Effect Of Marl Soil Specification On Seismic Response Of Tall Building Under Near And Far Field Earthquakes

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Abstract:
Marls are challenging soil types that pose a threat to the safety of construction projects. This type of soil tends to have reduced resistance and increased deformation as humidity levels rise. During an earthquake, the properties and characteristics of the soil change when it shakes. A study was conducted to assess the interaction between soil and structures during both near and far earthquakes on marls. The research focused on marly soils in the northwest region of Shiraz City. The findings indicate that for near-field earthquakes, the structural response values in non-marl regions are significantly lower compared to marly sections. Additionally, the response of drift, bending moment, and base shear for a specific cross-section is greater in high-rise buildings (e.g., 12-story buildings) compared to shorter ones (e.g., 6-story buildings). In marl sections, an increase in the thickness of marl layers leads to a higher building response. The highest response rate is observed when the thickness of the marl layer exceeds 5 meters, while the lowest structural response occurs when the thickness is 5 meters or less. Similar conditions apply for far-field earthquakes, with the distinction that the damping and frequency response of a 12-story building are greater than those of a 6-story building. This indicates that high-rise buildings are more affected by far-field earthquakes with longer periodicity.

key words: Marly soil, far field, near field, Seismic response.

1. Introduction

evaluating the response of the earth to the incoming loads and seismic excitations, in addition to the mechanical characteristics, the dynamic characteristics of the soil should also be known. Among the main properties of soil, we can mention specific weight, hardness, Poisson's coefficient, natural frequency, damping, and also the level of strain changes. These properties are directly used in construction impact studies and are a good guide in estimating soil response to earthquake excitations. Therefore, to understand the dynamic behavior of soils in solving geotechnical problems, a lot of care and investigation is needed. In this field, there is a wide range of field and laboratory tests, each of which has certain limitations or advantages. Some tests are specific for measuring soil parameters in low strains and many are related to measuring properties that appear in large strains. Among soil properties, hardness, natural frequency, and damping are more effective. This issue is true not only for small strains, but also due to nonlinearity even in medium and large strains. In large strains, the effect of loading speed and number of cycles on shear strength is important. Therefore, it is necessary to know the factors that are effective on the geotechnical and dynamic properties of soils and that affect the behavior of the soil-building interaction, whether small or large strains. So far, various studies have been conducted to understand the dynamic characteristics of soils. Some researchers have researched the relationship between shear modulus and shear strain range [1], [2] and [5].

In the past researches, many factors affecting the shear modulus have been extensively studied by many researchers through laboratory tests and periodic triaxial and resonant column devices [3], [4], [6], [7]. The conducted studies show that factors such as grain size characteristics, degree of saturation, porosity ratio, lateral earth pressure coefficient, internal friction angle and the number of stress cycles have little effect on the damping ratio of sands. However, the main factors affecting the damping ratio are the level of strain induced in the sand and the all-round effective pressure applied to it [3], [4]. The degree of curvature of the periodic resistance diagram of the mixture of clay and silt depends on the mineralogical composition of their composition, and the presence of montmorillonite instead of kaolinite in the soil content increases the periodic resistance of the sample because the periodic resistance will increase with the increase of the plasticity index [11-17]. Wang et al. (2013) investigated the periodic shearing behavior of silty soils with varying amounts of clay and low plasticity in the Mississippi River Valley. The results of their research show that the change in clay content in silty soil has a significant effect on the shear behavior of the sample, including strength. and its rigidity will also increase the clay content will decrease the liquefaction potential of the sample [18]. Yilmaz et al. (2004) investigated the deformation behavior and periodic shear strength of undrained clay and silt mixture of Adapazari city in Turkey. The results of the experiments show that the dynamic strength and stiffness of these types of soils are not lost under this earthquake, and their plastic strain depends critically on the type of loading and the amount of loading applied [19]. Broya et al. (2007, 2009) investigated the effect of clay mineralogy on the periodic behavior of clay and silt mixtures and concluded that the amount of clay minerals in this composition will play an important role in the periodic behavior of the mixture [20, 21]. Among clay soils, marl soils exhibit special dynamic behavior due to their special characteristics. These soils show different behavior especially when they are saturated and mixed with other materials such as plaster etc. The dynamic behavior of marly soils has not been comprehensively investigated so far, so the purpose of the present research is to consider the characteristics of marly soils, especially the dynamic characteristics and the state of vibrations entering the building based on them with regard to its frequency content, in order to better understand the characteristics of Their technique and seismic behavior can be used to better understand Marly's vast soil for future construction projects and provide better engineering judgments.

1. Data and Data Processing

2.1. Geotechnical Specifications of site

This study was conducted on marl soils located in the northwest of Shiraz city. The goal is to understand the behavior of soils in the range of small and large strains. This type of soil is located in different parts of Fars, Bushehr and Hormozgan provinces. Many parts of the studied soil, in addition to the characteristics of clay marl, contain gypsum and gypsum minerals, which sometimes cause swelling. In order to know the characteristics of the soil, a series of preliminary tests including granulation, direct cutting, uniaxial strength, consolidation and Etterberg limits have been carried out. In the unified classification system, this soil is in the category of clays with high to low pasting properties. Table 1 shows the basic characteristics of the soil for different depths.

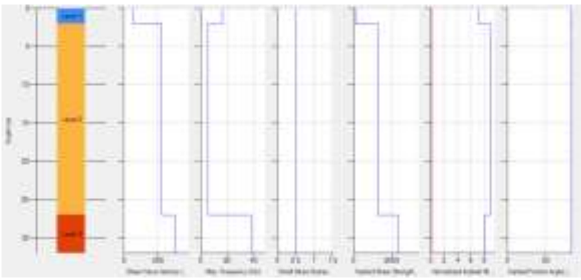
Table (1): mechanical characteristics of marl soil

2.02	γ_{wet} (gr/cm ^{3})
1.7	γ_d(gr/cm ^{3})
0.18	C_u (Kg/cm ^{2})
21	φ_u (deg)
1.0	q_u (Kg/cm ^{2})
37.5	*Percent lime Soil (Result the experiment Chemical)*
88	*The percentage of fine grains (sieve pass 200)*
16	*Soil swelling* potential(%)

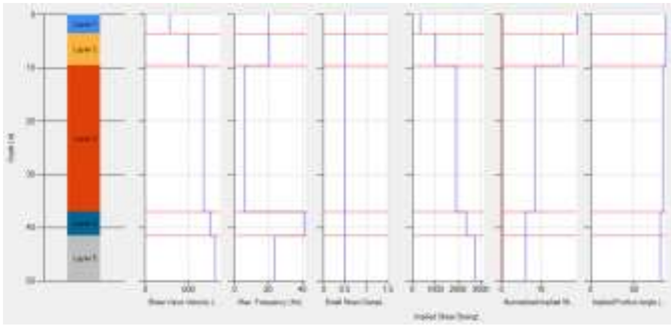
31	Liquid Limit, LL(%)
15.56	Plastic Index, PI(%)
CL	USCS Soil *Classification*

2.2. Geophysical Field Investigation of Marly and non-marly soil profiles

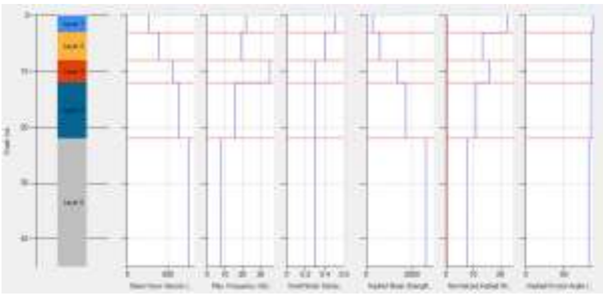
For the purpose of analysis, 10 soil profiles with different layering and having marly soil and one non-marly soil (to compare the results and evaluate the effect of presence of marly soil) have been used. These profiles are shown in Figure 1.



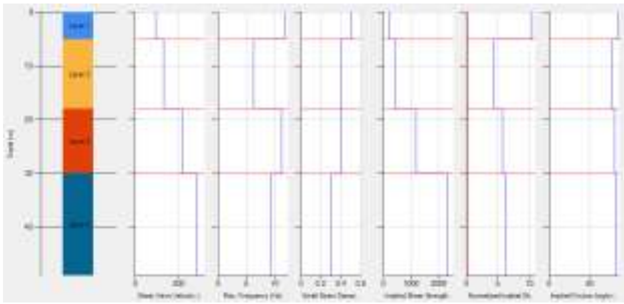
Profile P1



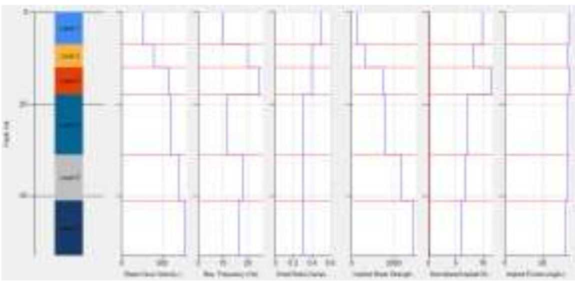
Profile P2



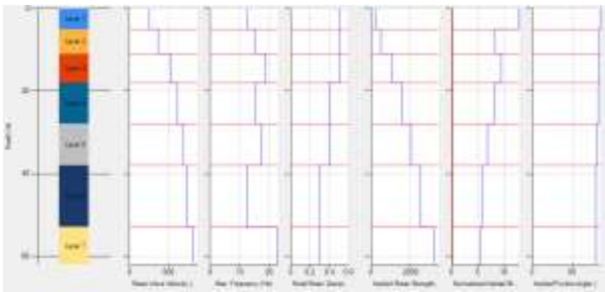
Profile P3



Profile P4



Profile P5



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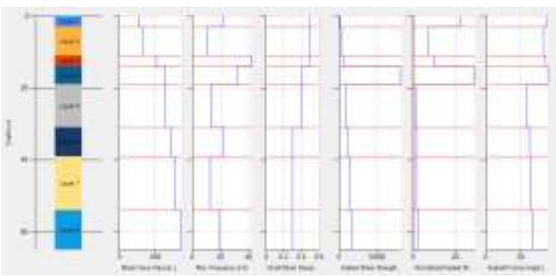

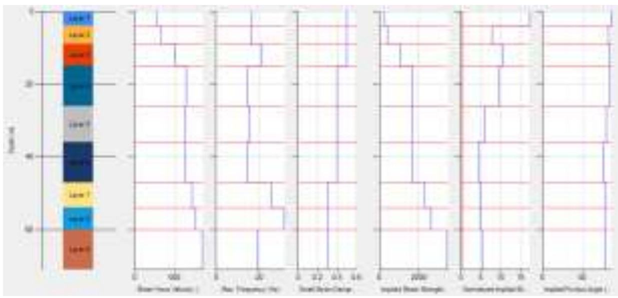

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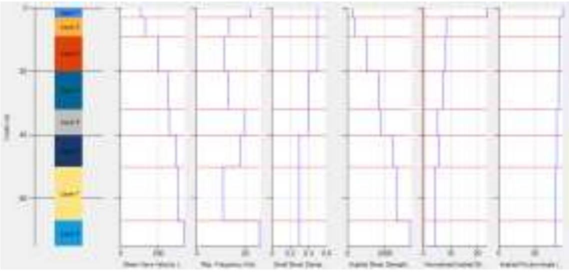

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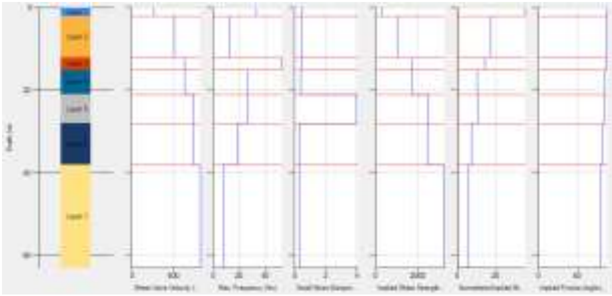
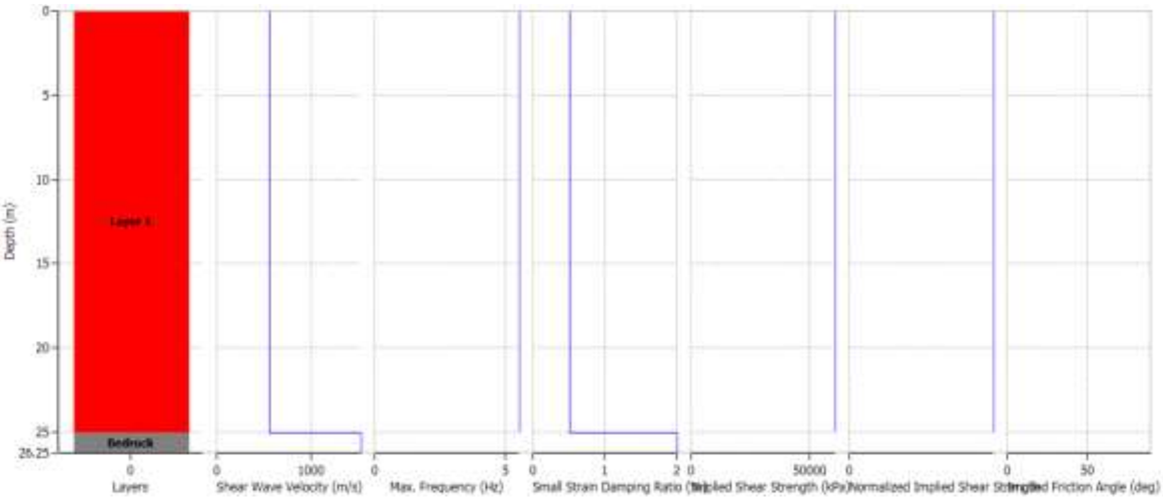


Profile P9

Profile P10

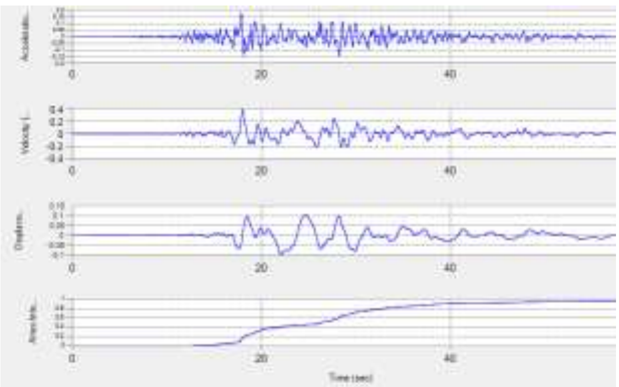


Profile P0

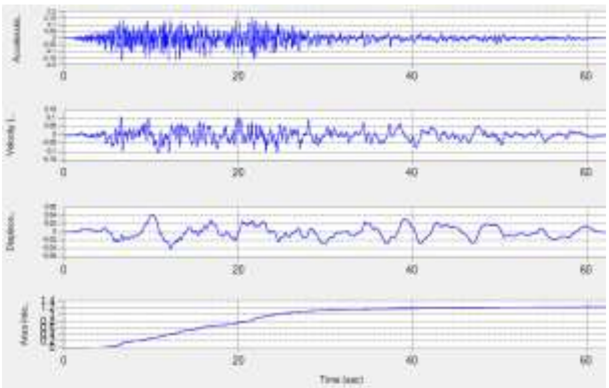
Figure (1): marl soils (profiles P1 to P2) and non-marl (profile P0) investigated

2.3. Investigated accelerations

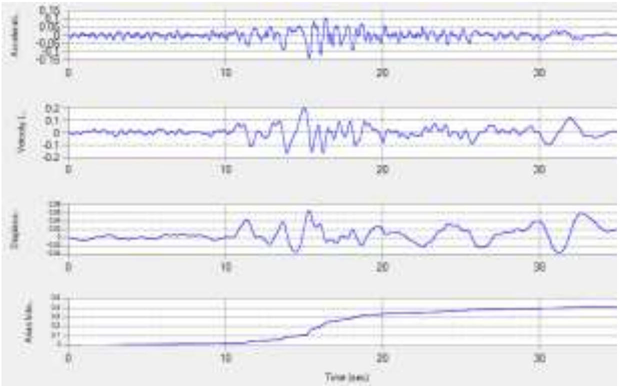
For this research, eight acceleration maps that have different application times, different PGA and different frequency content have been selected and used in the analysis. Out of the eight investigated map accelerations, four map accelerations of Chi Chi, Emprikaloli, Kojil and Northridge are considered as earthquakes in the near zone and four map accelerations of Korebas, Kobe, Sabzposhan and Tabas are considered as far zone earthquakes. Figure 2 shows the time history of acceleration, velocity, displacement and intensity of areas for these acceleration maps.



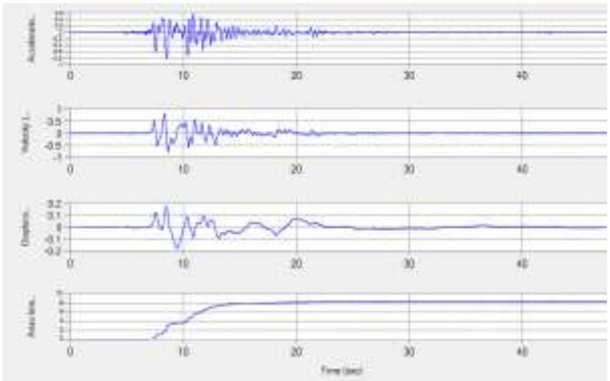
chichi



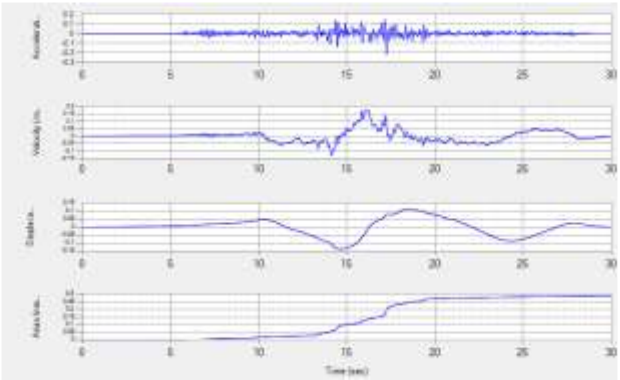
ImperialValley



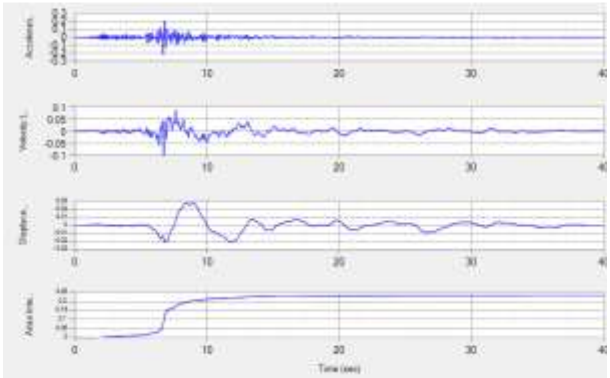
Karebas



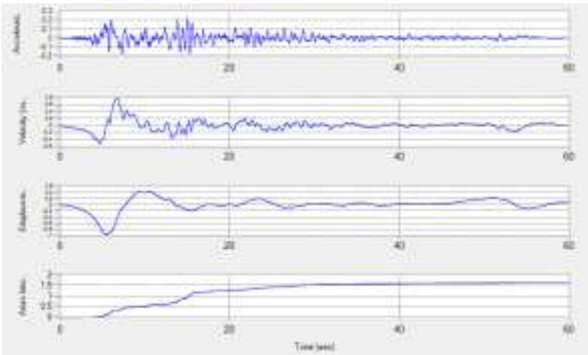
Kobe



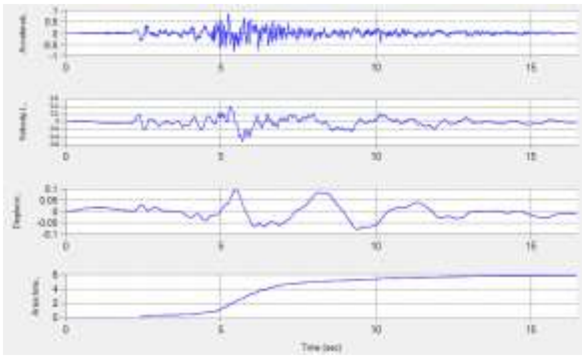
Kocaeli



Northridge



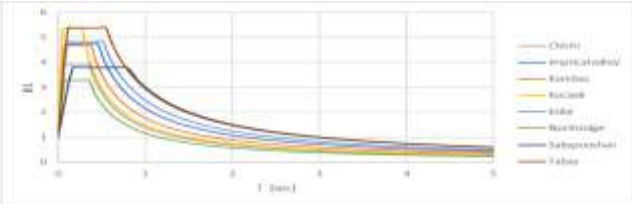
Sabspooshan



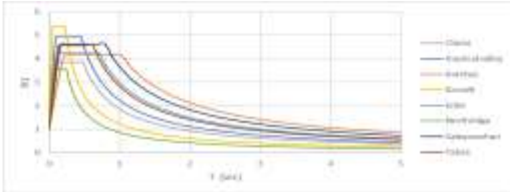
Tabas

Figure (2): Time history of acceleration, velocity, displacement and intensity of areas for the acceleration maps examined

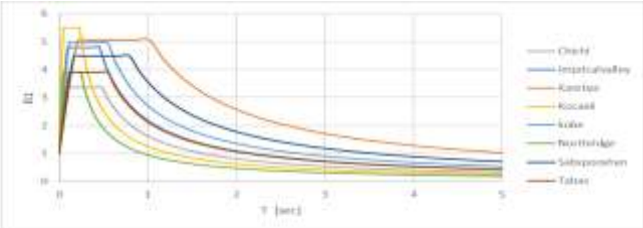
For the seismic loading of the building, it is necessary to normalize the acceleration spectrum based on the 2800 standard. In the design of buildings using period regulations methods, the first mode of the building is very important. In regular buildings, the behavior of the building depends to a large extent on the period of the first mode. Therefore, in a way, the behavior of a multi-story building (with several degrees of freedom) is considered similar to a one-degree-of-freedom system, with a period similar to the period of the first mode of the building. Figure 3 shows the normalized acceleration spectrum for 11 examined soil profiles**.**



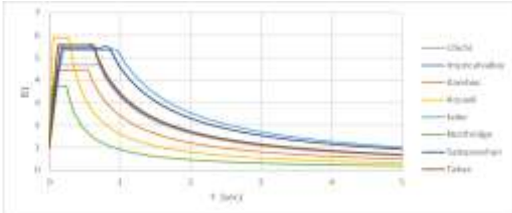
Profile P1



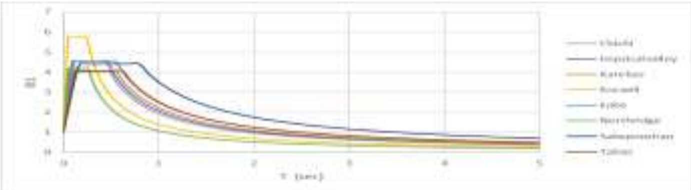
Profile P2



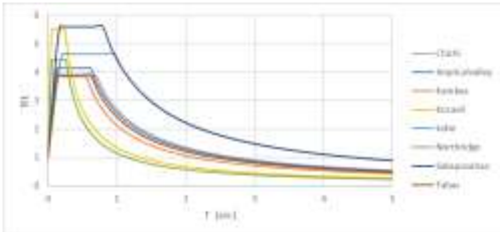
Profile P3



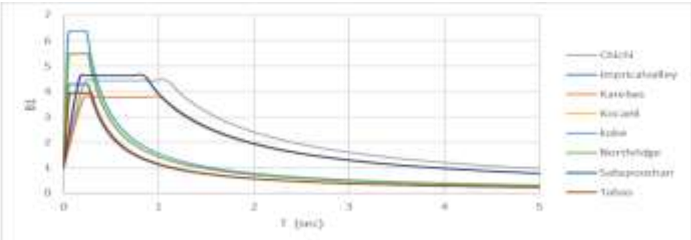
Profile P4



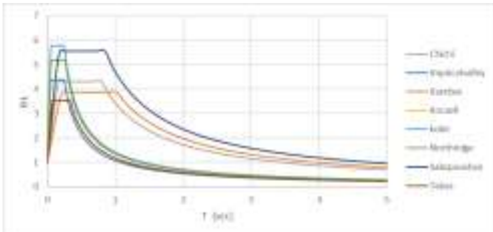
Profile P5



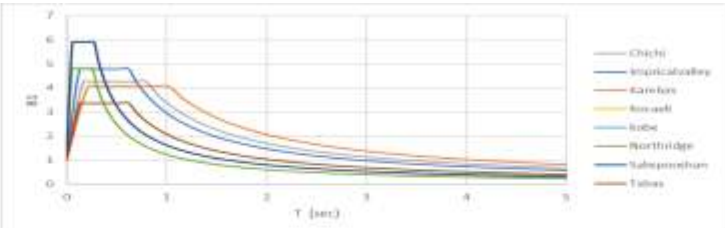
Profile P6



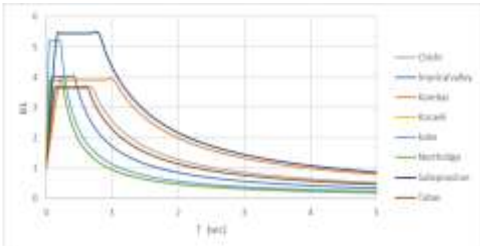
Profile P7



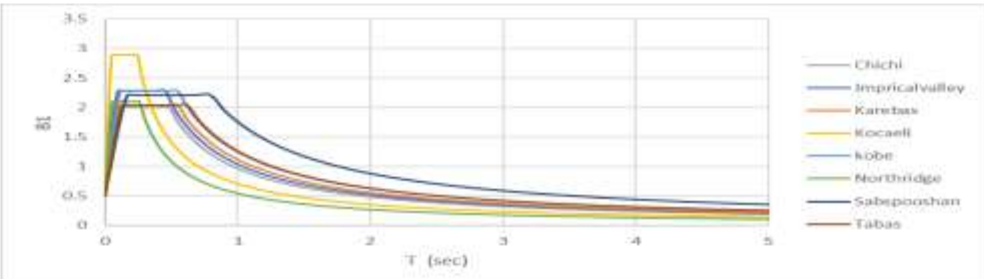
Profile P8



Profile P9



Profile P10



Profile P0

Figure (3): normalized acceleration spectrum for marl (profiles P1 to P2) and non-marl (P0)

3. Discussion

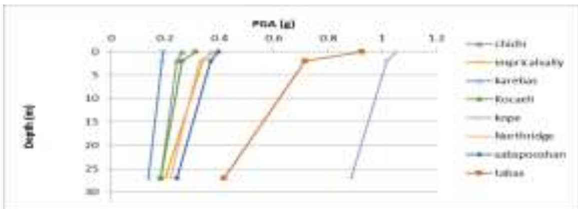
3.2. Investigated buildings

In the present research, two concrete buildings with the number of 6 floors (medium height building) and 12 floors (high height building) have been investigated, and the geometry of the plan designed for them is shown in Figure 4**.**

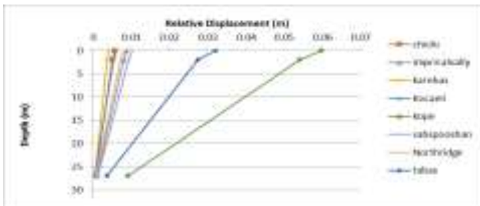
Figure (4): The plan geometry of the examined buildings

3.2. Presenting and analyzing the results

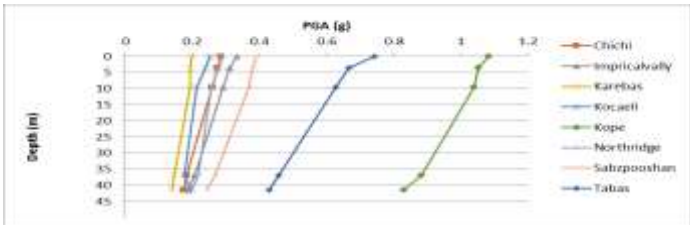
In this research, the non-linear method was used to determine the response of the building. In this method, the real nonlinear soil response analysis is obtained using direct numerical integration in the time domain. By integrating the equation of motion in short time steps, the nonlinear stress-strain model can be solved. In Figure 5, for the 11 investigated soil profiles, the acceleration and displacement response profiles for different earthquakes are compared**.**



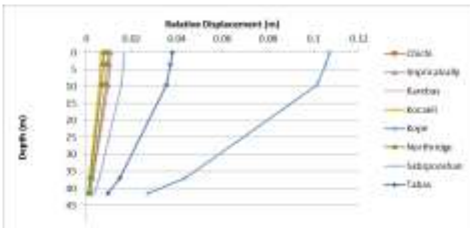
Acceleration response profile P1



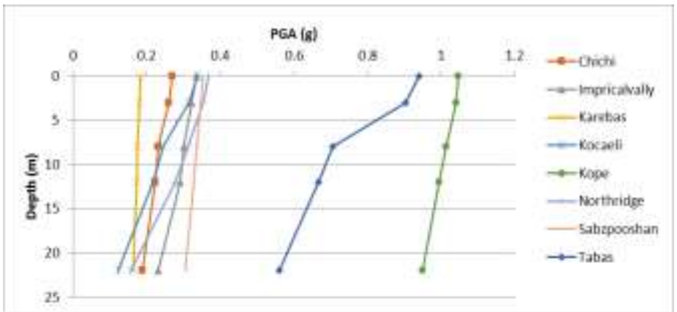
Acceleration response profile P1



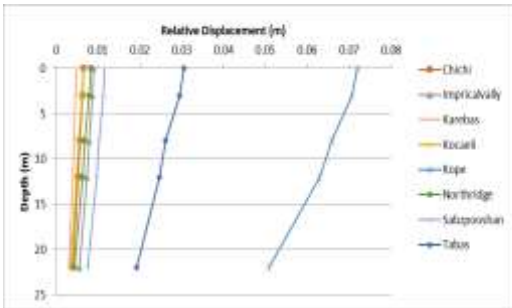
Acceleration response profile P2



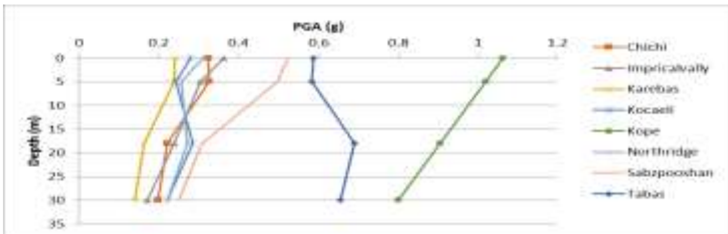
Acceleration response profile P2



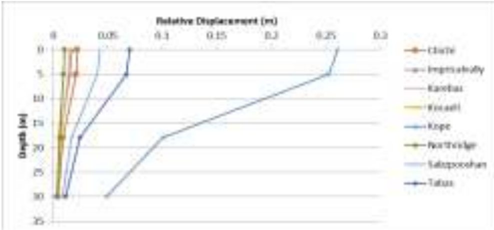
Acceleration response profile P3



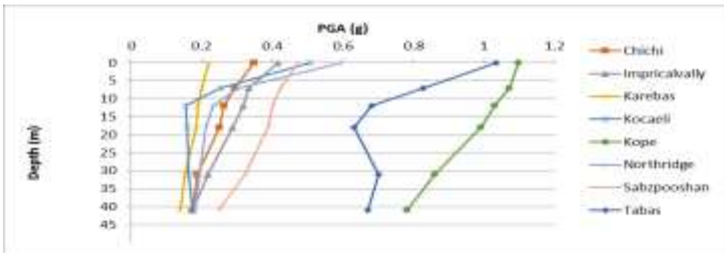
Acceleration response profile P3



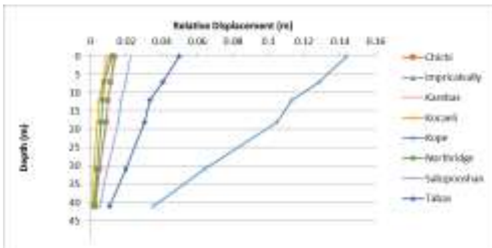
Acceleration response profile P4



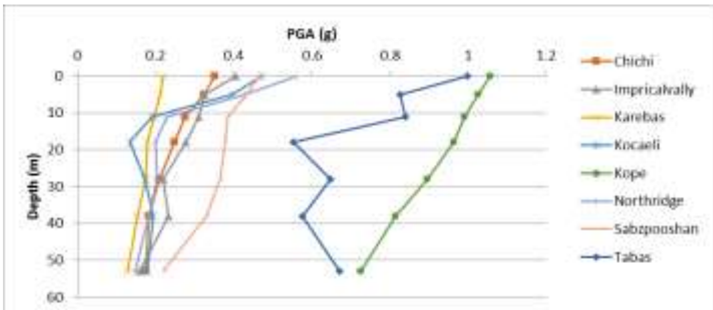
Acceleration response profile P4



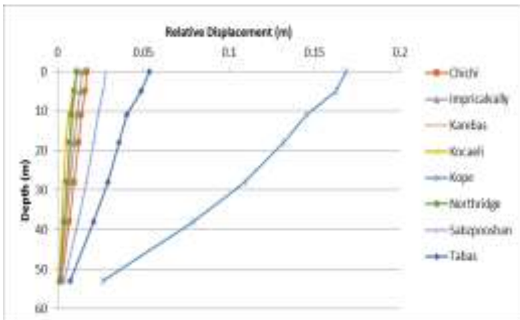
Acceleration response profile P5



Acceleration response profile P5



Acceleration response profile P6



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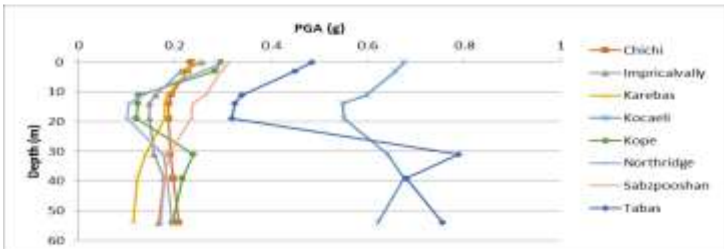
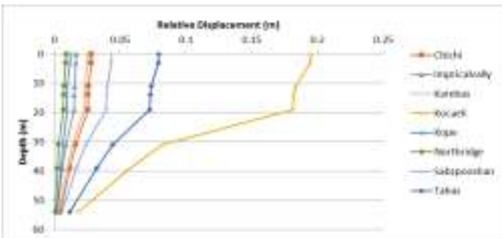
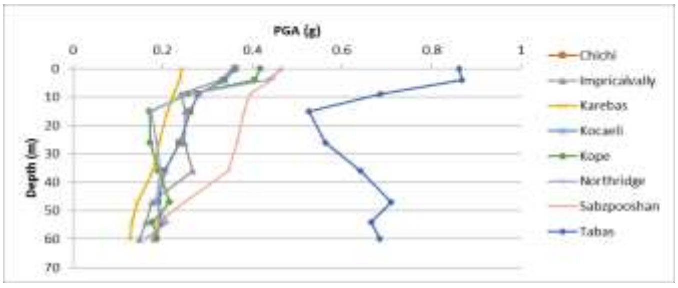


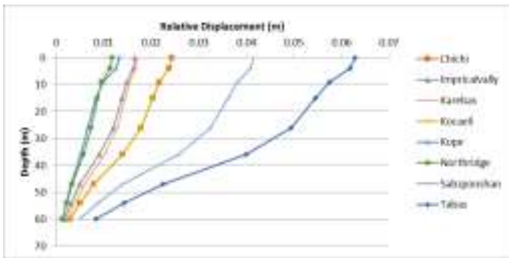
Acceleration response profile P7



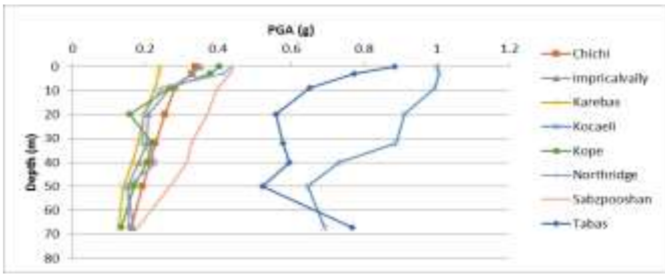
Acceleration response profile P7



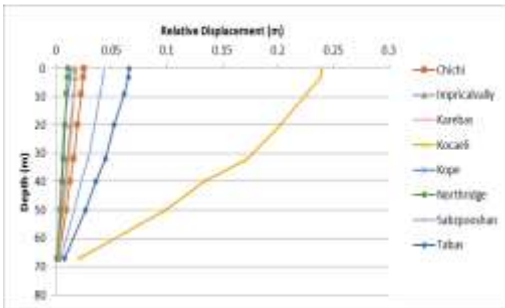
Acceleration response profile P8



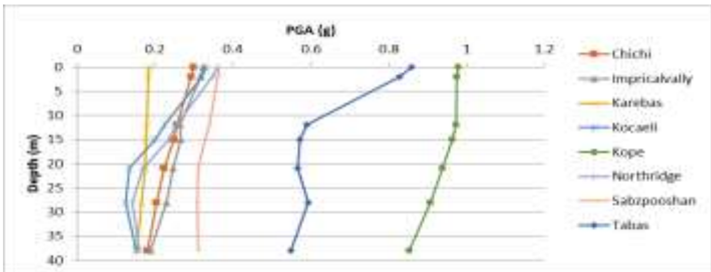
Acceleration response profile P8



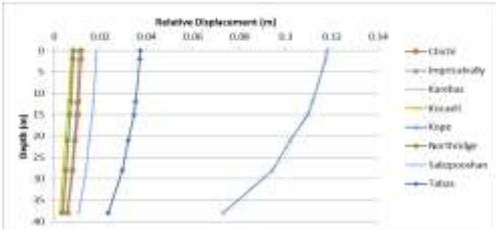
Acceleration response profile P9



Acceleration response profile P9



Acceleration response profile P10



Acceleration response profile P0

Figure (5): normalized acceleration spectrum for marl (profiles P1 to P2) and non-marl (profile P0)

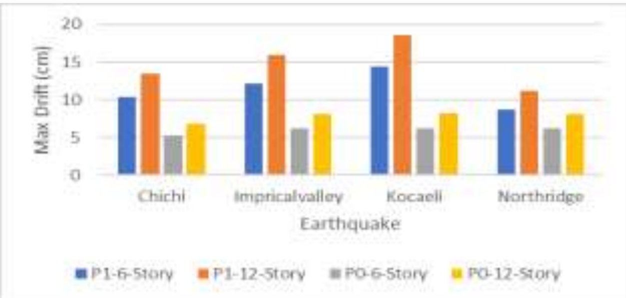
3.2. The response of building under near field earthquakes excitations

In Figure 6, the maximum values of drift (drift of the last floor of the building) in two buildings of 6 and 12 floors, for four earthquakes in the near area, are compared for Marly soil with non-Marly soil. According to Figure 6, for earthquakes in the near area, for the 10 Marly soil profiles examined, the amount of drift increases with the increase of the building's floors, and the amount of this increase (the last floor of the building compared to the first floor of the building) is about 93% for the 6-story building and about 93% for the 12th building. The floor is about 96. For earthquakes in the near area, the values of maximum drift (on the last floor of 6 and 12-story buildings) and base shear (on the first floor of 6- and 12-story buildings) are given in Table 2. According to Table 2, for earthquakes in the nearby area, for 10 marly soil investigated in a 6-story building, the maximum drift value (on the last floor of the building) is 96, 96, 64 respectively for profiles 1 to 10 compared to the non-marly soil. , 117, 97, 80, 93, 97, 95 and 69% more. Also, for the 10 Marly soil investigated in the 12-story building, the maximum drift value (on the last floor of the building) is 96, 86, 64, 117, 95, 76, 89 respectively for profiles 1 to 10 compared to the non-marly soil. , 95, 93 and 67% more. In the marl sections (sections P1 to P10) with the increase in the number and thickness of the marl layers, the drift of the building has increased, so that the P4 section, where the thickness of the marl layer is more than 15 meters, has the highest amount of drift and profile P3, where the thickness The marl layer is about 5 meters and has the lowest amount of drift. For four nearby earthquakes (Chichi, Impricalvalley, Kocaeli, Northridge), Northridge has more frequency content and PGA, therefore, for a certain section, the largest structural drift is related to the Northridge earthquake. In contrast, the Chichi earthquake has the lowest PGA value, and therefore, for a certain section, the lowest building drift is related to this earthquake**.**

Table (2): The values of the maximum drift of the last floor of the building in different buildings for earthquakes in the near area

Profile Number	**Acceleration**	**The drift of the last floor of the *6*-story *building* (mm)**	**The drift of the last floor of the *12* story-*building* (mm)**	**Shear force of the first floor of a *6*-story *building* (KN)**	**Shear force of the first floor of a *12* story-*building* (KN)**
p1	Chichi	10.25	13.51	254	279
p1	Impricalvalley	12.11	15.80	303	329
p1	Kocaeli	14.27	18.80	353	384
p1	Northridge	8.60	11.33	213	234
p2	Chichi	9.91	12.80	245	264
p2	Impricalvalley	12.57	16.40	311	342
p2	Kocaeli	14.40	18.97	360	388
p2	Northridge	9.61	12.54	240	259
p3	Chichi	8.56	11.28	214	230
p3	Impricalvalley	12.25	15.98	306	330
p3	Kocaeli	14.79	19.49	370	402
p3	Northridge	10.47	13.79	262	282
p4	Chichi	11.36	14.97	284	309
p4	Impricalvalley	13.51	17.80	335	368
p4	Kocaeli	15.80	20.60	387	421
p4	Northridge	10.03	13.08	248	270
p5	Chichi	10.29	13.42	255	274
p5	Impricalvalley	11.67	15.38	292	314
p5	Kocaeli	15.62	20.37	383	421
p5	Northridge	11.21	14.77	280	302
p6	Chichi	9.41	12.15	231	253
p6	Impricalvalley	10.21	13.32	255	275
p6	Kocaeli	14.93	19.28	366	402
p6	Northridge	11.92	15.55	295	318
p7	Chichi	10.09	13.03	247	272
p7	Impricalvalley	11.55	15.06	286	311
p7	Kocaeli	14.81	19.32	367	399
p7	Northridge	14.81	19.13	367	399
p8	Chichi	10.29	13.42	257	280

p8	Impricalvalley	11.82	15.42	293	318
p8	Kocaeli	14.00	18.08	343	377
p8	Northridge	14.00	18.26	343	373
p9	Chichi	10.20	13.30	252	277
p9	Impricalvalley	11.96	15.60	293	319
p9	Kocaeli	12.83	16.73	318	345
p9	Northridge	12.83	16.90	321	345
p10	Chichi	8.85	11.54	219	241
p10	Impricalvalley	10.48	13.68	257	280
p10	Kocaeli	10.47	13.80	262	285
p10	Northridge	10.47	13.66	259	285
P0	Chichi	5.23	6.89	130	142
P0	Impricalvalley	6.17	8.13	153	168
P0	Kocaeli	6.31	8.23	155	170
P0	Northridge	6.31	8.15	155	168



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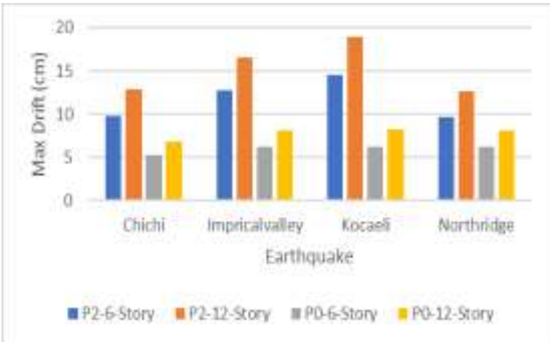

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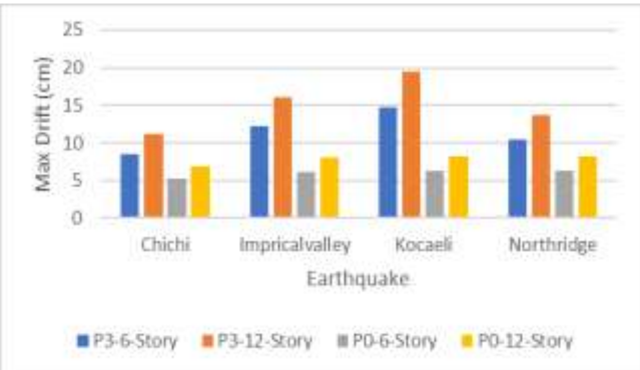

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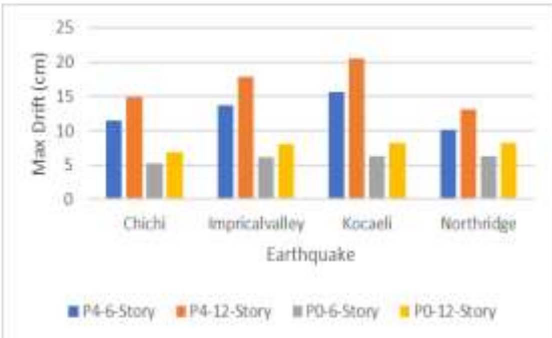

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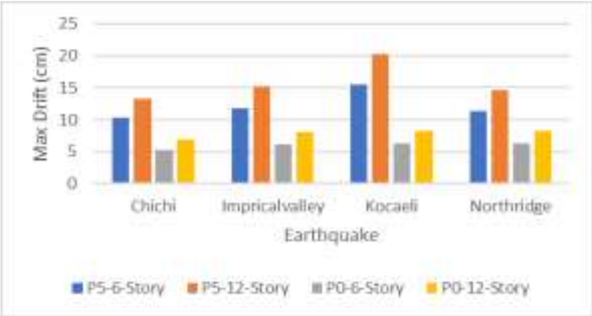

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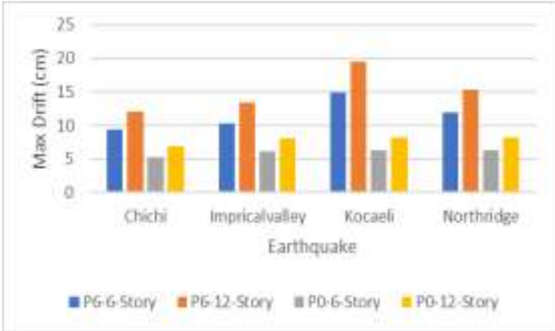

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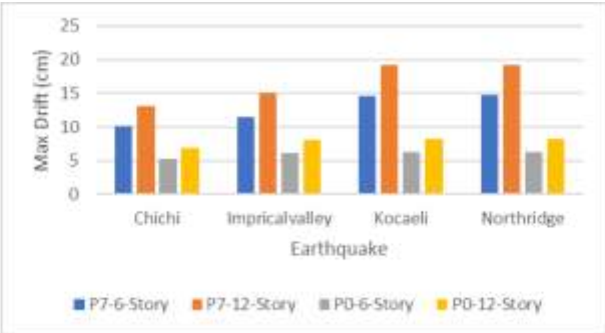

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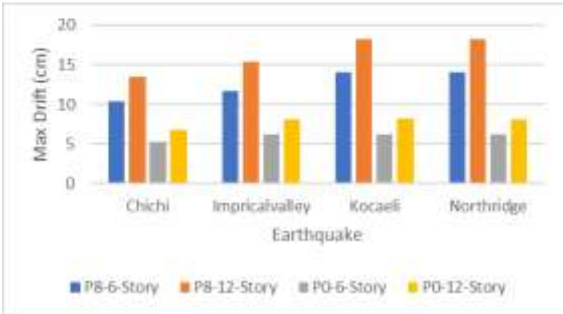

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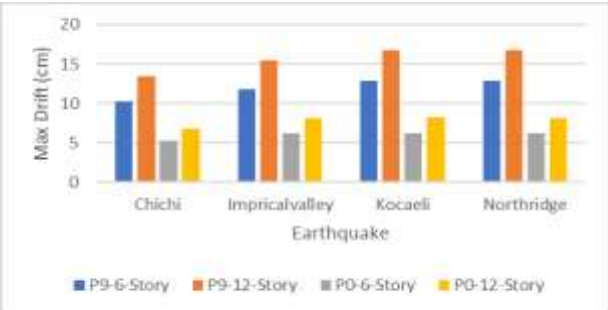

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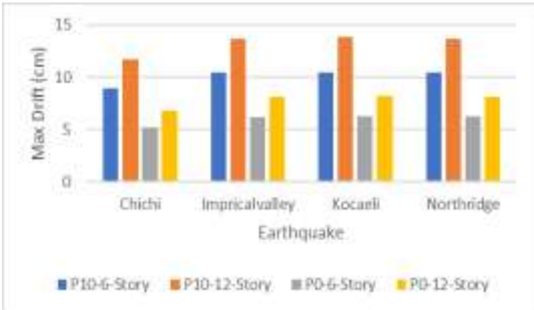
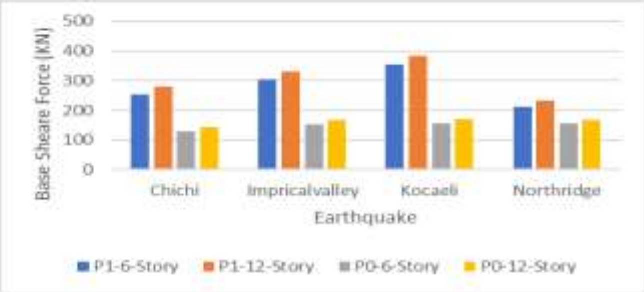


Profile P10

Figure (6): Comparison of the maximum drift in two buildings of 6 and 12 floors, for four nearby earthquakes in Marly soil with non-Marly soil.

In Figure 7, the shear values of the base of the building (the shear force of the first floor of the building) in two buildings of 6 and 12 floors, for four earthquakes in the nearby area, are compared for marly soil with non-marl soil. According to Figure 7 and Table 2, for earthquakes in the nearby area, for 10 marly soil investigated in a 6-story building, the maximum shear force value (on the first floor of the building) for profiles 1 to 10, respectively, compared to the non-marly soil on average 96, 89, 65, 119, 97, 78, 91, 97, 95 and 69% are more. Also, for the 10 Marly soil investigated in the 12-story building, the maximum shear force value (on the first floor of the building) is 96, 86, 62, 117, 93, 78, respectively, for profiles 1 to 10 compared to the non-marly soil. 91, 97, 95 and 69 percent are more. For earthquakes in nearby areas in the non-marl section (P0) compared to the marl sections (P1 to P10), the values of the maximum base shear (in the first floor of the building) are much lower, and the amount of this base shear for a section is more than 12 floors in the building. It is a 6-story building. In the marl sections (sections P1 to P10) with the increase in the number and thickness of the marl layers, the values of the maximum base shear (in the first floor of the building) have increased so that the P4 section, where the thickness of the marl layer is more than 15 meters, has the highest amount of drift. And the P3 profile, where the thickness of the marl layer is about 5 meters, has the lowest base cut. For four earthquakes in the nearby area (Chichi, Impricalvalley, Kocaeli, Northridge), Northridge has more frequency content and PGA, therefore, for a certain section, the largest shear of the building's base is related to the Northridge earthquake. In contrast, the Chichi earthquake has the lowest PGA value, and therefore, for a certain section, the lowest shear of the base of the building is related to this earthquake.



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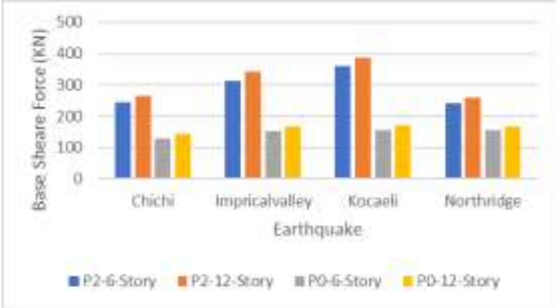
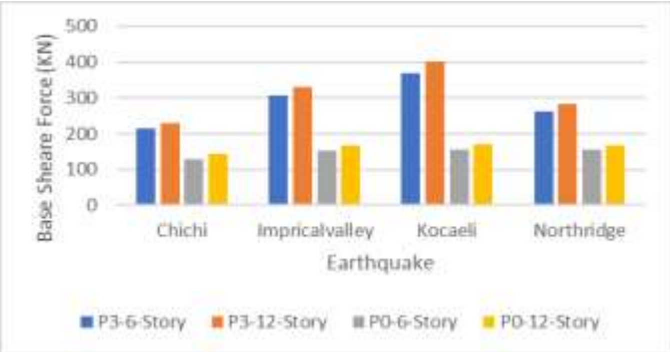
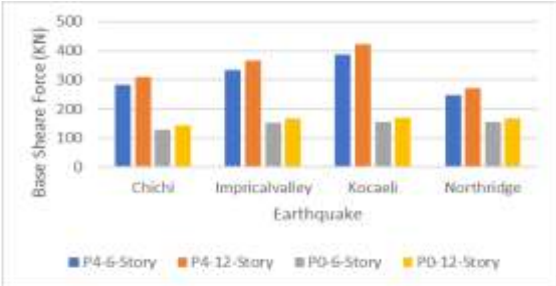


Profile P2



Profile P3



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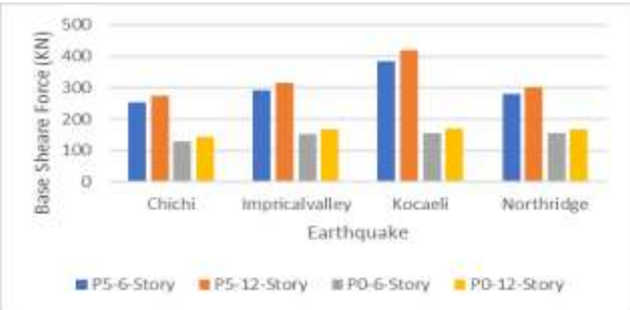

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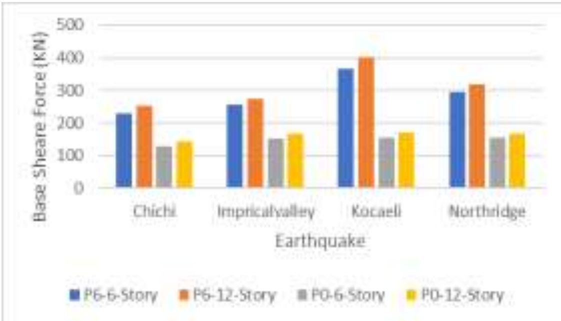

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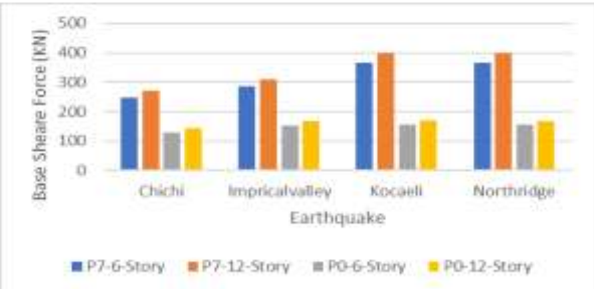

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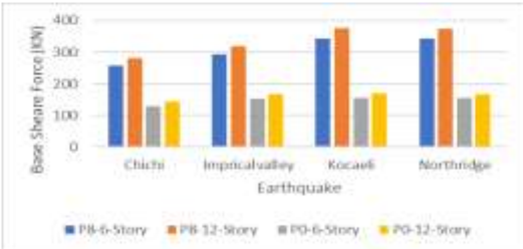

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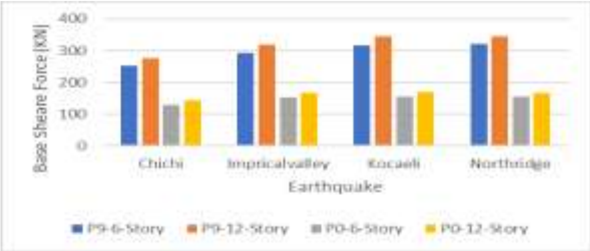

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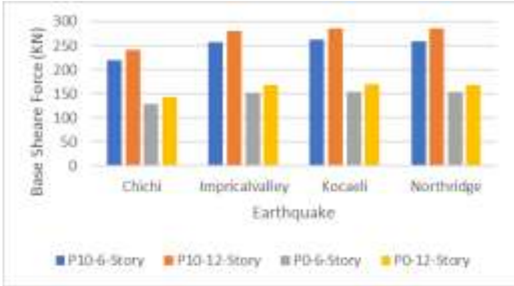


Profile P10

Figure (6): Comparison of the maximum base shear in two 6- and 12-story buildings, for four nearby earthquakes in Marly soil with non-Marly soil.

3.3. The response of building under far field earthquake excitation

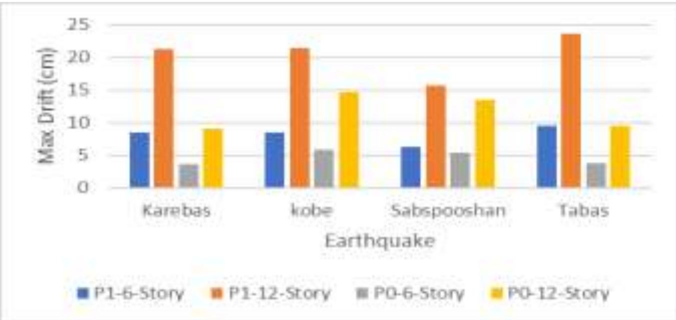
In Figure 7, the maximum values of drift (the drift of the last floor of the building) in two buildings of 6 and 12 floors, for four far-field earthquakes, are compared for marly soil with non-marl soil. According to Figure 6, for far area earthquakes, for the 10 investigated Marly soil, the amount of drift increases with the increase of the building floors, and the amount of this increase (the last floor of the building compared to the first floor of the building) is about 93% for the 6-story building and for the 12th building. The floor is about 96. For distant earthquakes, Table 3 shows the values of maximum drift (on the last floor of 6 and 12-story buildings) and base shear (on the first floor of 6 and 12-story buildings). According to Table 3, for earthquakes in the far area, for the 10 Marly soil investigated in the 6-story building, the maximum drift value (on the last floor of the building) is 134, 82, 122 respectively for profiles 1 to 10 compared to the non-marly soil. , 115, 97, 86, 64, 70, 78 and 70% more. Also, for the 10 Marly soil investigated in the 12-story building, the maximum drift value (on the last floor of the building) is 129, 81, 120, 111, 95, 86, 64 respectively for profiles 1 to 10 compared to the non-marly soil. , 67, 75 and 70% more. For far-field earthquakes in the non-marl section (P0) compared to the marl sections (P1 to P10), the drift values of the building are much lower, and the amount of this drift for a section is more in a 12-story building than in a 6-story building (it is obvious that As the height of the building increases, the amount of maximum drift in the last floor of the building will increase. In the marl sections (sections P1 to P10) with the increase in the number and thickness of the marl layers, the drift of the building has increased, so that the P1 section, where the thickness of the marl layer is more than 25 meters, has the highest amount of drift and profile P7, where the thickness The marl layer is about 7 meters and has the lowest amount of drift. For four distant earthquakes (Karebas, Kobe, Sabspooshan, Tabas), Kobe has the highest deflection and frequency content, and its PGA value is also significant, therefore, for a certain section, the largest drift of the building is related to the Kobe earthquake. In contrast to the Karebas earthquake, it has the lowest PGA value and therefore, for a certain section, the lowest building drift is related to this earthquake.

Table (3): The values of the maximum drift of the last floor of the building in different buildings for distant earthquakes

Profile Number	A*cceleration*	***The drift of the last floor of the*** 6-***story*** building ***(mm)***	***The drift of the last floor of the*** 12 ***story-*** building ***(mm)***	***Shear force of the first floor of a*** 6-***story*** building ***(KN)***	***Shear force of the first floor of a*** 12 ***story-*** building ***(KN)***
p1	earthquake	8.54	21.15	195	491
p1	Karebas	8.48	21.41	195	497
p1	kobe	6.36	15.73	143	365

p1	Sabspooshan	9.49	23.72	216	551
p2	Tabas	6.66	16.64	152	383
p2	Karebas	7.20	18.17	164	418
p2	kobe	7.72	19.31	174	444
p2	Sabspooshan	7.86	19.86	181	461
p3	Tabas	8.11	20.28	185	471
p3	Karebas	8.75	21.87	197	508
p3	kobe	7.44	18.61	170	437
p3	Sabspooshan	6.82	17.22	157	396
p4	Tabas	7.85	19.42	179	451
p4	Karebas	8.59	21.47	196	499
p4	kobe	8.94	22.57	204	519
p4	Sabspooshan	9.69	24.22	218	563
p5	Tabas	7.19	17.97	162	413
p5	Karebas	8.04	19.90	181	467
p5	kobe	7.39	18.47	167	425
p5	Sabspooshan	7.05	17.46	161	405
p6	Tabas	6.78	17.12	154	394
p6	Karebas	7.43	18.76	171	431
p6	kobe	9.39	23.47	214	540
p6	Sabspooshan	6.76	16.91	153	393
p7	Tabas	5.99	15.12	138	348
p7	Karebas	12.00	30.00	273	690
p7	kobe	7.67	18.99	173	441
p7	Sabspooshan	7.26	18.15	165	426
p8	Tabas	6.21	15.38	140	357
p8	Karebas	10.89	26.94	245	626
p8	kobe	9.21	22.79	210	535
p8	Sabspooshan	6.47	16.33	149	379
p9	Tabas	6.50	16.10	148	378
p9	Karebas	11.05	27.63	249	642
p9	kobe	11.05	27.35	249	642
p9	Sabspooshan	5.83	14.57	131	335
p10	Tabas	6.20	15.66	143	364
p10	Karebas	9.85	24.38	222	566
p10	kobe	9.03	22.57	206	524

p10	Sabspooshan	6.39	15.80	144	371
P0	Tabas	3.65	9.22	83	214
P0	Karebas	5.82	14.71	134	342
P0	kobe	5.33	13.46	123	310
P0	Sabspooshan	3.78	9.46	86	217



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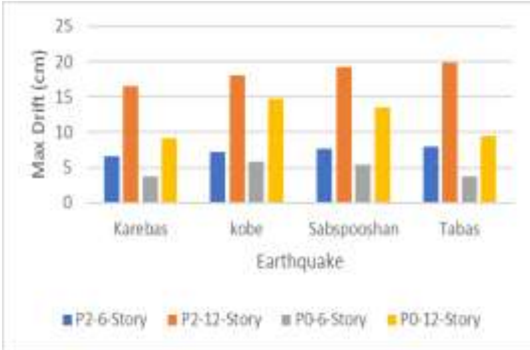

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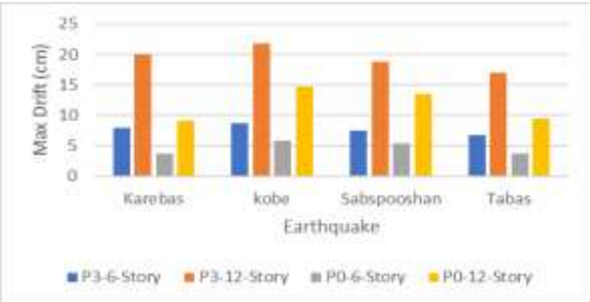
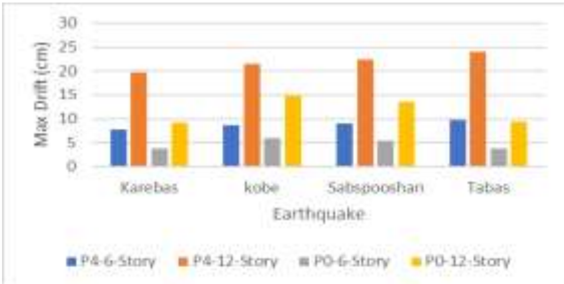


Profile P3



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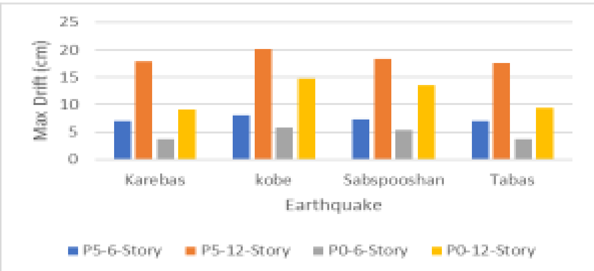

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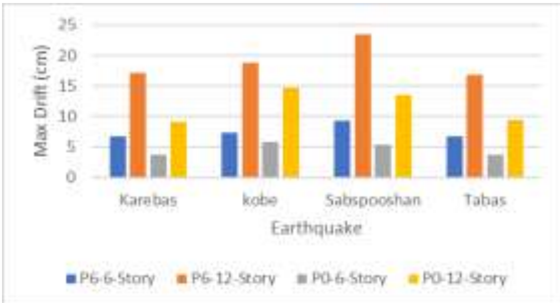
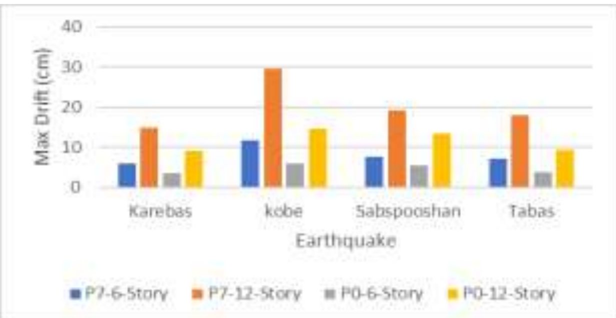
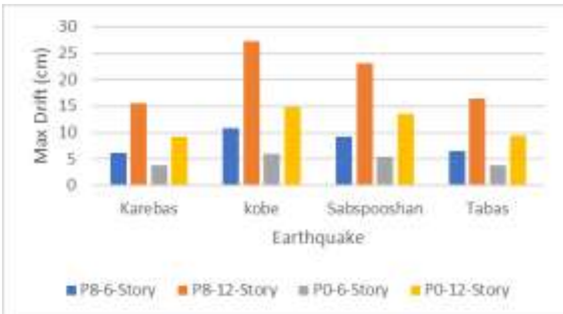


Profile P6



Profile P7



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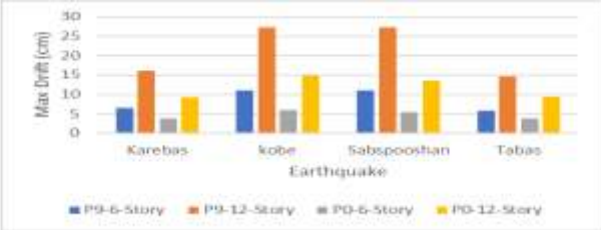

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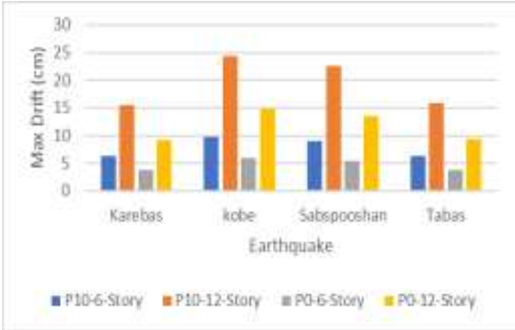
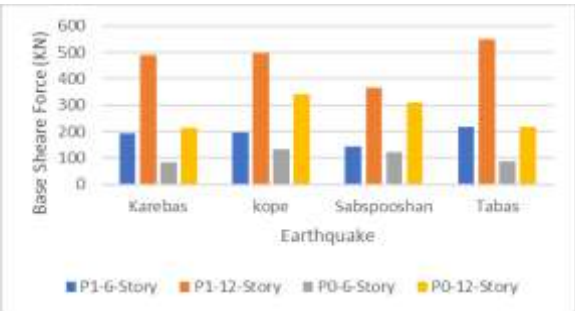


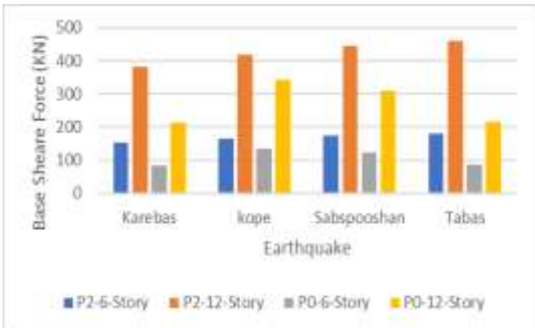
Profile P10

Figure (7): Comparison of the maximum drift in two buildings of 6 and 12 floors, for four distant earthquakes in Marly soil with non-Marly soil

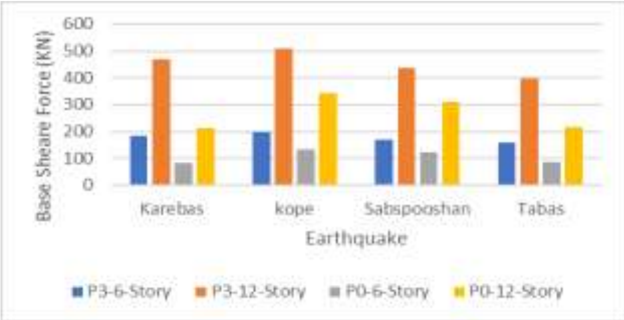
In Figure 8, the shear values of the base of the building (the shear force of the first floor of the building) in two buildings of 6 and 12 floors, for four far-field earthquakes, are compared for marly soil with non-marl soil. According to Figure 8 and Table 3, for far area earthquakes, for 10 marly soil investigated in a 6-story building, the maximum shear force value (on the first floor of the building) for profiles 1 to 10, respectively, compared to non-marly soil on average 134, 82, 122, 115, 95, 86, 66, 69, 78 and 72 percent are more. Also, for the 10 Marly soil profiles investigated in the 12-story building, the maximum shear force value (on the first floor of the building) is 129, 79, 120, 111, 93, 84 on average for profiles 1 to 10, respectively, compared to the non-marly building. 62, 67, 76 and 70 percent are more. For far-field earthquakes in the non-marly section (P0) compared to the marly sections (P1 to P10), the base shear values of the building are much lower, and the amount of this base shear for a section is more in a 12-story building than in a 6-story building (obviously). is that with the increase in the height of the building, the amount of maximum base shear in the first floor of the building will increase). In the marl sections (sections P1 to P10) with the increase in the number and thickness of the marl layers, the amount of base shear of the building has increased, so that the P1 section, where the thickness of the marl layer is more than 25 meters, has the highest amount of base shear and profile P7, which in The thickness of the marl layer is about 7 meters, and it has the lowest base cut. For four distant earthquakes (Karebas, Kobe, Sabspooshan, Tabas), Kobe has the highest deflection and frequency content, and its PGA value is also significant, therefore, for a certain section, the largest shear of the building's base is related to the Kobe earthquake. In contrast to the Karebas earthquake, it has the lowest PGA value and therefore, for a certain section, the lowest shear of the building's foundation is related to this earthquake.



Profile P1



Profile P2



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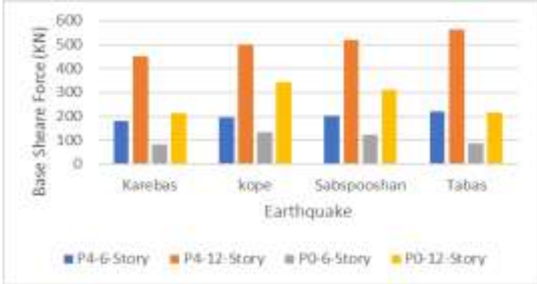

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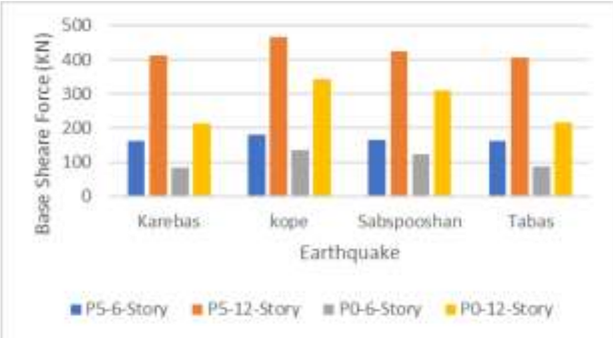

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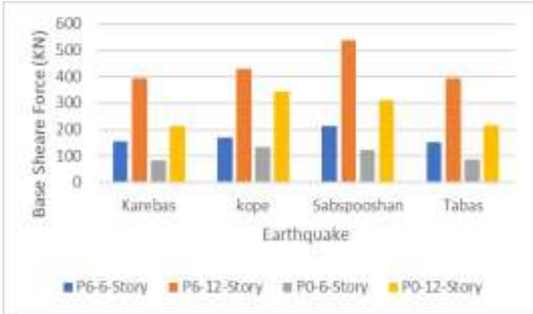
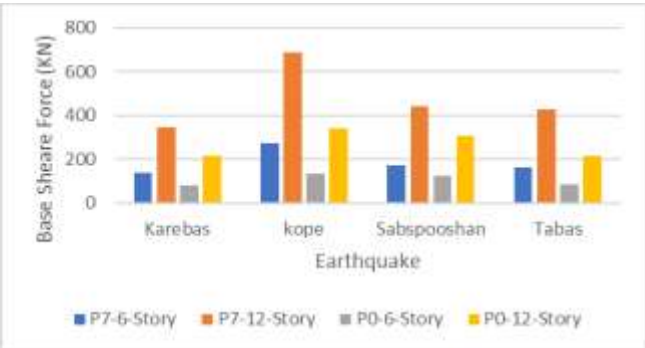
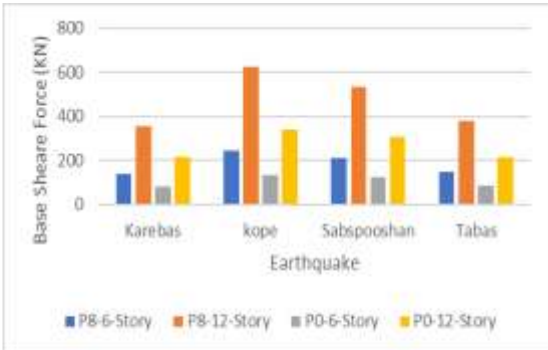


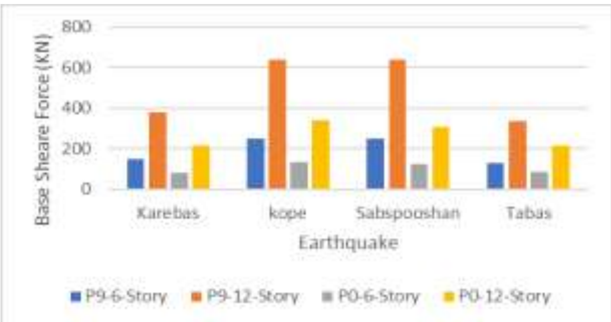
Profile P6



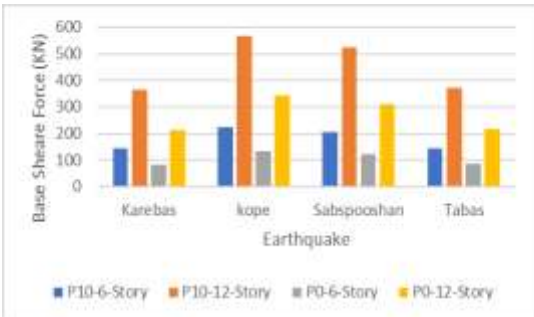
Profile P7



Profile P8



Profile P9



Profile P10

Figure (8): Comparison of the maximum base shear in two 6- and 12-story buildings, for four far-field earthquakes in marly soil with non-marl soil

4. **Conclusion**

In the present research, firstly, the determination of the seismic response of different Marly soil profiles has been investigated with the help of Deepsoil software, and finally, the seismic response of short and tall buildings has been investigated for near and far field acceleration maps using ETABS software. Out of the eight investigated map accelerations, four map accelerations of Chi Chi, Emprikaloli, Kojil and Northridge are considered as earthquakes in the near zone and four map accelerations of Korebas, Kobe, Sabzposhan and Tabas are considered as earthquakes in the far zone. The modeling results include the maximum horizontal displacement of the last layer of the building (maximum drift), the drift of different layers of the building, the frequency responses and damping of the building for different layers of the building, the bending moment and the shear of the building The acceleration response spectrum is the most important result to The result of the present research is presented.

- For earthquakes in the near area, for the 10 Marly soil profiles investigated, the amount of drift increases with the increase of the building's floors, and the amount of this increase (the last floor of the building compared to the first floor of the building) is about 93% for a 6-story building and about 96% for a 12-story building. Is. For earthquakes in the near area, for 10 marly soil investigated in a 6-story building, the maximum drift value (on the last floor of the building) is 96, 96, 64, 117, respectively, for profiles 1 to 10 compared to the non-marly soil. 97, 80, 93, 97, 95 and 69% are more. Also, for the 10 Marly soil investigated in the 12-story building, the maximum drift value (on the last floor of the building) is 96, 86, 64, 117, 95, 76, 89 respectively for profiles 1 to 10 compared to the non-marly soil. , 95, 93 and 67% more.
- For earthquakes in the nearby area, for 10 marly soil investigated in a 6-story building, the maximum shear force (on the first floor of the building) is 134, 82, 122 on average for profiles 1 to 10, respectively, compared to the non-marly soil. 115, 95, 86, 66, 69, 78 and 72 percent are more. Also, for the 10 Marly soil profiles investigated in the 12-story building, the maximum shear force value (on the first floor of the building) is 129, 79, 120, 111, 93, 84 on average for profiles 1 to 10, respectively, compared to the non-marly building. 62, 67, 76 and 70 percent are more.
- For far-field earthquakes, for the 10 investigated Marly soil, the amount of drift increases with the increase of the building's floors, and the amount of this increase (the last floor of the building compared to the first floor of the building) is about 93% for a 6-story building and about 96% for a 12-story building. Is. For the 10 Marly soil investigated in the 6-story building, the maximum drift value (on the last floor of the building) is 134, 82, 122, 115, 97, 86, 64, respectively, for profiles 1 to 10 compared to the non-marly soil. 70, 78 and 70 percent are more. Also, for the 10 Marly soil investigated in the 12-story building, the maximum drift value (on the last floor of the building) is 129, 81, 120, 111, 95, 86, 64 respectively for profiles 1 to 10 compared to the non-marly soil. , 67, 75 and 70% more.
- For earthquakes in far area, for 10 marly soil investigated in a 6-story building, the maximum shear force (on the first floor of the building) is 96, 89, 65 on average for profiles 1 to 10, respectively, compared to non-marly soil. 119, 97, 78, 91, 97, 95 and 69% are more. Also, for the 10 Marly soil investigated in the 12-story building, the maximum shear force value (on the first floor of the building) is 96, 86, 62, 117, 93, 78, respectively, for profiles 1 to 10 compared to the non-marly soil. 91, 97, 95 and 69% are more.
- For earthquakes in the near area in the non-marl section (P0) compared to the marl sections (P1 to P10), the structural response values (drift, bending moment, base shear, damping and frequency) are much lower, and the drift response, bending moment and The base cut for a certain section is more in a 12-story building than a 6-story building. In the marl sections (sections P1 to P10) with the increase in the number and thickness of the marl layers, the response of the building has increased, so that the P4 section, where the thickness of the marl layer is more than 15 meters, has the highest response rate and the P3 profile, where the thickness The marl layer is about 5 meters and has the lowest structural response. For the four nearby earthquakes (Chichi, Impricalvalley, Kocaeli, Northridge), the Northridge earthquake has more frequency and PGA content, so for a certain section, the highest response of the building is related to the Northridge earthquake. In contrast, the Chichi earthquake has the lowest PGA value, and for this reason, the building's response is the lowest for this earthquake.
- For distant earthquakes in the non-marly section (P0) compared to the marly sections (P1 to P10), the response values of the building (drift, bending moment, base shear, damping and frequency) are much lower that the drift response, bending moment and The base cut for a certain cross-section is more in a 12-story building than a 6-story building, but it is the opposite in terms of damping and frequency. In the marl sections (sections P1 to P10) with the increase in the number and thickness of the marl layers, the response of the building has increased, so that the P1 section, where the thickness of the marl layer is more than 25 meters,

has the highest response rate and the P7 profile, where the thickness The marl layer is about 7 meters and has the lowest response rate. For four distant earthquakes (Karebas, Kobe, Sabspooshan, Tabas), the Kobe earthquake has the highest deflection and frequency content, and its PGA value is also significant, therefore, for a certain section, the largest response of the building is related to the Kobe earthquake. In contrast to the Karebas earthquake, it has the lowest PGA value and therefore for a certain section, the lowest response of the building is related to this earthquake.

 For distant area earthquakes, the damping and frequency response of a 12-story building is more than a 6-story building, and it shows that for distant area earthquakes that have a longer periodicity, high-rise buildings are more affected by these earthquakes than low-rise buildings. Medium and short order.

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