

..... FIELD
SOIL AND FOUNDATION SURVEY GEOTECHNICAL
REPORT ON A PARCEL BASIS

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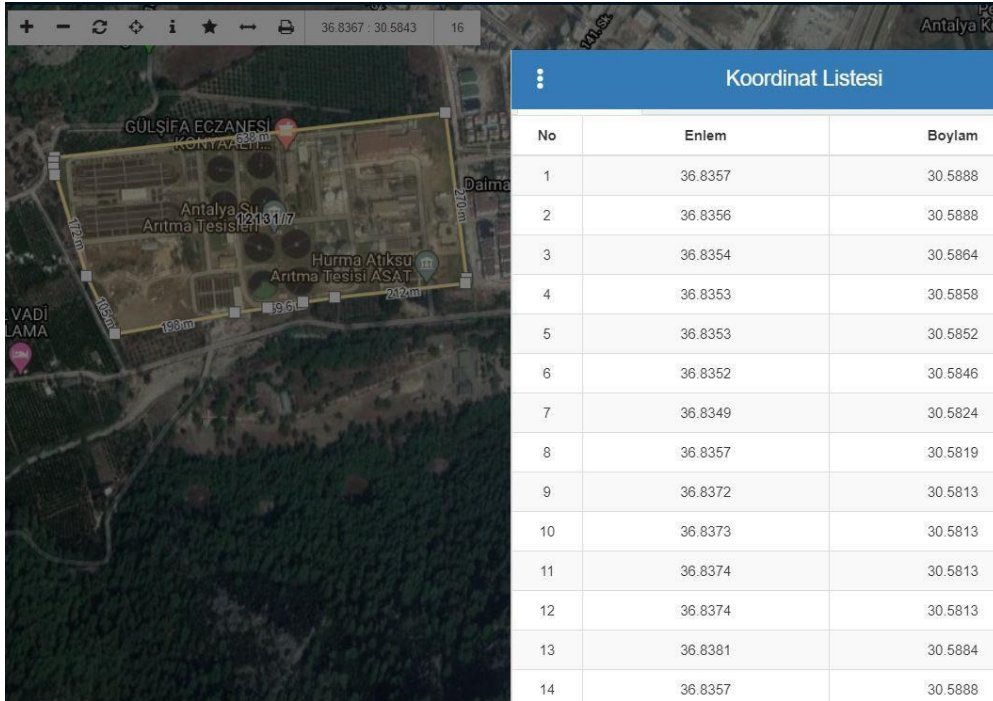
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1 INTRODUCTION

In the sludge incineration unit planned to be built on the land in 12131 lot 7 parcel within the borders of Hurma Neighborhood, Konyaaltı District, Antalya Province; The necessary examination and calculations were made for the product acceptance unit with a total construction area of 1000 m², approximately 20x50m, a turbine building with a total construction area of 300 m², approximately 40x50m, a combustion boiler unit with a total construction area of 2000 m², approximately 15x35m, and a laboratory-administrative building with a total construction area of 500 m², and a geotechnical report was prepared in accordance with the Turkish Building Earthquake Regulation 2018. In the report, the data report prepared by Toros Geotechnical Engineering Ltd. Co. and the laboratory study results prepared by Zemin Engineering Ltd. Co. were used.

2 INFORMATION ABOUT THE CONSTRUCTION SITE

The parcel subject to investigation is located in Hurma District of Konyaaltı District. It has a flat topography. There are 1-10 storey buildings of residential and commercial in the region. The parcel has an area of 174658 m².



3 INFORMATION ABOUT THE STRUCTURE

According to the information given by the relevant administration in the sludge incineration unit planned to be built in the parcel; It is planned to construct a product acceptance unit with a total construction area of 1000 m² with dimensions of approximately 20x50m, a turbine building with a total construction area of 300 m² with dimensions of approximately 20x15m, a combustion boiler unit with a total construction area of 2000 m² with dimensions of approximately 40x50m, and a laboratory-administrative building with a total construction area of 500 m² with dimensions of approximately 15x35m. Since the static preliminary calculations of the relevant structures have not been made yet, the building loads coming to the foundation, the foundation dimensions and the necessary information about the buildings are calculated according to the data given by the relevant administration and the preliminary assumptions made by us and taken into account in the report.

Tablo 3.1 – Bina Kullanım Sınıfları ve Bina Önem Katsayıları

Bina Kullanım Sınıfı	Binanın Kullanım Amacı	Bina Önem Katsayısı (I)
BKS = 1	Deprem sonrası kullanımı gereken binalar, insanların uzun süreli ve yoğun olarak bulunduğu binalar, değerli eşyanın saklandığı binalar ve tehlikeli madde içeren binalar a) Deprem sonrasında hemen kullanılması gerekli binalar (Hastaneler, dispanserler, sağlık ocakları, itfaiye bina ve tesisleri, PTT ve diğer haberleşme tesisleri, ulaşım istasyonları ve terminaleri, enerji üretim ve dağıtım tesisleri, vilayet, kaymakamlık ve belediye yönetim binaları, ilk yardım ve afet planlama istasyonları) b) Okullar, diğer eğitim bina ve tesisleri, yurt ve yatakhaneler, askeri kışlalar, cezaevleri, vb. c) Müzeler d) Toksik, patlayıcı, parlayıcı, vb. özellikleri olan maddelerin bulunduğu veya depolandığı binalar	1.5
BKS = 2	İnsanların kısa süreli ve yoğun olarak bulunduğu binalar Alışveriş merkezleri, spor tesisleri, sinema, tiyatro, konser salonları, ibadethaneler, vb.	1.2
BKS = 3	Diğer binalar BKS=1 ve BKS=2 için verilen tanımlara girmeyen diğer binalar (Konutlar, işyerleri, oteller, bina türü)	1.0

Tablo 3.3 – Bina Yükseklik Sınıfları ve Deprem Tasarım Sınıflarına Göre Tanımlanan Bina Yükseklik Aralıkları

Bina Yükseklik Sınıfı	Bina Yükseklik Sınıfları ve Deprem Tasarım Sınıflarına Göre Tanımlanan Bina Yükseklik Aralıkları [m]		
	DTS = 1, 1a, 2, 2a	DTS = 3, 3a	DTS = 4, 4a
BYS = 1	$H_N > 70$	$H_N > 91$	$H_N > 105$
BYS = 2	$56 < H_N \leq 70$	$70 < H_N \leq 91$	$91 < H_N \leq 105$
BYS = 3	$42 < H_N \leq 56$	$56 < H_N \leq 70$	$56 < H_N \leq 91$
BYS = 4	$28 < H_N \leq 42$	$42 < H_N \leq 56$	
BYS = 5	$17.5 < H_N \leq 28$	$28 < H_N \leq 42$	
BYS = 6	$10.5 < H_N \leq 17.5$	$17.5 < H_N \leq 28$	
BYS = 7	$7 < H_N \leq 10.5$	$10.5 < H_N \leq 17.5$	
BYS = 8	$H_N \leq 7$	$H_N \leq 10.5$	

The building usage class is BKS=1, the building importance coefficient is $I=1.5$ and the $BYS=8$.

Tablo 3.2 – Deprem Tasarım Sınıfları (DTS)

DD-2 Deprem Yer Hareketi Düzeyinde Kısa Periyot Tasarım Spektral İvme Katsayısı (S_{DS})	Bina Kullanım Sınıfı	
	BKS = 1	BKS = 2, 3
$S_{DS} < 0.33$	DTS = 4a	DTS = 4
$0.33 \leq S_{DS} < 0.50$	DTS = 3a	DTS = 3
$0.50 \leq S_{DS} < 0.75$	DTS = 2a	DTS = 2
$0.75 \leq S_{DS}$	DTS = 1a	DTS = 1

$SDS=0.910$ was taken from <https://tdth.afad.gov.tr> according to the building coordinates and accordingly, the Earthquake Design Class is $DTS=1a$.

4 CURRENT SOIL SURVEYS

Soil and Foundation Survey category is 2. Within the scope of the current "Soil and Foundation Survey Data Report", 1 36m, 1 27m, 3 39m deep ground drilling was carried out in the field, and SPT tests were carried out during the drilling phase. The ground is generally clay in character. There is a partial filling material up to about 3m. The local ground class is ZE.

5 ADDITIONAL GROUND SURVEYS

No additional ground survey has been carried out on the parcel.

6 IDEALIZED SOIL PROFILES (LAND SOIL MODEL) AND GROUNDWATER CONDITIONS

According to the studies carried out in the field and in the laboratory, the ground is generally clay. The local ground class is ZE. The layers detected in the ground along the drilling depth are shown in the Table below.

DRILLING NO	DEPTH (m)	LITHOLOGY	FORMATION
SK-1	0.00-2.50	Brown Silty Sand	Alluvial Qal
	2.50-7.00	Brown, silty sandy clay	
	7.00-33.00	Grey Silty Clay	
	33.00-36.00	Clay filled with limestone fragments Slope Debris	
SK-2	0.00-4.00	Brown low sand pebbly Clay Unit	Alluvial Qal
	4.00-6.00	Brown, gravelly clayey sand	
	6.00-22.00	Grey Silty Clay	
	22.00-27.00	Brown little gravelly sandy clay	
SK-3	0.00-4.00	Brown Less Gravel Clay Unit	Alluvial Qal
	4.00-7.00	Brown Sand Unit	
	7.00-30.00	Grey Silty Clay	
	30.00-31.50	Grabbly clay of gray color	
	31.50-39.00	Brown coarse limestone Blocky clay-filled hillside rubble	
SK-4	0.00-2.50	Filling Material	Alluvial Qal
	2.50-4.00	Brown Clay	
	4.00-6.00	Brown clay, sand unit	
	6.00-27.00	Grey Silty Clay	
	27.50-30.50	Grey coloured Clay with little gravel	
	30.50-39.00	Beige colored, with Clay Bands in places Limestone	Jkt-Tekedag fm.
SK-5	0.00-0.50	Filling Material	Alluvial Qal
	0.50-3.00	Brown Clay	
	3.00-5.50	Brown pebbly sand	
	5.50-7.00	Grey sandy, silty clay Unit	
	7.00-21.00	Grey Silty Clay	
	21.00-23.00	Grey-coloured, gravelly Clay Unit	
	23.00-28.00	Brown limestone fragmented clay Unit	
	28.00-37.50	Brown little gravelly sandy clay unit	
	37.50-39.00	Beige colored, with Clay Bands in places Limestone	Jkt-Tekedag fm.

According to the Soil Survey Report, **groundwater was found in approximately 3m in the boreholes drilled in the study area.** No rivers or similar active water structures have been detected above ground. In order to prevent rainwater and groundwater from damaging the structure and the foundation of the building, the existing groundwater level should be controlled by carrying out the necessary **waterproofing and drainage works.**

According to the soil survey report, the variable layers and/or discontinuities in the foundation soil within the effective depth of the foundation are shown in the Table above.

Yerel Zemin Sınıfları

Yerel Zemin Sınıfı	Zemin Cinsi	Üst 30 metrede ortalama		
		$(V_s)_{30}$ [m/s]	$(N_{60})_{30}$ [darbe/30 cm]	$(C_u)_{30}$ [kPa]
ZA	Sağlam, sert kayalar	> 1500	-	-
ZB	Az ayrılmış, orta sağlam kayalar	760 - 1500	-	-
ZC	Çok sıkı kum, çakıl ve sert kil tabakaları veya ayrılmış, çok çatlaklı zayıf kayalar	360 - 760	> 50	> 250
ZD	Orta sıkı - sıkı kum, çakıl veya çok katı kil tabakaları	180 - 360	15 - 50	70 - 250
ZE	Gevşek kum, çakıl veya yumuşak - katı kil tabakaları veya $PI > 20$ ve $w > \% 40$ koşullarını sağlayan toplamda 3 metreden daha kalın yumuşak kil tabakası ($C_u < 25$ kPa) içeren profiller	< 180	< 15	< 70
ZF	Sahaya özel araştırma ve değerlendirme gerektiren zeminler : 1) Deprem etkisi altında çökme ve potansiyel göçme riskine sahip zeminler (sıvılaşabilir zeminler, yüksek derecede hassas kiler, göçebilir zayıf çimentolu zeminler vb.), 2) Toplam kalınlığı 3 metreden fazla turba ve/veya organik içeriği yüksek kiler, 3) Toplam kalınlığı 8 metreden fazla olan yüksek plastisiteli ($PI > 50$) kiler , 4) Çok kalın (> 35 m) yumuşak veya orta katı kiler.			

7 DETERMINATION OF GEOTECHNICAL DESIGN PARAMETERS

The soil parameters to be used in the calculations were determined according to the relevant drilling studies, SPT experiments and laboratory results.

8 SEISMICITY

Data on earthquake ground movement determined on the basis [of the Turkey Earthquake Hazard Map \(https://tdth.afad.gov.tr\)](https://tdth.afad.gov.tr) of the study area;

$S_s=0.578$, $S_1=0.156$ $S_{DS}=0.910$ $S_{D1}=0.577$, horizontal design spectrum corner periods T_A and T_B ;

$$T_A = 0.2 \frac{S_{D1}}{S_{DS}} \quad ; \quad T_B = \frac{S_{D1}}{S_{DS}}$$

$$T_A= 0.127, T_B= 0.633$$

Assessment of liquefaction potential in the ground

According to the Turkish Building Earthquake Code (2018) Section 16.6;

For buildings with Earthquake Design Class DTS=1, DTS=1a, DTS=2 and DTS=2a according to Section 3, it is obligatory to examine whether there is a liquefaction potential in sandy soils that fall into the ZD, ZE or ZF group in Table 16.1, which are in the form of a continuous layer or thick lenses, except for the cases defined in 16.6.6 , with appropriate analysis methods based on field and laboratory experiments, and to report the analysis results in detail. Soil liquefaction is defined as a significant decrease in shear strength and rigidity of non-cohesive or low cohesive ($PI < 12\%$) soils located below the groundwater level and up to 20 m from the surface under earthquake shaking in parallel with the increase in cavity water pressure. Potentially liquefiable soils have been defined as sand, gravelly sand, silty clayey sand, non-plastic silt, and silt-sand mixtures located below the groundwater table.

Although the soil class is ZE, no liquefaction risk has been detected since the conditions are not met ($PI < 12\%$) in the relevant substances described above.

9 EXAMINATION OF BUILDING-GROUND INTERACTION

9.1 Geotechnical Analysis and Evaluations of the Foundation System

9.1.1 Superficial Basics

a) Bearing Strength Analysis

According to Article 16.8.3.2 of the Turkish Building Earthquake Code (2018), the characteristic strength of the foundation bearing capacity q_k will be calculated according to Equation 16.8a:

$$q_k = c N_c s_c d_c i_c g_c b_c + q N_q s_q d_q i_q g_q b_q + 0.5 \gamma B' N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$$

The bearing power coefficients contained in Equation 16.8a will be calculated according to Equation 16.8b:

$$N_q = e^{\pi \tan \phi'} \tan^2 (45 + \phi' / 2) \quad ; \quad N_c = (N_q - 1) \cot \phi' \quad ; \quad N_\gamma = 2 (N_q - 1) \tan \phi'$$

The foundation shape coefficients (s), depth coefficients (d), loading tilt coefficients (i), foundation soil slope coefficients (g), foundation base slope coefficients (b), which are included as dimensionless correction coefficients in equation 16.8a, will be calculated using generally accepted relations based on the literature.

$\Phi'=0^\circ$ $N_q=1$ $N_\gamma=0$ has been calculated as. $N_c=5.10$ (Figure 1)

The coefficients of loading slope correction, ground slope correction, basic base slope correction are calculated in common for all buildings :

Loading skew correction coefficients:

$$I_c = I_q = \left(1 - \frac{\beta^2}{90}\right) \quad i_\gamma = 0 \quad (\text{For } \Phi'=0^\circ) \quad \text{Hanna and Meyerhof (1981)}$$

$$i_c = i_q = 1 \quad i_\gamma = 1$$

Ground slope correction coefficient:

$$g_c = 1 - \left(\frac{2i}{\pi+2}\right) \quad g_q = g_\gamma = \frac{(1 - \text{diagnosis})^2}{\text{Meyerhof (1981)}} \quad (\text{For } \Phi'=0^\circ) \quad \text{Hanna and}$$

$$g_c = 1 \quad g_q = g_\gamma = 1$$

Basic base slope correction coefficient:

$$B_c = 1 - \left(\frac{2\alpha}{\pi+2}\right) \quad b_q = b_\gamma = (1 - \alpha \tan \phi')^2 \quad (\text{For } \Phi'=0^\circ) \quad \text{Vesic (1975)}$$

$$b_c = 1 \quad b_q = b_\gamma = 1$$

The coefficients for correcting the foundation shape and correcting the foundation depth are calculated separately for each building :

ADMINISTRATIVE BUILDING - LABORATORY:

B=15m L=35m Df=3m $\Phi'=0^\circ$ c=54 kN/m²

The coefficients for correcting the basic shape are:

$$s_c = 1 + 0.2 \frac{B}{L} \quad s_q = 1 \quad s_\gamma = 1 \quad (\text{For } \Phi' = 0^\circ) \quad \text{Meyerhof (1963)}$$

$$s_c = 1.08 \quad s_q = 1.00 \quad s_\gamma = 1.00$$

The coefficients for correcting the depth of the foundation are:

$$d_c = 1 + 0.4 \frac{D_f}{B} \quad d_q = 1 + 2 \tan \Phi' (1 - \sin \Phi')^2 \frac{D_f}{B} \quad d_\gamma = 1 \quad \text{Hansen (1970)}$$

$$d_c = 1.08 \quad d_q = 1.00 \quad d_\gamma = 1$$

PRODUCT ACCEPTANCE UNIT:

B=20m L=50m Df=9m $\Phi'=0^\circ$ c=54 kN/m²

The coefficients for correcting the basic shape are:

$$s_c = 1 + 0.2 \frac{B}{L} \quad s_q = 1 \quad s_\gamma = 1 \quad (\text{For } \Phi' = 0^\circ) \quad \text{Meyerhof (1963)}$$

$$s_c = 1.08 \quad s_q = 1.00 \quad s_\gamma = 1.00$$

The coefficients for correcting the depth of the foundation are:

$$d_c = 1 + 0.4 \frac{D_f}{B} \quad d_q = 1 + 2 \tan \Phi' (1 - \sin \Phi')^2 \frac{D_f}{B} \quad d_\gamma = 1 \quad \text{Hansen (1970)}$$

$$d_c = 1.18 \quad d_q = 1.00 \quad d_\gamma = 1$$

TURBINE BUILDING:

B=15m L=20m Df=3m $\Phi'=0^\circ$ c=55 kN/m²

The coefficients for correcting the basic shape are:

$$s_c = 1 + 0.2 \frac{B'}{L'} \quad s_q = 1 \quad s_\gamma = 1 \quad (\text{For } \Phi'=0^\circ) \quad \text{Meyerhof (1963)}$$

$$s_c = 1.15 \quad s_q = 1.00 \quad s_\gamma = 1.00$$

The coefficients for correcting the depth of the foundation are:

$$d_c = 1 + 0.4 \frac{D_f}{B} \quad d_q = 1 + 2 \tan \Phi' (1 - \sin \Phi')^2 \frac{D_f}{B} \quad d_\gamma = 1 \quad \text{Hansen (1970)}$$

$$d_c = 1.08 \quad d_q = 1.00 \quad d_\gamma = 1$$

COMBUSTION BOILER:

B=40m L=50m Df=6m $\Phi'=0^\circ$ c=59 kN/m²

The coefficients for correcting the basic shape are:

$$s_c = 1 + 0.2 \frac{B'}{L'} \quad s_q = 1 \quad s_\gamma = 1 \quad (\text{For } \Phi'=0^\circ) \quad \text{Meyerhof (1963)}$$

$$s_c = 1.16 \quad s_q = 1.00 \quad s_\gamma = 1.00$$

The coefficients for correcting the depth of the foundation are:

$$d_c = 1 + 0.4 \frac{D_f}{B} \quad d_q = 1 + 2 \tan \Phi' (1 - \sin \Phi')^2 \frac{D_f}{B} \quad d_\gamma = 1 \quad \text{Hansen (1970)}$$

$$d_c = 1.06 \quad d_q = 1.00 \quad d_\gamma = 1$$

According to the coefficients and other values calculated above:

$$q_k = c N_c s_c d_c i_c g_c b_c \quad q_t = \frac{q_k}{\gamma_{Rv}}$$

$$\gamma_{RV} = 1.4 \text{ (TBDY 2018 Table 16.2)}$$

	ADMINISTRATIVE BUILDING	PRODUCT ACCEPTNCE UNIT	TURBINE BUILDIN G	COMBUSTION BOILER
c (kN/m2)	54	54	55	59
Nc	5,1	5,1	5,1	5,1
Sc	1,08	1,08	1,15	1,16
dc	1,08	1,18	1,08	1,06
lc	1	1	1	1
Gc	1	1	1	1
Bc	1	1	1	1
QK (t/m2)	32,12	35,10	34,84	37,00
QT (t/m2)	22,94	25,07	24,88	26,43

SPT N30 AVERAGES	
SK-1	13
SK-2	18
SK-3	13
SK-4	14
SK-5	22
AVERAGE	16

Bedding Coefficient: $K_v = 180N_{30} = 180 \cdot 16 = 2880 \text{ t/m}^3$ (Scott, 1981)

b) Settlement Analysis

$$\Delta H = 31.2 \cdot q_{\text{net}} / N_{\text{Avg}} \quad (\text{Raft Basic}) \quad (\text{Meyerhof, Terzaghi-Peck})$$

	ADMINISTRATIVE BUILDING	PRODUCT ACCEPTAN CE UNIT	TURBINE BUILDING	COMBUSTION BOILER
qnet (T/M2)	1,5	25	3	3
Nort	16	16	16	16
ΔH	2,925	48,75	5,85	5,85

Since the settlement limit conditions are generally not met in the settlement analysis made according to the loads coming to the building, it **will be appropriate to make** a pile raft foundation, the details of which will be explained below.

9.2 Soil Improvement Alternatives

Against the risk of swelling and the risk of damage by the groundwater level to the foundation of the structure and the ground under the foundation, it is recommended to carry out chemical remediation, pre-wetting, solidification, improvement by one or more of the injection type methods, and necessary drainage and insulation. By adding approximately 2-8% lime or cement in the improvement with materials such as lime, cement, etc., it can be achieved to reduce the plasticity index, increase the permeability and shear strength and reduce swelling.

The material extracted during the excavation in the ground **should not be used** as filling material again. If filling is necessary, it should be compacted in layers of maximum 50 cm with stabilized filling material.

9.3 Recommended Foundation System

The building foundation type should be evaluated by the static project author (depending on the superstructure carrier system, element openings and column sections), **PILE RAFT FOUNDATION** should be selected. Although limestone was partially detected at about 40m during the drilling works, there is generally no rock floor in the construction area. It is positive in terms of application that there is no heaving in the ground in bored piles, the pile length can be adjusted according to the conditions on site, and the soil data can be verified during excavation. For this reason, it would be appropriate to make cast-in-place reinforced bored piles and to make these piles as end piles that sit on limestone ground where possible, and as friction piles where not possible. In friction piles, the bearing power can be increased by expanding the tip of the pile during manufacturing. According to TBDY conditions, the minimum diameter of bored piles should be 35cm. After the pile fabrication, a loading test should be carried out on at least two piles and at least 1% of the total number of piles and it should be confirmed that the calculation conditions are met on site.

9.4 Other Considerations Related to Building Foundations

Evaluation of Swelling and Shrinkage Potential

Since the foundation of the building will sit on a clay floor, there is a possibility of swelling. The risk of swelling varies according to the Atterberg limits of the clay floor. According to the work of Seed and others (1962);

$$S=60 \cdot K \cdot (PI)^{2.44}$$

S=Probability of

swelling % $K=3.6 \cdot 10^{-5}$

$$5=0.000036$$

PI=Plasticity Index

$$S=60 \cdot 3.6 \cdot 10^{-5} \cdot (23.90)^{2.44} = 4.98 (\%)$$

According to Chen (1998) studies; $S=Be$

$A^{(PI)}$ ($B=0.2558$, $A=0.0838$ constants)

$$S=0.2558e^{0.0838(23.90)} = 1.89 (\%)$$

The risk of swelling on the ground where the building foundation will be settled is moderate. It is recommended to reduce the risk of swelling by chemical remediation, pre-wetting, solidification, injection-type methods and necessary drainage and insulation.

10 SHORING SYSTEMS- SLOPE STABILITY ANALYSIS AND EVALUATION

There is a basement floor on site. Although clay soils are soils that can hold themselves in short-term excavations, according to the preliminary information given to us on site, it is recommended to excavate inclined or use shoring systems when excavating the basement, since approximately 9m basement excavation will be carried out. If inclined excavation is to be done; Approximately 1.0-1.5m wide palliated (straight strip) excavation should be carried out every 3m. The excavation slope should be no more than 45°. A 1m wide strip of ground should not be loaded from the top edge of the excavation.

If shoring systems are desired to be used, it may not be appropriate to make steel or concrete sheet curtains in order to ensure water tightness. Considering the groundwater; It is recommended to make reinforced concrete walls or pile wall systems. Reinforced concrete walls can be made by digging a narrow trench and pouring concrete into it or placing prefabricated ready-made elements. This application should be supported by waterproofing the reinforced concrete elements and installing a drainage system. If a pile curtain is arranged, sealing against water can be achieved by overlapping the piles. To ensure water tightness, it will be useful to make partially jet grout columns behind the curtains. The method to be chosen should be decided by the relevant project designer and site manager according to the controls to be carried out on site.

Susceptibility of Slopes Under the Influence of Earthquakes

Since the land has a slightly sloping topography and the foundation will be placed on a flat ground, the slope stability analysis was not carried out because the buildings are not in the building class to be built on and near the natural or artificial slopes in TBDY Article 16.13.1.

11 CONCLUSION AND RECOMMENDATIONS

The values found according to the studies carried out above are given in the Table below.

	ADMINISTRATIVE BUILDING	PRODUCT ACCEPTANCE UNIT	TURBINE BUILDING	COMBUSTION BOILER
EARTHQUAKE DESIGN CLASS (DTS)	1a	1a	1a	1a
BUILDING IMPORTANCE COEFFICIENT (I)	1.5	1.5	1.5	1.5
SPECTRUM CORNER PERIODS (TA/TB)	0.217/0.633	0.217/0.633	0.217/0.633	0.217/0.633
GROUND BEARING COEFFICIENT (t/m ³)	2880	2880	2880	2880
LOCAL GROUND CLASS	ZE	ZE	ZE	ZE
DESIGN SPECTRAL ACCELERATION COEFFICIENT (SDS)	0.910	0.910	0.910	0.910
BUILDING USAGE CLASS (BKS)	1	1	1	1
BUILDING HEIGHT CLASS (BYS)	8	8	8	8
GROUNDWATER LEVEL (m)	3	3	3	3
EARTHQUAKE GROUND MOTION LEVEL	DD-2	DD-2	DD-2	DD-2
CHARACTERISTIC OF THE BASIC BEARING POWER STRENGTH QK (t/m ²)	32,12	35,10	34,84	37,00
BASIC BEARING STRENGTH DESIGN STRENGTH QT (T/M ²)	22,94	25,07	24,88	26,43

The building foundation type should be evaluated by the static project designer (depending on the superstructure carrier system, element openings and column sections), **PILE RAFT** FOUNDATION should be selected.

If there is vegetable soil on the ground in the on-site determinations, the vegetable soil part should be removed, and the foundation should be placed on the ground below. If it is necessary to fill on the foundation due to the elevation difference, the filling should be done with appropriate methods by using stabilized filling material and using material in accordance with the relevant regulations. In case of removal and filling of vegetable soil, the ground must be arranged in such a way that it is a flat topography, and the foundation must be placed on a flat ground.

In order to prevent rainwater and groundwater from damaging the structure and the foundation of the building, the existing **groundwater level should be reduced by carrying out the necessary waterproofing and drainage works.** By insulating and pouring concrete under and next to the foundation and pouring groconcrete, the contact of the foundation concrete and reinforcements with soil and water should be prevented.

After examining the entire report, the relevant static project designer should make the calculations related to this report in the static project and make an on-site application by taking this report into account together with the relevant site manager.

12 RESOURCES USED

- Özyayın, K., 1999, Soil Mechanics
- Uzuner, B.A., 1998, Foundation Soil Mechanics
- Yılmaz, R., 2004, Foundation Construction, Birsen Publication
- Yıldırım, S., 2004, Soil Investigation and Foundation Design
- Das, B., 2011, Principles Of Foundation Engineering
- Turkey Building Earthquake Code (Effective Date: 01/01/2019)
- Soil and Foundation Survey Application Principles and Report Format (2019)

13 ANNEXES

- Figure 1 Bearing Strength Factors Dependent on Slip Resistance Angle
- Seismic Hazard Map Report

ANGLE OF FRICTION ϕ (DEGREES)	TERZAGHI			MEYERHOF			HANSEN		
	N_c	N_q	N_γ	N_c	N_q	N_γ	N_c	N_q	N_γ
0	5.70	1.00	0.00	5.10	1.00	0.00	5.10	1.00	0.00
2	6.30	1.22	0.18	5.63	1.20	0.01	5.63	1.20	0.01
4	6.97	1.49	0.38	6.19	1.43	0.04	6.19	1.43	0.05
5	7.34	1.64	0.50	6.49	1.57	0.07	6.49	1.57	0.07
6	7.73	1.81	0.62	6.81	1.72	0.11	6.81	1.72	0.11
8	8.60	2.21	0.91	7.53	2.06	0.21	7.53	2.06	0.22
10	9.60	2.69	1.21	8.34	2.47	0.37	8.34	2.47	0.39
12	10.76	3.29	1.70	9.28	2.97	0.60	9.28	2.97	0.63
14	12.11	4.02	2.23	10.37	3.59	0.92	10.37	3.59	0.97
15	12.86	4.45	2.50	10.98	3.94	1.13	10.98	3.94	1.18
16	13.68	4.92	2.94	11.63	4.34	1.37	11.63	4.34	1.43
18	15.52	6.04	3.87	13.10	5.26	2.00	13.10	5.26	2.08
20	17.69	7.44	4.97	14.83	6.40	2.87	14.83	6.40	2.95
22	20.27	9.19	6.61	16.88	7.82	4.07	16.88	7.82	4.13
24	23.36	11.40	8.58	19.32	9.60	5.72	19.32	9.60	5.75
25	25.13	12.72	9.70	20.72	10.66	6.77	20.72	10.66	6.76
26	27.09	14.21	11.35	22.25	11.85	8.00	22.25	11.85	7.94
28	31.61	17.81	15.15	25.80	14.72	11.19	25.80	14.72	10.94
30	37.16	22.46	19.73	30.14	18.40	15.67	30.14	18.40	15.07
32	44.04	28.52	27.49	35.49	23.18	22.02	35.49	23.18	20.79
34	52.64	36.50	36.96	42.16	29.44	31.15	42.16	29.44	28.77
35	57.75	41.44	42.40	46.12	33.30	37.15	46.12	33.30	33.92
36	63.53	47.16	51.70	50.59	37.75	44.43	50.59	37.75	40.05
38	77.50	61.55	73.47	61.35	48.93	64.07	61.35	48.93	56.17
40	95.66	81.27	100.39	75.31	64.20	93.69	75.31	64.20	79.54
42	119.67	108.75	165.69	93.71	85.37	139.32	93.71	85.37	113.96
44	151.95	147.74	248.29	118.37	115.31	211.41	118.37	115.31	165.58
45	172.29	173.29	294.50	133.87	134.87	262.74	133.87	134.87	200.81
46	196.22	204.19	426.96	152.10	158.50	328.73	152.10	158.50	244.65
48	258.29	287.85	742.61	199.26	222.30	526.45	199.26	222.30	368.67
50	347.51	415.15	1153.15	266.88	319.06	873.86	266.88	319.06	568.57

Figure 1