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Geotechnical field investigation on giresun hazelnut licenced warehause and spot exchange

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Abstract. This paper describes a geotechnical field investigation in Giresun hazelnut licenced warehause and spot exchange during twelve months to determine the soil profile and static project applicability. It is also aimed to determine the superstructure loads and evaluate the relevance of foundation filling materials of the main, laboratory, package and admin buildings. The main building has 88.50×63.20 (5593.2) m^2 site area. It has a big raft foundation. Eleven geotechnical reports were prepared between 2 December 2014 and 25 May 2015. Maximum settlements and safe bearing capacities were calculated to decide to be able to proceed to the next step. Also, the detail observations and evaluations were presented from October 2014 to December 2014. It has been seen that the foundation is designed as a single foundation one. But, in the light of observations, it has been evaluated that the foundation project for package building is not adequate, and after these excavations it must be revised as a raft foundation. The thickness of foundation and structural details should be defined/drawn after analyzing the details by using a special software. Construction joints should be designed between different buildings interfaces to avoid damages and cracks with in different settlements. The environmental drainage must be projected and applied to avoid the probable damage of surface waters on foundations.

Keywords: environmental drainagel foundation; geotechnical field investigation; safe bearing capacities

1. Introduction

The foundations are always constructed below the ground level so as to increase the lateral stability of the structure and transfer the upper loads to soil. Different type of the foundation can be projected according to the soil parameters such as shallow (spread, strip, raft, etc.) and deep (pile, well, caisson, etc.). But, some differences can be attained after the static project during the construction in the field. So, before the construction of structures, the soil profile and parameters should be verified and the applicable revisions should be done in the foundation type.

Plate Load Test is a field test for determining the ultimate bearing capacity of soil and the likely settlement under a given load. This test basically consists of loading a steel plate placed at the foundation level and recording the settlements corresponding to each load increment. The test load is gradually increased till the plate starts to sink at a rapid rate. The total value of load on the plate

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in such a stage divided by the area of the steel plate gives the value of the ultimate bearing capacity of soil. The ultimate bearing capacity of soil is divided by suitable factor of safety (which varies from 2 to 3) to arrive at the value of safe bearing capacity of soil.

Many articles can be available in the literature about the field investigation of different type of foundation. Goktepe *et al*. (2008) studied about the Shear strength estimation of plastic clays with statistical and neural approaches. Gao *et al*. (2010) introduced a geotechnical investigation and tension-pile solution for foundation of SFT prototype at Qiandao Lake. Demiröz and Tan (2010) performed an experimental study for settlement of strip foundation on geogrid-reinforced sand. Altun *et al*. (2013) present a research related to load displacement relationship for a rigid circular foundation anchored by Mindlin solutions. Çakır (2014) display the influence of wall flexibility on dynamic response of cantilever retaining walls. Arasan *et al*. (2015) carried out the rapid stabilization of sands with deep mixing method using polyester. Yu *et al*. (2015) attained the field investigations of high stress soft surrounding rocks and deformation control. Evdokimov and Romanov (2015) studied about the investigation of soils in the Zhiguli Hydroelectric Station foundation contact area. Tajeri *et al*. (2015) aimed to present indirect estimation of the ultimate bearing capacity of shallow foundations resting on rock masses. It can be seen that there is not enough study about the field investigation of licenced warehause and spot exchange which have different type of foundation in each section.

For this purposes, in this paper, it is aimed to performed to a geotechnical field investigation in Giresun hazelnut licenced warehause and spot exchange during twelve months to determine the soil profile and static project applicability. Eleven geotechnical reports were prepared between 2 December 2014 and 25 May 2015. Maximum settlements and safe bearing capacities are calculated to decide to be able to proceed to the next step. And also, the detail observations and evaluations were presented from October 2014 to December 2014.

2. Static project detailing

In this part of the paper, it is aimed to present the superstructure loads, designing the criteria, assumptions, material properties, loads, and foundation properties of Giresun Hazelnut Licensed Buildings in Giresun, Turkey. The main building has 88.50×63.20 (5593.2) m^2 site area. It has a big raft foundation.

2.1 Designing the criteria and assumptions

Location:	Giresun, Turkey
Eathquake zone:	4
Soil Class:	Z3
Soil bearing capacity =	1.02 kg/cm^2
Dilatation:	No
Silo Pieces:	24

2.2 Materials

Compressive strength:	20 MPa
Modulus of elasticity:	28000 MPa
Weight per unit volume:	24N/m^2
Poisson's ratio:	0.2

2.3 Loads

2.3.1 Foundation self loads
Foundation self loads are calculated by automatically.

2.3.2 Foundation dead loads
Soil filling and ground slab are considered on the foundation.
$g = 1.35 \text{ m} \times 18 \text{ kN/m}^3 + 0.15 \text{ m} \times 24 \text{ kN/m}^3 = 27.9 \text{ kN/m}^2$

2.3.3 Foundation live loads
5 kN/m^2 live loads are considered on the ground floor.

2.3.4 Storage bunker loads
Storage bunkers heights are 10 m and stand on to the 20 pieces steel columns.

- Total Dead Loads of one empty bunker = 120 kN
- Total Live Loads of one bunker (material loads) = 7100 kN
- Total Loads for one bunker = 120 + 7100 = 7220 kN
- Column Loads = 7220/20 = 361 kN
- Silo earthquake loads (V_t) = W × 0.1 × 2.5 × 1.0/3 = 0.083W
- W = 120 + 0.8 × 7100 = 5800 kN (80% material filling)
- V_t = 0.083 × 5800 = 481.4 kN
- Approximate applied height (h) = 10 m
- Total moment at base (M) = 10 × 481.4 = 4814 kNm

2.3.5 Foundation properties
Foundation calculations were performed by the program.

- Soil spring: 10000 kN/m^3
- Net allowable bearing capacity of soil: 1.02 kg/cm^2

According to the superstructure loads given in above, the calculation of the raft foundation (displacements, stresses etc.) were determined with detail. It can be seen that raft foundation slab thickness (50 cm) is adequate.

3. Relevance of foundation filling materials

In this part of the report, it is aimed to evaluate the relevance of foundation filling materials. For this purpose, a soil survey report prepared by Usta Engineering Industry Trade Limited Company using field and laboratory studies and filling materials test results prepared by Jeomet Engineering Limited Company are attained. This part of the report is organized by using these documents.

Soil survey report prepared by Usta Engineering Industry Trade Limited Company between 03-09 July 2006 for Giresun Hazelnut Licenced Warehause and Spot Exchange are investigated. At the end of these investigations, it is seen that this report is prepared accordance with to the general format of soil and foundation report for buildings and building type structures (more information can be found in Ministry of Environment and Urbanization web site). The following observations can be made:

- Six different boreholes are opened at 65 m depth on the study area. Disturbed and undisturbed soil/ground samples are taken from the opened boreholes and necessary soil mechanics tests are conducted.
- According to the sounding profile, the foundation soil/ground is consist of 0-0.5 m vegetable soil layer and 0.5-10 m volcanic gravelly sandy and silty clay layer from top to bottom.
- SPT-N numbers are attained between 4 and 24 from the standard penetration tests. These impact numbers shows that foundation soil/ground layers are middle rigid.
- Groundwater level is found between 2.5 m and 3.5 m in the boreholes.
- Geotechnical tests are performed on the disturbed and undisturbed soil/ground samples. From these studies, it is observed that the foundation soil/ground consist of two different soil/ground namely as High Plasticity Clay and High Plasticity Silt.
- Site plan of the study area is given in Fig. 1. Allowable bearing capacity of A, B1 and B2 regions are determined as 92.1 kPa (0.921 kg/cm^2), 102.18 kPa (1.022 kg/cm^2) and 160 kPa (1.6 kg/cm^2) by Kaya Soil/Ground Engineering Limited Company, respectively. The detail information can be found in the report prepared by Usta Engineering Industry Trade Limited Company. According to the field investigations on the foundation excavation completed area, it can be evaluated that the soil/ground safety stress is acceptable.
- According to the Turkish Earthquake Resistant Design Code-2007 (TERDC 2007), the foundation soil/ground of B1 region corresponds to the soil group C and local soil class Z3.

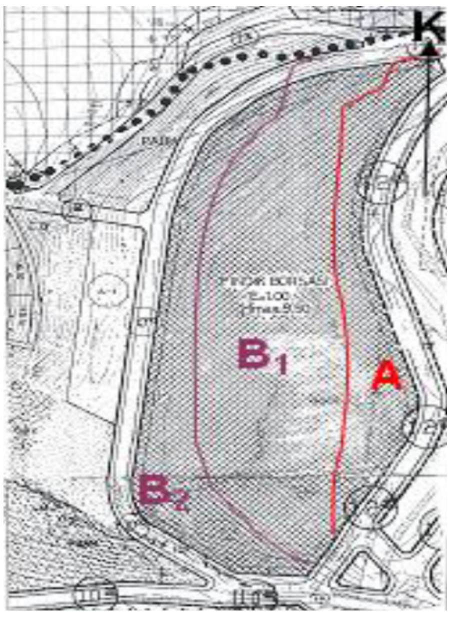

Fig. 1 Site plan of the study area

- When the soil survey report prepared by Usta Engineering Industry Trade Limited Company is investigated, it is specified that high plasticity soil layers should be removed and filling with 1.5 m depth should be done. According to the field investigations on the foundation excavation completed area, it can be evaluated that the thickness of filling layers is acceptable.
- According to the Turkish Earthquake Resistant Design Code-2007 (6.2.2. Investigation of Liquefaction Potential), in all seismic zones, it is mandatory to investigate whether the liquefaction potential exists in Group (D) soils according to Table 6.1, by using appropriate analysis methods based on in-situ and laboratory tests in the cases the ground water level is less than 10 m from the soil surface and to document these results. The investigated region corresponds to the soil group C and local soil class Z3. So, liquefaction potential analyses cannot perform.

The experimental studies are conducted by Kaya Soil/Ground Engineering Limited Company to determine the mechanical properties of filling material. The attained properties are given with detail in technical report prepared by Jeomet Engineering Limited Company on October 2014. The report is investigated by us and following observations can be made:

- The soil/ground, which will be used for filling materials, is determined as non-plastic.
- Two different filling materials and their test results are given in the report. The detail investigations are carried out by us and using of A-1-a type filling materials is suggested considering Highway Classification System (AASHTO).
- When the magnesium sulfate and compaction tests of suggested filling material are examined, it is seen that magnesium sulfate, maximum dry unit weight and optimum water content are obtained as 3.9%, 21 kN/m^3 and 4.72%, respectively. It is seen that the values between the limits specified in the standards.
- The application of foundation filling must be controlled on field/study area at each layer step (25 cm, 50 cm, 75 cm, 1 m, 1.3 m and 1.5 m) by the reporter/researcher/us. The plate loading tests must be conducted at the end of the some layer (50 cm, 1 m, 1.3 m and 1.5 m) to avoid the probability of error at all study area. The last 20cm between 1.30 m and 1.50 m layer should be created using stabilizing materials.
- The plate loading tests should be conducted once on each 500 m^2 for the silo and 3 tests for the admin building. Also, these tests should be done once on each 1000 m^2 for the rest.
- To interpret the plate loading tests results, the settlement-load graphic should be drawn and the ultimate bearing capacity should be determined. The safe bearing capacity can be calculated using a factor of safety of 3. The allowable bearing capacity should be checked against the building/structural loads.
- The drainage system around the excavation should be done to protect the foundation soil.

4. Geotechnical test results for main, laboratory, package and adbin Buildings

In this part of the paper, it is aimed to determine the safe bearing capacity of foundation (main building, laboratory building, package building and admin building) in each filling layer and evaluate the ability of proceeding to the next step.

Table 1 Report No: 1 / 2 December 2014 / Admin Building (0-50 cm)

Test date	27 November 2014		
Number of tests	3		
Parameters	Test-1	Test-2	Test-3
Load (kN)	0-175	0-175	0-175
Maximum stress (MN/m^2)	0.618	0.618	0.618
Maximum settlement (mm)	6.703	6.463	5.720
Plate width	60 cm	60 cm	60 cm
Safety factor	2.5	2.5	2.5
Safe bearing capacity (kg/cm^2)	1.80	1.87	2.00

Table 2 Report No: 2 / 8 December 2014 / Admin Building (50-100 cm)

Test date	4 December 2014		
Number of tests	3		
Parameters	Test-1	Test-2	Test-3
Load (kN)	0-175	0-175	0-175
Maximum stress (MN/m^2)	0.618	0.616	0.618
Maximum settlement (mm)	2.780	3.713	2.710
Plate width	60 cm	60 cm	60 cm
Safety factor	3.0	3.0	3.0
Safe bearing capacity (kg/cm^2)	2.08	2.22	2.22

Table 3 Report No: 3 / 17 December 2014 / Admin Building (100-130 cm / 130-145 cm)

Test date	8 and 10 December 2014		
Number of tests	3		
Parameters	Test-1	Test-2	Test-3
Load (kN)	0-175	0-175	0-175
Maximum stress (MN/m^2)	0.618	0.618	0.618
Maximum settlement (mm)	2.583	3.537	3.003
Maximum settlement (mm)	4.167	2.327	2.327
Plate width	60 cm	60 cm	60 cm
Safety factor	3.0	3.0	3.0
Safe bearing capacity (kg/cm^2)	2.39	2.28	1.94
Safe bearing capacity (kg/cm^2)	2.06	1.81	2.36

4.4 Observation and evaluation report from October 2014 to December 2014

4.4.1 Field observations on October 2014

The first field investigations were carried out in the study area on October 2014. All the

(a) Admin building

(b) Main building

(c) Laboratory building

(d) Package building

Fig. 2 Some views from the investigation in the field area on October 2014

Fig. 3 Some views from the investigation at the field area on November 2014

4.4.2 Field observations on November 2014

The second field investigations were carried out in studying area on November 2014. All commissioned persons were attended during the field investigations and exchanged the ideas. The following observations are obtained as:

- Admin building: The excavation is fully completed. All the filling layers are done and the plate loading tests are conducted.
- Main building: The excavation is continuing. But, the soft soil is determined at the some edge part of the main building. This region is located on the interface/border of the with package building. So, the next investigation is planned with all commissioned persons after 1-2 m excavation on this area (soft soil).
- Laboratory building: The excavation is continuing
- Package building: During the excavation, soft soil is determined. After the initial observational investigation in the field studying area, it is thought that the soft soil is located nearly about 5 m. So, the next investigation is planned with all commissioned persons after 2-3 m excavation on this area (soft soil).

Some views from the investigation on the field area are given in Fig. 3.

4.4.3 Field observations on December 2014

The third field investigations were carried out in studying area on December 2014. All the commissioned persons were attended the field investigations and exchanged the ideas. The following observations are obtained as:

- Admin building: The excavation is fully completed. All filling layer are done and plate loading tests are conducted. Blinding concrete (10 cm) is poured according to the static project drawing. The preparation for raft foundation construction is continuing.
- Main building: The excavation is continuing. The detail information is given below.
- Laboratory building: The excavation is fully completed. The detail information is given below.
- Package building: The excavation is continuing. The detail information is given below.

It is observed from the investigation that the excavation is fully completed on laboratory building. The first filling layer between 0-50 cm is done at some places and plate loading tests are conducted. In the superstructure loads and filling materials of foundation technical report were prepared on 3 December 2014, it is stated that *"The plate loading tests should be conducted once on each 500 m^2 for the silo and 3 tests for the admin building. Also, these tests should be done once on each 1000 m^2 for the rest."* It is seen that the values of safe bearing capacities are suitable to proceed to the next steps. But, the number of the conducted plate loading tests are not adequate compared with the technical report.

Some views from the investigation on field area (laboratory building) are given in Fig. 4. According to the plate loading tests results, the observation report was prepared on 13 January 2015 to determine the safe bearing capacity of foundation in the first filling layer and evaluate the ability of proceeding to the next step. Also, the report was prepared again for each filling layer (laboratory building, 50-100 cm, 100-130 cm and 130-150 cm) on 13 January 2015.

Fig. 4 Some views from the investigation in the field area for the laboratory building in December 2014

Fig. 5 Some views from the first filling layer between 0-50 cm in the main building

Fig. 6 Some views from the soft soil regions (front end) of the main buildings

It is observed from the investigation that the excavation is continuing in the main building. The first filling layer between 0-50 cm is done in some places and plate loading tests are conducted (Fig. 5). In the superstructure loads and filling materials of foundation technical report, prepared on 3 December 2014, it is stated that *"The plate loading tests should be conducted once on each 500 m^2 for the silo and 3 tests for the admin building. Also, these tests should be done once on each 1000 m^2 for the rest."* It is seen that the values of safe bearing capacities are suitable to proceed to the next steps. But, the number of the conducted plate loading tests are not adequate compared with the technical report.

It is observed from the investigation that some places (front end) of the main buildings have a soft soil (Fig. 6). The detail investigations are carried out with all commissioned persons and it is suggested to ensure the 50 cm support layer under 1.50 m filling layers by using of well-graded rock fill material (with a variable size distribution with a maximum rock size of 50 cm) is suggested to ensure the 50 cm support layer under 1.50 m filling layers. Before the application, the drainage system around the excavation should be done to protect the foundation soil.

At the end of the observations, soft soil is determined at the some edge part of the main building. This region is located on the border with the package building (Fig. 7). The detail investigations are carried out with all the commissioned persons and 2.0-2.5 m excavation (this value is determined in field, observationally and can change during operation) is suggested to obtain for the sufficient foundation soil. In this region, the using of the well-graded rock fill material (with a variable size distribution with a maximum rock size of 50 cm) is suggested to ensure the 2.0-2.5 m support layer under the 1.50 m filling layers. Before the application, the drainage system around the excavation should be done to protect the foundation soil.

Fig. 7 Some views from the soft soil at the some edge part of the main building which is located on the border with the package building

At the end of the investigation, it is seen that the package building region has a soft soil (Fig. 8). The sinking is observed during excavation by dipper dredger in the studying area (the package building). The detail investigations are carried out with all commissioned persons and 2.0-2.5 m excavation (same to soft soil of main building remarked at previous pages) is suggested to obtain

Fig. 8 Some views from the soft soil at package building

Table 4 Report No: 4 / 13 January 2015 / Laboratory Building (0-145 cm)

Test date	16 December 2014			
Elevation/level	93.07 m, 93.02 m, 93.05 m, 93.08 m			
Number of tests	4/4/3/4			
Parameters	Test-1	Test-2	Test-3	Test-4
Load (kN)	0-175	0-175	0-175	0-175
Maximum stress (MN/m^2)	0.618	0.618	0.618	0.618
Maximum settlement (mm)	4.253	3.757	2.870	2.673
Maximum settlement (mm)	3.017	4.667	6.033	2.793
Maximum settlement (mm)	2.330	2.740	2.790	------
Maximum settlement (mm)	2.560	2.077	3.280	2.117
Plate width	60 cm	60 cm	60 cm	60 cm
Safety factor	3.0	3.0	3.0	3.0
Safe bearing capacity (kg/cm^2)	2.07	2.00	2.64	2.56
Safe bearing capacity (kg/cm^2)	2.17	2.39	2.28	2.64
Safe bearing capacity (kg/cm^2)	2.78	2.44	2.50	------
Safe bearing capacity (kg/cm^2)	2.92	2.86	2.50	2.64

more sufficient foundation soil. Also, filling of the well-graded rock fill material is suggested under this 2.0-2.5 m excavation (nearly 3.0-4.0 m) to interlock the movements. In this application, it is aimed to ensure the sufficient support layers under 1.50 m filling layers. Before the

Table 5 Report No: 5 / 23 March 2015 / Main Building (0-50 cm)

Test date	24 February 2015	
Elevation/level	94.07 m, 94.07 m	
Number of tests	2	
Parameters	Test-1	Test-2
Load (kN)	0-175	0-175
Maximum stress (MN/m^2)	0.618	0.618
Maximum settlement (mm)	3.080	2.573
Plate width	60 cm	60 cm
Safety factor	3.0	3.0
Safe bearing capacity (kg/cm^2)	2.06	1.94

Table 6 Report No: 6 / 23 March 2015 / Package Building (0-5 0 cm)

Test date	03 March 2015							
Elevation/level	93.05 m, 93.07 m, 93.06 m, 93.06 m, 93.08 m, 93.06 m, 93.07 m, 93.07 m							
Number of tests	8							
Parameters	Test-1	Test-2	Test-3	Test-4	Test-5	Test-6	Test-7	Test-8
Load (kN)	0-175	0-175	0-175	0-175	0-175	0-175	0-175	0-175
Maximum stress (MN/m^2)	0.618	0.618	0.618	0.618	0.618	0.618	0.618	0.618
Maximum settlement (mm)	1.820	2.833	3.127	2.353	2.000	4.717	1.633	2.360
Plate width	60 cm	60 cm	60 cm	60 cm	60 cm	60 cm	60 cm	60 cm
Safety factor	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Safe bearing capacity (kg/cm^2)	2.92	2.11	2.33	2.50	2.22	2.17	2.22	3.06

Table 7 Report No: 7 / 23 March 2015 / Main Building (50-100 cm)

Test date	07 March 2015			
Elevation/level	93.55 m, 93.58 m, 93.58 m, 93.57 m			
Number of tests	4			
Parameters	Test-1	Test-2	Test-3	Test-4
Load (kN)	0-175	0-175	0-175	0-175
Maximum stress (MN/m^2)	0.618	0.618	0.618	0.618
Maximum settlement (mm)	2.010	2.543	4.667	2.440
Plate width	60 cm	60 cm	60 cm	60 cm
Safety factor	3.0	3.0	3.0	3.0
Safe bearing capacity (kg/cm^2)	2.67	2.33	2.06	2.78

application, the drainage system around the excavation should be done to protect the foundation soil.

According to the static project drawings of the package building, it is seen that the foundation is designed as a single foundation. But, in the light of the observations, it is evaluated that the

Table 8 Report No: 8 / 25 May 2015 / Laboratory Building (50-100 cm)

Test date	10 March 2015	
Elevation/level	93.56 m, 93.58 m	
Number of tests	2	
Parameters	Test-1	Test-2
Load (kN)	0-175	0-175
Maximum stress (MN/m^2)	0.618	0.618
Maximum settlement (mm)	1.600	2.060
Plate width	60 cm	60 cm
Safety factor	3.0	3.0
Safe bearing capacity (kg/cm^2)	2.78	2.25

Table 9 Report No: 9 / 25 May 2015 / Main Building (100-130 cm)

Test date	10 March 2015			
Elevation/level	93.86 m, 93.87 m, 93.87 m, 93.88 m			
Number of tests	4			
Parameters	Test-1	Test-2	Test-3	Test-4
Load (kN)	0-175	0-175	0-175	0-175
Maximum stress (MN/m^2)	0.618	0.618	0.618	0.618
Maximum settlement (mm)	1.523	2.087	2.363	3.420
Plate width	60 cm	60 cm	60 cm	60 cm
Safety factor	3.0	3.0	3.0	3.0
Safe bearing capacity (kg/cm^2)	2.50	2.31	2.47	2.36

Table 10 Report No: 10 / 25 May 2015 / Main Building (130-145 cm)

Test date	26 March 2015			
Elevation/level	94.06 m, 94.06 m, 94.07 m, 94.07 m			
Number of tests	4			
Parameters	Test-1	Test-2	Test-3	Test-4
Load (kN)	0-175	0-175	0-175	0-175
Maximum stress (MN/m^2)	0.618	0.618	0.618	0.618
Maximum settlement (mm)	2.590	1.593	2.047	1.303
Plate width	60 cm	60 cm	60 cm	60 cm
Safety factor	3.0	3.0	3.0	3.0
Safe bearing capacity (kg/cm^2)	2.64	2.89	2.50	2.56

foundation project for the package building is not adequate after these excavations and it must be revised as a raft foundation. The thickness of the foundation and structural details (reinforced details, concrete details etc…) should be defined/drawn after analyzing the details by using a special software. Also, construction joint should be designed between different buildings interfaces such as the package, main and laboratory buildings to avoid damages and cracks in different settlements. The views of the package buildings (soft soil) are shown in Fig. 8. In these figures, the soft soil regions can be easily seen.

5. Conclusions

In this report, it is aimed to determine the superstructure loads and evaluate the relevance of the foundation filling materials of the main building which is the part of warehouse building to be constructed as a component of the Giresun Hazelnut Licensed Buildings at Giresun, Turkey. The following observations can be made:

- According to the superstructure loads, the calculation of the raft foundation (displacements, stresses etc.) are determined with detail. It can be seen that raft foundation slab thickness (50 cm) is adequate.
- The detail investigations are carried out and using of well-graded rock fill material (with a variable size distribution with a maximum rock size of 25 cm) is suggested to ensure the distribution harmony. The filling material should be laid as 25 cm layers and compacted using a vibratory smooth roller. Also, maximum grain size should be chosen in proportion as 2/3 of each layer for filling materials under foundation.
- The identified groundwater level is located at the creek (in the east of the project area) altitude. This altitude will be located under 1 m from the bottom point of 1.5 m filling layers.
- The foundation should be constructed as a raft foundation using bundling method.
- In the whole project area, the environment drainage must be projected and applied to avoid the probable damage of surface waters on foundations.
- The project area is located on the third earthquake region.
- Effective ground acceleration coefficient, site classes and spectrum characteristic periods can be chosen as A_o = 0.2, Z3, T_A = 0.15s, T_B = 0.60s, respectively.
- The application of the foundation filling must be controlled on field/study area at the each layer step (25 cm, 50 cm, 75 cm, 1 m, 1.3 m and 1.5 m) by the reporter/researcher/us. The plate loading tests must be conducted at the end of the some layer (50 cm, 1 m, 1.3 m and 1.5 m) to avoid the probability of an error in the whole studying area. The last 20 cm between 1.30 m and 1.50 m layer should be created by using stabilizing materials.
- The plate loading tests should be conducted once on each 500 m^2 for the silo and 3 tests for the admin building. Also, these tests should be done once on each 1000 m^2 for the rest.
- To interpret the plate loading tests results, the settlement-load graphic should be drawn and the ultimate bearing capacity should be determined. The safe bearing capacity can be calculated using a factor of the safety of 3. The allowable bearing capacity should be checked against the building/structural loads.
- The drainage system around the excavation should be done to protect the foundation soil.

Field observations on October 2014

- The excavation is fully completed in the admin building. The first filling layer between 0-50 cm is done and three plate loading tests are conducted.
- The excavation is continuing in the main, laboratory and package buildings.

Field observations on November 2014

- The excavation is fully completed in the admin building. All filling layer are done and plate loading tests are conducted.
- The excavation is continuing in the main and laboratory buildings. But, the soft soil is determined at the some edge part of the main building. This region is located on the interface/border of the package building.
- During the excavation, soft soil is determined in the package building. After the initial observational investigation in the field studying area, it is thought that the soft soil is located nearly about 5 m.

Field observations on December 2014

- The excavation is fully completed. All the filling layers are done and plate loading tests are conducted. Blinding concrete (10 cm) is poured according to the static project drawing. The preparation for raft foundation construction is continuing.
- It is observed from the investigation that the excavation is fully completed on the laboratory building. The first filling layer between 0-50 cm is done at some places and the plate loading tests are conducted. It is seen from the test results that the values of the safe bearing capacities are suitable to proceed to the next steps. But, the number of the conducted plate loading tests is not adequate comparing with the technical report.
- It is observed from the investigation that the excavation is continuing in the main building. The first filling layer between 0-50 cm is done in some places and the plate loading tests are conducted. It is seen from the test results that the values of the safe bearing capacities are suitable to proceed to the next steps. But, the number of the conducted plate loading tests is not adequate comparing with the technical report.
- It is observed from the investigation that some places (front end) of the main buildings have a soft soil. Using the well-graded rock filling material (with a variable size distribution with a maximum rock size of 50 cm) is suggested to ensure the 50 cm support layer under 1.50 m filling layers.
- At the end of the observations, soft soil is determined at the some edge part of the main building. This region is located on the border of the package building. The 2.0-2.5 m excavation (this value is determined in field, observationally and can change during operation) is suggested to obtain the sufficient foundation soil. In this region, the using of well-graded rock filling material (with a variable size distribution with a maximum rock size of 50 cm) is suggested to ensure the 2.0-2.5 m support layer under 1.50 m filling layers.
- At the end of the investigation, it is seen that the package building region has a soft soil. The sinking is observed during excavation by dipper dredger in the studying area (package building). The 2.0-2.5 m excavation (same to soft soil of main building remarked at previous pages) is suggested to obtain more sufficient foundation soil. Also, filling of the well-graded rock filling material is suggested under this 2.0-2.5 m excavation (nearly 3.0-4.0 m) to interlock the movements. In this application, it is aimed to ensure the sufficient

support layers under 1.50 m filling layers.

- According to the static project drawings of the package building, it is seen that the foundation is designed as a single foundation. But, in the light of observations, it is evaluated that the foundation project for the package building is not adequate after these excavations and it must be revised as a raft foundation.

At the end of the paper, the following suggestions can be defined as:

- The thickness of the foundation and structural details (reinforced details, concrete details etc…) should be defined/drawn after detailing the analyses by using a special software.
- Construction joints should be designed between different buildings interfaces such as the package, main and laboratory buildings to avoid damages and cracks in different settlements.
- In all project area, the environment drainage must be projected and applied to avoid the probable damage of the surface waters on the foundations.

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