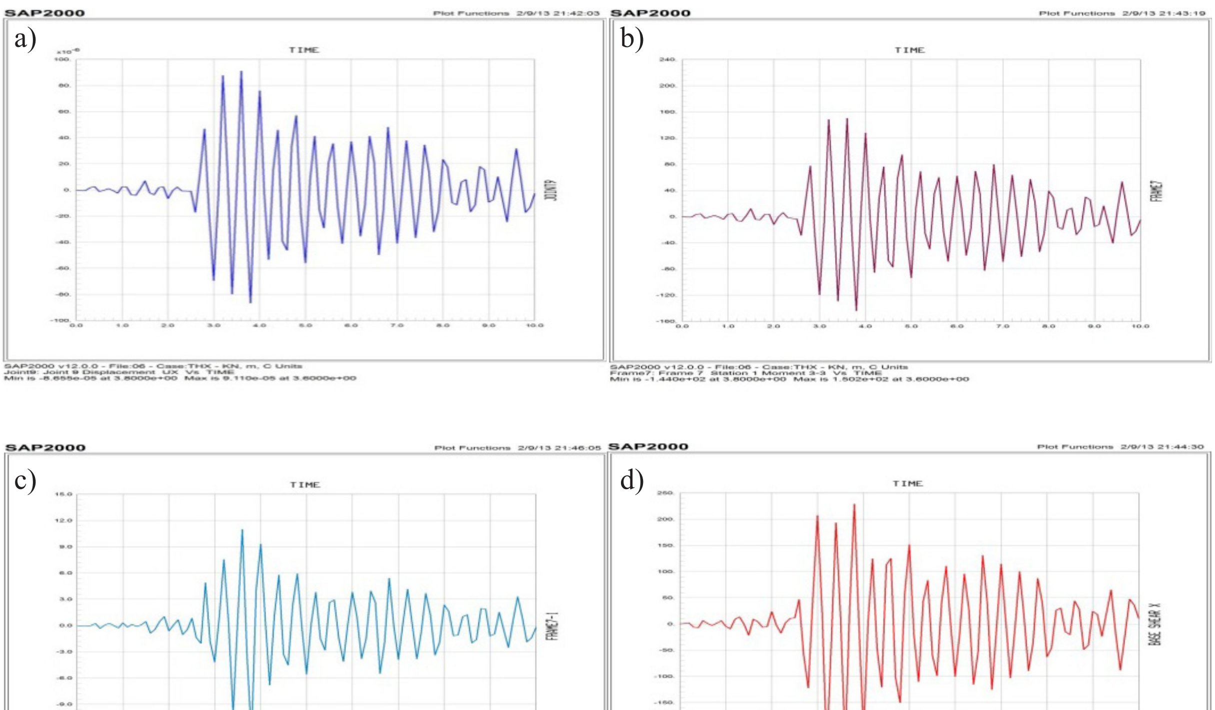

Fig. 15. Displacement-time, bending moment-time, basic shear-time and axial force-time, curves in Manjil earthquake

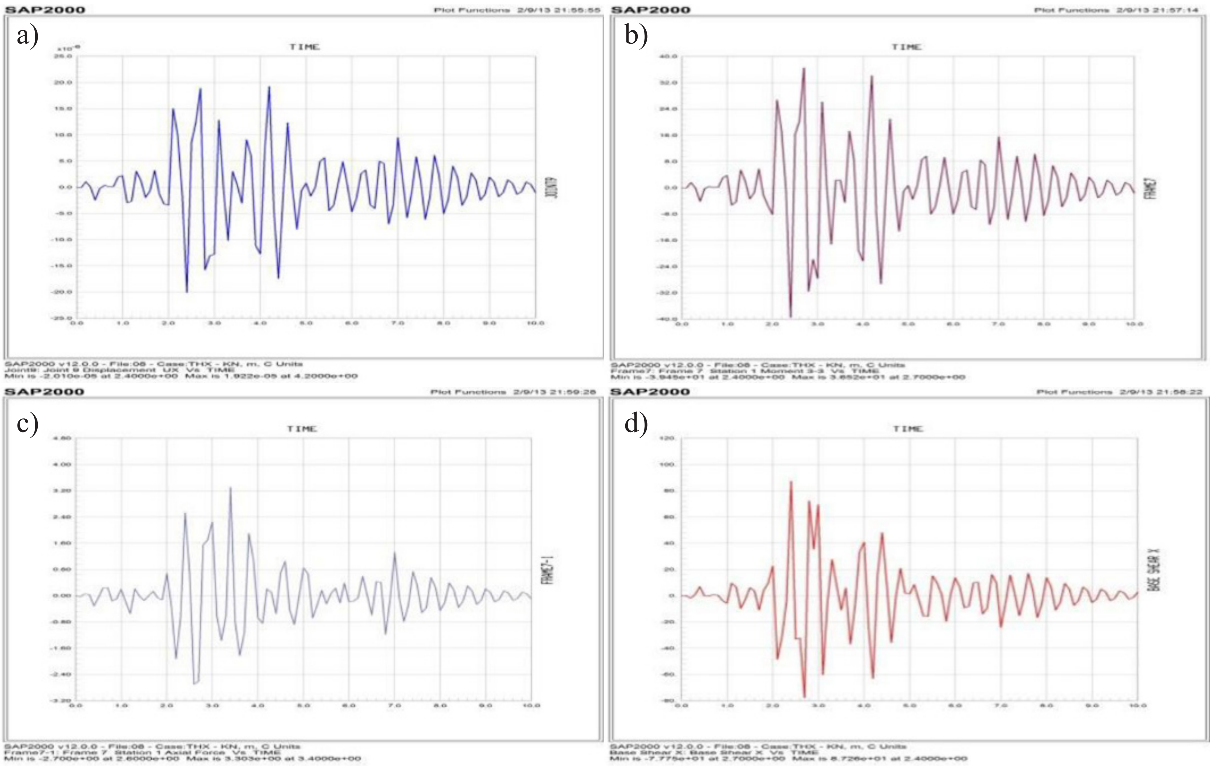

Fig. 16. Displacement-time, bending moment-time, basic shear-time and axial force-time, curves in Northridge earthquake

Table 2. time history analysis result for two near -field earthquake fault

Maximum shear force	Maximum basic shear	Maximum bending moment	Maximum displacement in top of critical column	
1.654E+01	5.807E+02	3.439E+02	2.024E-04	Bam
1.290E+01	2.847E+02	1.833E+02	1.113E-04	Loma Prieta
1.283E+00	2.452E+01	1.502E+01	9.110E-05	Manjil
3.303E+00	8.726E+01	3.945E+01	2.010E-05	Northridge

on the axial deformation magnitude. One of effective parameters on structure behavior in earthquake is closing the structure period and earthquake acceleration record period. So near -field earthquakes have larger period rather than far earthquakes acceleration period. Therefore engineering structures such as structure frames with larger period in near -field fault shows more critical behavior. So it is better that for designing the large period structures that are near the fault, consider the special consideration in seismicity point of view. In addition it can be said that for selection of necessary earthquake acceleration map for engineering structure seismic so much attention should be paid to distance between earthquake record center and earthquake center and also structure natural period in near -field earthquakes fault. In the above Figures the axial force curves with considering static gravity load in two loading condition based on near fault -field and far fault -field earthquakes. As can be seen applying near -field earthquake result to increasing the axial force variations and the axial force value on critical column for near -field earthquakes are more than far -field earthquakes. Also the result show that the maximum values od bending moment and basic shear in critical column for near -field earthquakes is more than far -field earthquakes. So it can be concluded that by considering the vertical component of earthquake in the case of far fault earthquake, axial force value variation, basic shear and bending moment in structural model increases. The computed values for the columns which are affected by near -field earthquakes loading can be multiple times more than the computed value for far -field earthquake loading. In addition it can be said that if vertical component for structural systems design is not considered (the usual work for near -field earthquakes design) can result to create a tension in the columns. Reinforced concrete and concrete structures members in this condition affected by additional tension that is because of reversal and may this matter conclude to brittle fracture mechanism increasing in the structures.

CONCLUSION

After performing time history analysis using near-fault and far-fault records, the results for axial force, shear force and bending moment of a critical column were presented in the form of comparative diagrams. Pulses occur at the beginning of the record indicates high kinetic energy release in a short time due to the failure of the fault. For better expression, history analysis charts for both near and far-fault records were provided. This energy pulse is evident in the results presented above that indicate a need for high ductility in structures and columns located in the near fault region. Following items are the results of the structural behavior under earthquake near-field time history analysis:

- maximum displacement values, maximum values of bending moment and base shear at the top of the column in near field earthquakes is more than far-field earthquakes.
- the amount of axial deformations of the columns under axial loading force in the near field earthquake is affected of amount of axial force of them.
- applying of near field earthquakes lead to increase the differences of axial force and the axial force on the critical column in near filed earthquake is more.
- near-field earthquakes have longer period so engineering structures, such as building frames with longer periods in near filed have more critical behavior therefore it is better to design buildings that are near the fault with high periods and special consideration must be considered.
- considering the vertical component of the earthquake in the near field earthquake, varying the values of of axial forces, shear and bending moment at the structural model are improved. The calculated values for the columns under near field seismic loading can be up to several times to the amounts calculated under far field earthquake loading.
- you could say that if the vertical component to be considered in the design of structural systems (commonly used in the design of near-field earthquakes), can cause the columns to stretch. At this state, Members of reinforced concrete and concrete structures get extra strength due to collapsing and this may raise brittle failure mechanisms in the structures.

According to the results it can be found in following items recommendations for improving the design basis earthquake regulations in the areas of fault:

In the near field state, effect of directivity in a cross-spectrum of traditional pushover method analysis is not permissible, because this method is based on structural damping effect. Proper selection Accelerogram, Iran's 2800 regulation code should provide information based on close range limits of the site to seismic source and type of faulting for Accelerogram used in each region.

Structure displacement against near-filed earthquakes in some cases is 30% more than earthquakes of design approximately and also displacements that are because of far-field earthquake are 50% less. The recent studies have been done on near-field show that the horizontal maps perpendicular to fault has some pulses with long period. Therefore this kind of maps has more effects on the structures rather than far fault maps.

It is proposed that it is better to consider increase of spectrum response in long periods that is result of large values of acceleration, velocity and displacement in the regulation and the other hand pay attention to increase of ductility need in rigid structures that is proportional to pulse time to structure period ratio, respectively. Also some parameters such as site conditions, failure propagation direction relative to site and distance from failure surface should be considered in design regulations.

Near-fault earthquake ductility requirements in comparison with the earthquake fault was greater therefore, in order to resist earthquake faults near the structure must be designed for more ductility.

Near fault earthquakes that their peak pulse velocity is more severe or have greater pulse duration, increase the response of structure. So structures that are near to seismic source should have more ductility in order to reduce the structural response.

By study of near fault pulse period it is seen that increase of ratio of pulse period of earth motion to natural period of structure and also increase of earth acceleration to structure yield resistance ratio conclude to nonlinear response and also structure damages, and as the near fault effects is more in large periods range, increase of structures principal periods and ductility result to near fault effects. As high frequency structures that are in linear range, have not large response in near-field earthquakes that contains short frequency (large period), but if this structures enter to nonlinear range, their frequency will be reduced and their period will be increased and in this condition will become vulnerable in near fault earthquakes. After doing time history analysis using near fault and far fault records, the results of axial force, shear force and bending moment of critical column have been presented as some graphs for comparison. This energy pulse in clear in the presented results that express that there is a high ductility need for the structures and also the column located in near fault zone.

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