Effect of Soil Formations to Ground Failure During Earthquake in Adapazari City, Northern Turkey

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Received 31 October 2013; revised 18 November 2013

In terms of the formation of the ground in each country, especially in earthquakes, structure damages are much observed in cities due to soil problems. In Turkey, Adapazari soils show the rare feature in terms of formation in the world. 17 August 1999 Kocaeli earthquake is remembered significant number of casualties, damage and the soil problems. Adapazari Plain is the largest alluvial plain of the Marmara region. Adapazari was shaped by both the tectonic events and contribution of sediments carried by the rivers. The largest share belongs to the Sakarya River in the filling of the plain, Mudurnu water takes the second place. The geotechnical properties of this alluvial area are highly variable. Because of geology and local soil conditions soils of Adapazari has shown potential in terms of soil problems during earthquake. In this study a description of the damage suffered throughout history in Adapazari will be given.

[Keywords: Earthquake, History, Flood, Alluvial Soil, Soil Problems]

Introduction

Earthquake ground motion is affected by the local soil conditions and geological structure. The variations in the strong ground motion caused by local soil conditions are reflected in the dynamic behavior of soils. During earthquakes, the soil has played important role as a contributing factor in the failure of built in cities. For this reason, many researchers have studied about effect of local soil conditions on structure damages. Zamarbide examined to assess the potential damageability due earthquake in San Juan (Argentina). San Juan city is located in the Tulum Valley, west of the San Juan River. The valley is consist of rock, alluvial fan deposits of the San Juan river, flood plain deposits of the present course of the San Juan river, transition zone of old fan deposits and flood plain deposits. In the 1977 earthquake most of ground failure was related to liquefaction in the valley.

DeLisle presented maps potentially liquefiable sediment area. He collected geotechnical data from more than 600 sites where one or more boreholes were drilled. The study area is a peninsula bound by the Pacific Ocean on the west and San Francisco Bay on the north and east. Current topography of study area was shaped by Quaternary tectonism, marine and estuarine deposition, and man-made land. Soil properties and soil conditions are used to identify and correlate liquefaction susceptible soils. It is indicated that liquefaction susceptibility maps showed similar to Quaternary geologic maps. As a result of investigation was characterized by grouping deposits into high, moderate, low, and very low categories. Kayen and Barnhardt examined the geomorphology and seismic stability of the Duwamish River delta at the Port of Seattle in western Washington State. Geotechnical investigation indicated that these river deposits show high initial liquefaction susceptibility during earthquakes.

Niigata city is located on the west coast of Japan where the Shinano River enters the sea. The river built up sand deposits nearly 100 meters thick on which the city was built. The soils of Niigata City consist of young sedimentary deposits having low density soils and shallow ground water table. At the time of 1964 Niiaigata earthquake, there were many reinforced concrete buildings in Niigata City. The National Information Service for Earthquake Engineering 2000 states: The Niigata Earthquake resulted in dramatic damage due to liquefaction of the sand deposits in the low-lying areas of it.

Especially in the 17 August 1999 Kocaeli earthquake, Adapazari faced extreme destruction,
thousands of lives were lost and serious material losses occurred. The soil problems observed after the earthquake are toppling, strength decay, bottom heave, exceeded bearing capacity and liquefaction. Bol and Onalp stated that liquefaction especially occurred in regions where crevasse splay deposits develop on lower facies and where silt and fine sands are dominant. They also stated that crevasse splay deposits form by the destruction of the river barriers along the river bed due to high flow rate and the accumulation of the material composed of silt and fine sand in the flood plain through the crevasse, and that cavities form between the barrier of the deserted bed and the current bed causing swamp deposits to accumulate in those cavities. These lower facies showing different deposit properties form different basic soils for engineering structures. Meanwhile, Bol prepared the thematic maps reflecting the various characteristics of soils with Geology Information Systems (GIS) using wide a database for Adapazarı city center. Researcher compared soil classification, liquefaction potential, liquid limit, average grain size and liquidity index maps and 1999 earthquake damage map. Consequently, he stated that it may understand approximate expected damage to the regions with soil properties. The research studies support that different soil problems depend on different layer properties in different lower facies of the region established in a river facies stage. For this purpose the studies related to the formation of Adapazari soils are generally compiled.

Even though we know that the Britons and Byzantines lived in this region, no accommodation area belonging to the Britons, Romans or Byzantines could be detected in the Adapazari area. However, it can be understood that there are bridges such as the Justinyen Bridge, haunts, castle relics and temples in the region. Eröz and Alpan stated that Adapazari is a recently established city. Towards the end of the XIII. century, the Ottomans conquered the Adapazari basin. As it is in an island shape stuck between 2 bayous of the Sakarya River, these places were called “island” in the following years. Researchers state that the Sakarya river is divided into 2 bayous at the place which was called Uzunköprü before and that one of the bayous flows below the Beşköprü today and the other bayou flows almost through the current bed of the river today and that these two bayous combine around Söğüt and direct towards north until disemboguing into the Black Sea.

In this study, important collimating information will be given to researchers performing studies on Adapazari soils. The information about the formation mechanism of the Adapazari soils will provide an important contribution in order to understand the geotechnical properties of the soils. For this purpose, the notes of foreign travelers who have visited Adapazari and soil formations originated from Sakarya River will be briefly given. After that, the summary of earthquakes and floods that have affected Adapazari city will be given. In addition, it will be referred to the soil problems observed in the 17 August 1999 Kocaeli earthquake.

Informations about soil formation, earthquakes and the notes of travelers of Adapazari city

Adapazari location and features

Adapazari is a busy agricultural, business and industrial city in the Northern Turkey. The city was ruined with unexpected death toll and building damage in the past earthquakes. Especially it was observed to many building damage during 17 August 1999 Kocaeli earthquake. The location of Adapazari is given in Fig. 1 on turkey earthquake map. Adapazari is located in the immediate vicinity of the North Anatolian Fault. This transform fault has been known to be active approximately every decade.
Adapazari geography and geology

Sakarya which is located in the north east of the Marmara region is surrounded by Düzce city, Bolu Mountain to the east, by the Gölpażarı and Osmanlı districts of Bilecik city to the south, by the Kandıra, Merkez and Gölçeük districts of Kocaeli to the west and by the Black Sea to the north. Adapazari which is the center of Sakarya city is at the lower part of the Sakarya basin, on the Akova plains. The plains cover 22.1% of the city area. The biggest plain of the city is Akova (Adapazari plain). The plain, which is located to the east of Sapanca Lake and Adapazari, is one of the biggest plains in the Marmara region (Fig. 2). The plain is irrigated by the Sakarya River flowing from south to north and by the Mudurnu River flowing from east to west. The cross sectional area of Akova is 620km² with a width of 23 km and with a length of 27 km in the east – west direction.

The Sakarya River, which originates in the Çifteler district of Eskişehir, has a length of 824 km together with its bayous. However, considering that some of the sources have dried up, the length can be assumed to be 720 km. The length within Sakarya city borders is 159,5 km. The river is combined with the Gökşu bayou which irrigates the İnegöl and Yenisehir plains after passing Osmanlı and reaches Pamukova after combining with the Göynük River. It flows through the narrow Gevye straight between Gevye and Doğancay and reaches the Adapazari plain. Here the valley bottom is below 35m and the river becomes a characteristic plain river. The Sakarya River which passes from 4km east of Adapazari city center (Fig. 3), is combined with the Mudurnu River at the northern part of the plain and after that it is combined with the Çark River which empties the excess water of Sapanca Lake and disemboque to the Black Sea from the Yenimahalle neighborhood of the Karasu district center.

Böl gave the geological map of Adapazari region. Characteristics of the study area are the outcropping of Permian-Triassic red sandstones and grey dolomites, sandstones and quartzites outcrop on hills to the North. Upper Cretaceous formations intrude from the southwest containing marl, sandstone and their mixtures with limestones. The Lower-Mid Eocene Upper Cretaceous is overlain by basalt, agglomerate and tuffs in Serdivan a suburb of Adapazari to the West.

The studies related to the formation of the Adapazari plain started in the beginning of the 1900’s. Rish stated “Sapanca lake was a graben which was a part of İzmit bay and the Sakarya River used to disembose to Marmara from there at that time. It later was separated from the bay and became sweet. Moreover, Sakarya was connected to the Black Sea by an old valley. Baykal determined the fault line areas in north of Sapanca lake and Adapazari and did studies about the geological
developments of the Gevye strait and the mountains in the east. Lahn described Sapanca Lake as a dam lake formed by the separation of the rivers coming from the high areas in the north and south by the alluvions. He says that the sea bayou entering here most probably covered the Adapazari plain and so the Sakarya River disembogued to Izmit Bay and after that it disembogued to the Black Sea due to the blockage of the river by the alluvions of the Adapazari plain. According to Inandık, the bed of the Sakarya River flowing towards the west was blocked by alluvions and therefore the river changed its direction to the Black Sea.

Bilgin stated that the Adapazari plain was becoming thicker day by day due to the accumulated materials and would collapse slowly under the weight of these materials. The river loses its speed after the Gevye strait in the Adapazari plain and leaves pebbles, sand, silt and sand to the plain and as the flow rate of the river decreases, these results in clay and silt deposits to be accumulated in the river bed. Uludağ stated that the precipitation environments in the Adapazari plain and Sogutlu plain in the north have different characteristics and that the Adapazari plain was covered by sea or lake from time to time.

Kerey showed the development of the flora with the samples taken from the Sakarya River old bed and the Sakarya delta and showed that it changed from open continental area to mixed forest consisting of pine, oak, fir, hornbeam, hazelnut and elm. They stated at the end of drilling studies that different numeric ages were obtained from different depths which show the tectonic activity of the region during the Holocene. Komazawa explained the alluvion depth as 1000-1500 mt at the end of geophysical studies and that the depth of the rigid soil at the end of the city center is 1000 mt.

Uludağ stated in his study that the Sakarya river disembogues to the Adapazari basin before reaching the Black Sea and it flows for enough time to form a coast delta in the opening of the Gevye strait and depending on the precipitations occurring in the Adapazari plain, it made the bed deeper by splitting the delta formed by the Sakarya River. Bol examined the soil in Adapazari and determined the distribution and depths of flood plain sediments in the past and gave the distribution of alluvions in the city center. He explained the clay, sand and pebbles in the upper levels of the drilling as the deposits of the final filling stage of the plain and explained the different characteristics of sediments in different places as the frequent bed changes of Sakarya River. The researcher determined the reality that the river might have flown from the path where the city lies today. The carbon age determination made with the samples taken from 4mt depth resulted as 960±40 years. This shows that the precipitation time necessary for a 1m thick alluvion layer in geological periods when no precautions were taken against flooding is approximately 250 years.

Bol and Bol et al. used geographic information systems to find the distribution of lower facies of the Adapazari soils. The work results of Bol et al. are summarized in Fig.4. They showed that 2 river bayous used to flow in the place where Adapazari city lies today and that other lower facies developed around the channel facies sediments left by these rivers and that all lower facies present different geotechnical properties. They presented the change of river originated alluvion profiles that are dominant in Adapazari city. As the
geomorphologic formation stages in a river originated area such as Adapazari cannot be monotone, they stated that Adapazari city soils which are very active in terms of earthquakes are geotechnically very important. Based on all of these, it is understood that a river flowing 1500 years ago from south to north through the Gevye strait split into two bayous to the south of Erenler hills. One bayou used the Beşköprü valley in the west and the other bayou advanced from the east foothills of the Erenler hill and the two bayous combined again around the city center of Adapazari and proceeded towards the north. As the basin of the river bayou in the west descended continuously due to tectonic events and the collapses, the bayou left its valley and used only the channel in the east and in modern times it probably immigrated to further east to its current position.

They stated that in drilling operations made in Adapazari city center, materials with sometimes heavy odor consisting of plant remains with fiber and wood pieces came out. The Sakarya River through the paths it followed in the past resulted in the formation of a more rigid subsoil compared with other regions and the precipitated thin materials in floods and swamp environments formed problematical areas for engineering structures.
Moreover, the floods affected Adapazari very much until the 1960’s. In Table 1 part of the information of floods in Adapazari and its surroundings is given. In Fig. 5 photos taken after the flood can be seen. However, the dams built in the upper parts of the river and the barriers built on both coasts of the Sakarya River have taken the floods under control. There are still floods in the Mudurnu River which is another river irrigating the Adapazari plain but it has little effect as it is away from the city centers.

In the past, Sakarya River plays a primary role in the formation of Adapazari soils due flowed from different parts of the city and it was caused by different soil stack in plain. Two typical soil profile of the studied area with CPT data is given in Fig. 6. In Fig. 6a is seen soil profil about the old river channel (channel facies). In this soil profile, a thick layer of coarse sand is outstanding. In Fig. 6b is seen soil profil about the backswamp region. This soil profile is observed in thin layers of silt and sand in places where fine clays with. This thin layer of sand and silt is indicated crevasse splays caused by time to time the Sakarya River floods.
The seismicity of Adapazari and History of Earthquakes

Turkey is in an active location in terms of earthquakes because of the North Anatolian fault line with a length of 1500 km lying in east-west direction. Fig. 7 shows the Anatolian one is under pressure by the northward movements of both African and Arabian plates. The Anatolian plate, bounded by the North Anatolian Fault Zone (NAFZ) and the East Anatolian Fault Zone (EAFZ), is pushed westward against the Agean plate as a result of the relative movement of the Arabian plate with respect to African plate.

The North Anatolian Fault line starts from Saroz Bay and lies along the Marmara Sea, Sapanca Lake, Adapazari, Tosya and Erzincan until the north of Van Lake. In the tectonic collapse of the basin formed by this fault line which crosses the Marmara sea as far as Izmit bay, Sapanca and Adapazari, many earthquakes have occurred in history (Fig. 8). Adapazari is located in a first degree earthquake zone and the Adapazari earthquake map is given in Fig. 9. As Adapazari lies on a deep alluvial soil, it was affected seriously by the earthquakes in the past. Caution is always necessary in Adapazari city where various soil problems may occur during earthquakes. In Table 2 part of the earthquakes which have affected Adapazari starting from the Byzantium and Ottoman eras until today are given. When the table is examined it can be seen that Adapazari has always been affected by the earthquakes in the region due to the tectonic and soil properties of the region. The photos taken after earthquakes are shown in Figs. 10, 11 and 12.

The notes of travelers about Adapazari

Knowing the notes written by travelers visiting Adapazari and its surroundings will ease the interpretation of soil behaviors.

In 1548, Gabriel d’Aramon stated that the Adapazari region is a sea of trees, which means it was covered with dense forests.

In 1640 Evliya Çelebi described the east of Izmit by saying “A person can get lost in the sea of trees in the mountains in the east, there are such trees reaching high to the sky that ten thousand sheep can rest in their shade.”

In 1648 after Evliya Çelebi got in contact with the endless sea of trees next to Sapanca Lake to the east, he wrote “there is such a muddy swamp in this area....”

In 1740, Richard Pococke stated that the water amount from the Sagaris/Sakarya is plentiful. He also noted that the Sagaris used to flow through another bed but now the same river cannot be seen under the bridge where the convoy passes.

In 1817 a traveler named William Heute who visited the region stated that he reached Sapanca after passing through Beşköprü, he did not mention about Adapazari accommodation. However, he noted that he had reached Izmit from Sapanca through a muddy road which is difficult to pass through.

In 1817-1819 a traveler named Minas Bıjikyan who passed through Sakarya during his visit to the Black Sea coast mentioned the Sakarya River and...
Beşköyprü but he did not mention accommodation in Adapazari.

In 1862 Kont A. De Moustier who made a visit to the region stated that Adapazari was an accommodation area with a population of 10,000 on the left side of the Sakarya River beyond a small valley named Adaköy (Ada is island and köy is village) which contained minerals.

In 1832 Charles Texier stated about Ada: “After passing the bridge a small village named Adapazari is reached through a road to the northeast. The reason for the name is that the shape is like an island between the 2 bayous of the Sakarya River. The width of the river is 100m here. It is separated by two bayous and forms this small island.”

In 1838 William Ainsworth stated that he reached to Sapanca from Izmit by passing through a sea of trees.

In 1840 J. Ballie Fraser stated that his only complaint in the Sakarya region was the rain and muddy land.

In 1862 A.D. Moustier visited Sakarya and took some notes: “The terrain is low, road is almost under water. Sometimes we move in the water. We passed the bridge built by Justinianus in 6th century. Sagarius is not passing under this bridge anymore. There is weak water current under the bridge. It is most likely a swamp. The French traveler who visited here 25 years ago states that there is an arch of triumph relic in Sapanca River. I could not see it now. Adapazari is a small town with a population of 10,000 lying next to the river. It is also called Adaköy.”

In 1888 German traveler Bernard Schwarz noted the famous swamp of Adapazari.

In 1890 Edmund Naumann took these notes about Adapazari: “Sakarya is not flowing below the bridge but from its surrounding. The flow of the river was changed in the 1300s. He also noted: “I jumped over many puddles on the way to Adapazari after passing Justinianus bridge and the cows lie in some of these puddles which are almost completely submerged in the water. Mud baths can be seen everywhere. The Adapazari name is formed by ada (island) and pazar (market) words and is located in a muddy area.” 11, 24.

It can summarized from the notes of travelers that Adapazari was wet, muddy and covered with forests in the past years and was not suitable for city accommodation. The tree roots found at 4-5 m depths in drilling operations today are not surprising according to this information.

**Major earthquakes and 17 August 1999 Kocaeli earthquake**

The city of Adapazari is extraordinarily high seismic risk. Adapazari is located in the immediate vicinity of the North Anatolian Fault and therefore it was recorded important earthquakes in 1943, 1957, 1967 and 1999. The 1943 Adapazari-Hendek earthquake occurred in Sakarya Province, Turkey. It registered an estimated magnitude of Ms=6.5, earthquake have aftershocks and quakes at regular intervals. It was recorded 346 people lost their lives. In Adapazari and Hendek has been heavy damage. In this earthquake, a few thousand houses was destroyed. 1957 Abant earthquake had a magnitude of Ms=7.0, the earthquake caused total almost destruction within the 40km long narrow valley between Abant Lake (east) and Dokurcun (west) 28. 1967 Akyazı earthquake was been 7.2 magnitude and it was claimed one hundred lives and destroying numerous houses and buildings. This earthquake was felt around of Adapazari, Istanbul, Bolu, Eskisehir and Ankara but major structural damage occurred mainly in the capital city of Adapazari 29.

The 17 August 1999 Kocaeli earthquake occurred at 03:02a.m. This earthquake had a magnitude of Ms= 7.8, the depth was about 10 km and the epicenter was Golcuk at the eastern end of Marmara Sea. The earthquake affected city centers of Golcuk, Yalova, Adapazari, Izmit, Istanbul (Avcılar area), Duzce, Akyazi, Golyaka, Sapanca and Izmit. Sahin and Tari 30 gave the total number of house unit collapsed and heavily damaged is 19,043, and the owner or occupant families of these houses are nowhomeless. After the damage evaluation, 12,200 house units are classified as moderately damaged and total number of slightly damaged housing units are 18,720, in Adapazari, Sakarya. Especially, after 17 August 1999 Kocaeli earthquake, many researchers studied about the problems of Adapazari soil. Onalp 31, Erken 32, Bray 33, Bray 34, Bol 7, Bol et al 32, Bol 12, Sert 35, and also.

Onalp 31 summarised the damage to the buildings in 1999 Kocaeli earthquake in six main groups. They gave were the shear magnitude of the
earthquake experienced by the structures caused immediate collapse of many, consist of buildings which had a height/breadth ratio of larger than 2.5, those buildings simply toppled over and broke. They gave the buildings settled up to 1 m equally or tilted, with no evidence of ground failure on the surface, the bursting of the soft subsoil into the basement if the foundation was not a raft, buildings have simply undergone bearing capacity failure and they said the last damage is liquefaction.

Bray\textsuperscript{34} presented a comprehensive study of the soils Adapazari. There are CPT profiles, borings with SPTs and soil index tests in this study. They said that many of the affected buildings had sand boils in their vicinity, although often ejecta were not present. To the effects of ground on building performance, they investigated areas of extensive ground failure occurred as evidenced by building settlement, sliding, and tilting. They claimed that the fluvial nature of the deposition of soils in Adapazari are vitally important in understanding the occurrence and nonoccurrence of ground failure and building damage in Adapazari. They said that the liquefaction triggering analyses were performed for free-field, level ground conditions and they do not take into consideration the effect of the structure, and in Adapazari it appears that the inertial loading of the reinforced concrete structures was largely detrimental, because ground failure was systematically found adjacent to structures and found to be less prevalent away from structures.

<table>
<thead>
<tr>
<th>Date</th>
<th>Damge case</th>
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<tbody>
<tr>
<td>28 December 1924</td>
<td>Due to overflow in Mudurnu water, Adapazari-Hendek way was damaged.</td>
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<tr>
<td>09 July 1938</td>
<td>Due to intensive and heavy rains, Adapazari's Karapürçek township was flooded.</td>
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<tr>
<td>30 December 1939</td>
<td>Water level of Sakarya River was extremely increased and was severe damaged around.</td>
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<tr>
<td>27 February 1941</td>
<td>Due to overflow in Sakarya River, settlements near the river remained under water.</td>
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<tr>
<td>04 July 1941</td>
<td>Due to heavy rains, Sakarya river was increased.</td>
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<tr>
<td>05 April 1948</td>
<td>Sakarya River overflowed and the surrounding residential areas remained under water, approximately 1m.</td>
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<tr>
<td>28 October 1950</td>
<td>In Sapanca and villages, as a result of intense rains occurred big floods</td>
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<tr>
<td>12 February 1951</td>
<td>In Sapanca and Derbent occurred large floods.</td>
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<tr>
<td>18 February 1953</td>
<td>Sakarya River overflowed and around Adapazari and 10 thousand acres of land remained under water.</td>
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<tr>
<td>04 March 1953</td>
<td>Due to the increased water of Sakarya river, flood waters were came up to the edge of downtown.</td>
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<tr>
<td>24 February 1956</td>
<td>Sakarya River was increased sets of Güneşler village was destroyed.</td>
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<tr>
<td>11 March 1956</td>
<td>The waters of Sakarya River were increased again in spring and contact with some of the villages with city were cut to the maximum extent.</td>
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<tr>
<td>23 January 1963</td>
<td>As a result of melting of the snow falling heavily, Çark River was flooded and thousands of homes remained under water in Adapazari.</td>
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<tr>
<td>16 April 1965</td>
<td>Due to rainfall Sakarya river water level was increased.</td>
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<tr>
<td>14 March 1968</td>
<td>As a result of the falling rain and melting snow overflowed the Sakarya River, settlements and roads was damaged.</td>
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<tr>
<td>29 October 1968</td>
<td>Between Adapazari and İzmit remained flooded lowland sites.</td>
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<tr>
<td>24 November 1968</td>
<td>Sakarya River was increased.</td>
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<tr>
<td>02 July 1969</td>
<td>Pouring rain and strong wind, some neighborhoods in Adapazari was led electricity poles break and electricity discontinuation.</td>
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<tr>
<td>13 February 1970</td>
<td>Sakarya River was increased as a result of rain and snow melt.</td>
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<tr>
<td>18 April 1970</td>
<td>Sakarya River was increased, as a result of rain.</td>
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<tr>
<td>04 July 1972</td>
<td>Due to rain, the province of Sakarya was flooded.</td>
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<tr>
<td>07 September 1979</td>
<td>Due to rain, in Sakarya and around was flooded and in the Safi village of Geyve's was existed loss of lives.</td>
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<tr>
<td>02 March 1981</td>
<td>Due to intense rains, in Arifiye–Sapanca was landslide.</td>
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<tr>
<td>30 July 1984</td>
<td>Due to heavy rain, especially Yenidogan, Şeker, Semerciler, Yenigun and Yaşcilar neighborhoods of Adapazari covered with rainwater.</td>
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<tr>
<td>02 April 1999</td>
<td>Due to rainfall and snowmelt, Sakarya River was increased.</td>
</tr>
<tr>
<td>26 June 1999</td>
<td>Due to heavy rain, Adapazari city center was occurred lake.</td>
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</table>
Earthquakes was caused great devastation in Istanbul, city and castles was collapsed, in Trakya, İzmit and Karamürsel almost completely destroyed, except a single church was destroyed in Iznik. 64 castle and many cities was destroyed in Anatolia. Regions in the west of the Sakarya River, settlements was destroyed. This earthquake was the largest earthquake that occurred in the eastern Mediterranean. 4-5 thousand people died (Istanbul population at 160,000), many monumental buildings were destroyed or suffered damage. The 5 mosques and 300 houses was destroyed in İzmit city. During the earthquake continued throughout the 45 days, sections of the sea-shore of the city walls was collapsed. Ottoman historians of this earthquake, "little apocalypse" they said. Istanbul, İzmit and surroundings was been affected this earthquake. İzmit 4/5's destroyed, more than 4,000 people died. Tsunami was occurred during the earthquake, many mosques and the capital building was destroyed in Istanbul. Approximately 2.5 months after the 5 August 1766, has been again an earthquake. Both earthquakes affected eastern of Marmara Sea. Earthquake was increasing in intensity and lasted 80 sec. Then stopped suddenly this earthquake. People living in the earthquake said "passing through the courtyard and the garden to go to the shelter they had difficulty standing" and "we are just like the passengers on board a ship caught in a storm". Trees suspended from right to left more than half a meter. Sakarya river was increased and fields flooded water. Earthquake was been 7.2 magnitude. Earthquake was felt around the of Adapazari, Istanbul, Bolu, Eskişehir and Ankara. The earthquake was collapsed concrete buildings, wooden houses, was caused the opening of large fissures on roads, large landslides, was overthrown stone and trees. 89 people died in the earthquake and this earthquake is one of the most important disasters occurring in the Republican history. Gölçük-Arifiye focused on this earthquake was 7.4 magnitude, 45-50 sn long. The earthquake affected completely Marmara region. The earthquake occurred in the Marmara Region has the highest concentration of industry and urbanization, so was resulted in loss of life and the damage is too great. Loss of life has led to around 20 000. Between Highway Sapanca-Adapazari, in Anatolia was occurred part of the settlements, tensile cracks and failure, so it did not reach the earthquake area.

Conclusion

In this paper was described the creation of the Adapazari soils with the historical perspective. Soils of Adapazari city is on a very deep alluvial deposit. In history Adapazari city has always been affected by the earthquakes in the region due to the tectonic and soil properties of the region. Especially after 17 August 1999 Kocaeli earthquake, soil problems related to different soil types and foundation types have been observed. It is very important to learn the formation mechanism of the Adapazari soils in terms of understanding the geotechnical properties of the soils. It is thought the fact that Adapazari used to be wet, muddy, covered with forests and therefore not suitable for city accommodation should not be forgotten. Consequently, it is showed that Adapazari plain have different soil types, and it is understood that this like soils can show bad soil conditions in terms of building performance, especially during earthquake shaking. It is thought that this like research paper will be an important resource for alluvial sites which are on risk of the earthquake.
URAL: FORMATIONS TO GROUND FAILURE DURING EARTHQUAKE IN ADAPAZARI

695

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