

**EVALUATION OF ALLUVIAL DEPOSITS IN GEMLİK BASIN
IN TERMS OF EARTHQUAKE CODES**

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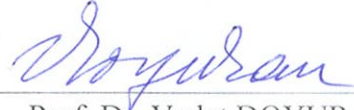
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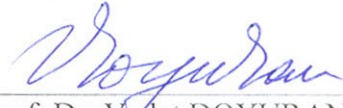
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ABSTRACT

EVALUATION OF ALLUVIAL DEPOSITS IN GEMLİK BASIN IN TERMS OF EARTHQUAKE CODES

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Gemlik County is located in the Marmara Region (NW Turkey), which has been affected by destructive earthquakes sourced from North Anatolian Fault System throughout its history. The bulk of the settlement rests on alluvial deposits of the Gemlik pull-apart basin. So, it is vital to investigate the foundation soils in this basin and the response of them to earthquakes. Many earthquake codes were established by the authorities in different countries of the world to estimate the possible ground shaking and seismic loads which may act on buildings. In this study, Turkish Earthquake Code (TEC-1998) and Eurocode-8 (EN-1998) have been utilized. The analyses showed that EN-1998 results in more conservative estimates relative to TEC-1998, in terms of spectral ordinates. The source of difference between TEC-1998 and EN-1998 has been investigated and three possible reasons have been identified. The variation is probably due to the different seismic characteristics of Turkey and Europe, different soil amplification levels defined by the codes, and different soil classification procedures of the codes.

Keywords: Gemlik, Turkish Earthquake Code, Eurocode8, Soil classification, Response spectrum, North Anatolian Fault System.

ÖZ

GEMLİK HAVZASI ALÜVYON ÇÖKELLERİNİN DEPREM YÖNETMELİKLERİNE DAYANARAK DEĞERLENDİRİLMESİ

AVŞAR, Ulaş

Yüksek Lisans, Jeoloji Mühendisliği Bölümü

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Gemlik İlçesi, tarihi boyunca Kuzey Anadolu Fay Sistemi'nden kaynaklanan yıkıcı depremlerden etkilenmiş olan Marmara Bölgesi'nde yer almaktadır. Yerleşkenin büyük bölümü Gemlik çek-ayır havzası alüvyon çökelleri üzerindedir. Bu nedenle, havza içindeki zeminlerin deprem sırasında yer sarsıntısına nasıl tepki vereceğinin incelenmesi hayati önem taşımaktadır. Dünyanın çeşitli ülkelerindeki merciler tarafından, olası yer sarsıntılarını ve binalara etki eden sismik yükleri tahmin etmek için, birçok deprem yönetmeliği geliştirilmiştir. Bu çalışmada, Türk Deprem Yönetmeliği (TDY-1998) ile Avrupa Deprem Yönetmeliği (EN-1998) kullanılmıştır. Yapılan analizler, spektral ivmeler açısından, EN-1998' in TDY-1998' e göre daha ihtiyatlı tahminlerle sonuçlandığını göstermiştir. TDY-1998 ve EN-1998 arasındaki bu fark incelenmiş ve üç olası neden belirlenmiştir. İki yönetmelik arasındaki fark muhtemelen; Türkiye ve Avrupa'nın farklı sismik özelliklere sahip olmasından, iki yönetmelik tarafından belirlenen farklı zemin büyütmesi seviyelerinden, ve farklı zemin sınıflama yöntemlerinden kaynaklanmaktadır.

Anahtar Kelimeler: Gemlik, Türk Deprem Yönetmeliği, Eurocode8, Zemin sınıflaması, Tepki spektrumu, Kuzey Anadolu Fay Sistemi.

To My Parents

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TABLE OF CONTENTS

ABSTRACT.....	iv
ÖZ	v
DEDICATION	vi
ACKNOWLEDGEMENTS	vii
TABLE OF CONTENTS.....	viii
LIST OF TABLES	x
LIST OF FIGURES	xi

CHAPTER

1. INTRODUCTION	1
1.1 Purpose and Scope	3
1.2 Geographical Setting	4
1.3 Background Information on Earthquake Codes used in This Study	6
1.3.1 Eurocode 8 (EN-1998)	7
1.3.1.1 General Information for EN-1998	7
1.3.1.2 Classification According to EN-1998	9
1.3.2 Turkish Earthquake Code (TEC-1998)	16
1.3.2.1 General Information for TEC-1998	16
1.3.2.2 Classification According to TEC-1998	18
2. GEOLOGY	25
2.1 Local Geology	25
2.1.1 Basement Rocks.....	26
2.1.2 Quaternary Deposits.....	31
2.2 Neotectonics and Seismicity	32
2.2.1 Gemlik Fault	41
2.2.2 Gürle, Gençali and Kurşunlu Faults.....	41
2.2.3 Narlıca, Şükrüye and Fevziye Faults	44
2.2.4 Çamdibi Fault.....	44

3. DATA REQUIREMENTS.....	49
3.1 Seismological Data.....	50
3.2 Geological Data.....	52
3.3 Geotechnical Data	56
3.4 Geophysical Data	59
4. SOIL CLASSES AND CORRESPONDING RESPONSE SPECTRA.....	71
4.1 Classification.....	71
4.2 Response Spectra	89
5. DISCUSSIONS.....	90
6. CONCLUSIONS AND RECOMMENDATIONS	102
REFERENCES	104
APPENDICES	
A. BOREHOLE LOGS	113
B. LABORATORY TEST RESULTS	183
C. SPT BLOW-COUNT AND (V_s) PROFILES.....	194
D. ELASTIC RESPONSE SPECTRA.....	214
E. SPATIAL DISTRIBUTION OF SPECTRAL ORDINATES	227
F. NORMALIZED ACCELERATION RESPONSE SPECTRA FOR RECENT DESTRUCTIVE EARTHQUAKES.....	235

LIST OF TABLES

Table 1.1 Contents of EN-1998	8
Table 1.2 Importance classes for buildings.....	10
Table 1.3 Ground types suggested by EN-1998	13
Table 1.4 Parameters describing the Type-1 elastic response spectra	14
Table 1.5 Parameters describing the Type-2 elastic response spectra	14
Table 1.6 Contents of Turkish Earthquake Code 1998.....	17
Table 1.7 Effective ground acceleration coefficient (A_0)	18
Table 1.8 Building importance factors for different buildings	20
Table 1.9 Spectrum characteristic periods	22
Table 1.10 Soil groups suggested by TEC-1998	23
Table 1.11 Local site classes suggested by TEC-1998	23
Table 2.1 Renewal-model characteristic earthquake parameters for the segments.....	47
Table 3.1 Coordinates, depth, elevation and groundwater level of boreholes ...	57
Table 3.2 Results of seismic refraction surveys conducted during MEER-A3 .	61
Table 3.3 Porosity, void ratio, and unit weight of typical soils in natural state.	64
Table 3.4 Typical unit weights for various soils.....	64
Table 3.5 Suggested unit weight ranges for Gemlik alluvial deposits.....	66
Table 3.6 Typical values of ϕ for granular soils	68
Table 4.1 Assessment of site classes according to TEC-1998 and EN-1998	88

LIST OF FIGURES

Figure 1.1 Historical earthquakes in Marmara Region in period 282 BC – 1897 AD.....	2
Figure 1.2 From SE to NW, Gemlik settlement resting on Gemlik pull-apart basin.....	3
Figure 1.3 Geographic setting of the study area	5
Figure 1.4 General outline of elastic response spectra suggested by EN-1998	10
Figure 1.5 Recommended Type-1 elastic response spectra by EN-1998 for ground types A to E	15
Figure 1.6 Recommended Type-2 elastic response spectra by EN-1998 for ground types A to E	15
Figure 1.7 Seismic Zoning Map of Turkey.....	19
Figure 1.8 General outline of Spectrum Coefficient, $S(T)$	21
Figure 1.9 Recommended elastic acceleration response spectra for site classes Z1 to Z4	24
Figure 2.1 Geological map of the study area and its vicinity	26
Figure 2.2 Typical views of the graywacke (a) north of Umurbey looking northwest, near to Gemlik Fault (b) in Umurbey settlement looking west.....	27
Figure 2.3 A typical view of schists in Middle Jurassic to Early Cretaceous units, from northern highlands of Gemlik, looking north.....	29
Figure 2.4 Photomicrograph of a meta-conglomerate sample from the Middle Jurassic to Early Cretaceous units.....	29
Figure 2.5 Photomicrograph of a calc-schist sample from the Middle Jurassic to Early Cretaceous units	30

Figure 2.6 A typical view of the Early-Middle Eocene units at the southwest of the Gemlik Basin, looking east.....	31
Figure 2.7 From SE to NW, Gemlik Basin.....	32
Figure 2.8 Simplified map showing major active fault systems in Turkey and its vicinity.....	33
Figure 2.9 Neo- and seismo-tectonic map of the Gemlik area and its neighborhood	40
Figure 2.10 From NW to SE, general view of the Gemlik settlement and the southern margin-boundary fault (Gemlik fault).....	41
Figure 2.11 From N to S, general view of the Gürle fault and the Karsak restraining bend.....	42
Figure 2.12 From N to S, general view of the Gençali fault.....	43
Figure 2.13 Stereographic plot of slip-plane data of the Kurşunlu fault on lower hemisphere of the Schmidt net	43
Figure 2.14 From WNW to ESE, general view of the Çamdibi fault.....	45
Figure 2.15 Tectonic map of the Gulf of Gemlik	46
Figure 2.16 Revised fault segmentation model for time-dependent PSHA of the Marmara Region	47
Figure 3.1 Revised fault segmentation model for time-dependent probabilistic seismic hazard assessment of the Marmara Region	51
Figure 3.2 PGA contour map for Gemlik region at NEHRP B/C Boundary for 10% probability of exceedance in 50 years.....	52
Figure 3.3 Topographical thematic map of the study area.....	53
Figure 3.4 3-Dimensional surface view of the study area	54
Figure 3.5 Geological map of the study area with relief shading	55
Figure 3.6 Borehole locations	58

Figure 3.7 Unit weight ranges for different soils in Gemlik alluvial basin.....	65
Figure 3.8 Plot of estimated vs. measured void ratio	69
Figure 3.9 Examples for estimated and measured shear wave velocity profiles	70
Figure 4.1 Plasticity Index (PI) distribution of the Gemlik soils	72
Figure 5.1 Spatial distribution of local site classes of TEC-1998.....	91
Figure 5.2 Spatial distribution of ground types of EN-1998	91
Figure 5.3 Plot of attenuation relationships, which can be used for Turkey and Europe	93
Figure 5.4 Response spectra obtained from the average of Sadigh et al. (1997) and Boore et al. (1997), and from Ambraseys et al. (1996).....	95
Figure 5.5 Change in spectra (Left: the original spectra, Right: after the application of the reference peak ground acceleration as 0.4 g).....	96
Figure 5.6 Plot of normalized acceleration response spectra of recent destructive earthquakes and the design spectra of TEC-1998	97
Figure 5.7 Illustration of [D(area)]	98
Figure 5.8 Spatial distribution of [D(area)]	99

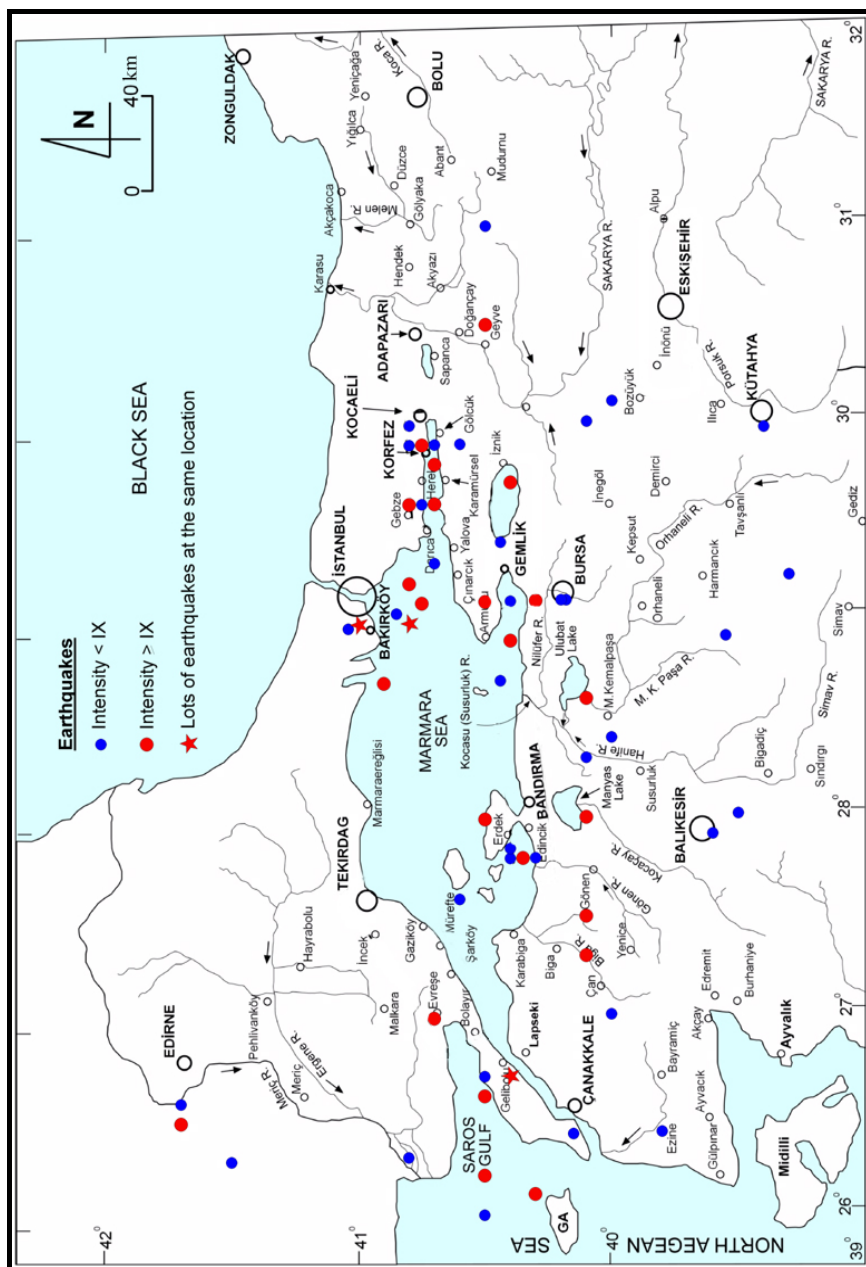
CHAPTER 1

INTRODUCTION

Thousands of people lose their lives due to natural disasters every year all over the world. In addition to the life loss and the physical destruction the world economy is seriously affected from natural disasters. Earthquakes constitute the significant proportion of damages due to natural disasters. Thus, in order to reduce direct and indirect losses originated from earthquakes, crucial precautions should be taken. After the 1999 earthquakes of Turkey, many studies and projects concerning earthquake disaster mitigation have been implemented in Turkey (e.g. World Institute for Disaster Risk Management: Microzonation for Municipalities (2004); and Marmara Earthquake Emergency Reconstruction Project (2005)).

Turkey being one of the most actively deforming regions in the world has been subjected to many destructive earthquakes due to its neotectonic nature. Major source of the seismicity in Turkey is the North Anatolian Fault System which is a simple shear system in the nature of dextral strike-slip continental transform fault. This fault system (NAFS) appears in a zone of about 2-110 km wide and 1600 km long and cuts across the northern part of Turkish main land (Bozkurt, 2001; Koçyiğit, 2005).

Gemlik settlement is located in the Marmara Region (NW Turkey), which has been affected by destructive earthquakes sourced from the NAFS throughout its history. Figure 1.1 illustrates the historical earthquakes in the Marmara Region. The data in this figure have been compiled by Koçyiğit (2005) from Straub (1966), Soysal et al. (1981), Guidoboni et al. (1994), Ambraseys and Finkel (1991) and (1995), Ambraseys (1988), Ambraseys and Jackson (1998) and (2000). Obviously, tens of destructive earthquakes have taken place in the Marmara Region between 282-BC and 1897 AD.



In order to minimize damages due to earthquakes, buildings must be designed resistant against seismic loads due to ground shaking. At this point of view, many earthquake codes have been established by the authorities in different countries of the world to estimate the possible ground shaking and seismic loads which may act on buildings. As it is seen in Figure 1.2, bulk of the Gemlik settlement rests on Gemlik pull-apart basin. So, it is vital to investigate the foundation soils in this basin and the response of them to earthquakes.



Figure 1.2: From SE to NW, Gemlik settlement resting on Gemlik pull-apart basin (Picture was taken from the southern highlands, Umurbey).

1.1 Purpose and Scope

The purpose of this study is to investigate and evaluate the soils in Gemlik Basin with respect to two earthquake codes namely Turkish Earthquake Code (TEC-1998) and Eurocode-8 (EN-1998). The scope of the study involves the presentation of general information on the geological, neotectonic and seismic properties of the study area and its vicinity, the presentation of classification procedures for both earthquake codes, the presentation of data requirements and the available data, determination of soil classes and the corresponding elastic response spectra and finally the discussions on the obtained results.

To perceive the seismic risk of the study area, it is vital to gain sufficient background on the neotectonics and seismicity around Gemlik. Extensive literature review has been carried out and the geological, neotectonic and seismic properties of the study area are presented in Chapter 2. The related documents of EN-1998 and TEC-1998 have been examined in detail. Types of input data and data requirements for the classification procedures and elastic response spectra calculations are given in Chapter 3. In Chapter 4, it is explained in detail how the classifications have been done for Gemlik foundation soils. Finally, the results are discussed and conclusions and recommendations are drawn in Chapter 5 and Chapter 6, respectively.

1.2 Geographical Setting

Gemlik is located at the eastern coasts of Marmara Sea at the NW of Turkey. The study area (Gemlik) is located 28 km to the north of Bursa city center and is accessible through the D575 state road. There exists a harbor in Gemlik and ferryboat services are available from İstanbul. From Ankara, Gemlik is accessible through the E90 state road which passes through Eskişehir, Bozüyük, İnegöl and Bursa. Figure 1.3 presents the geographical setting of the study area.

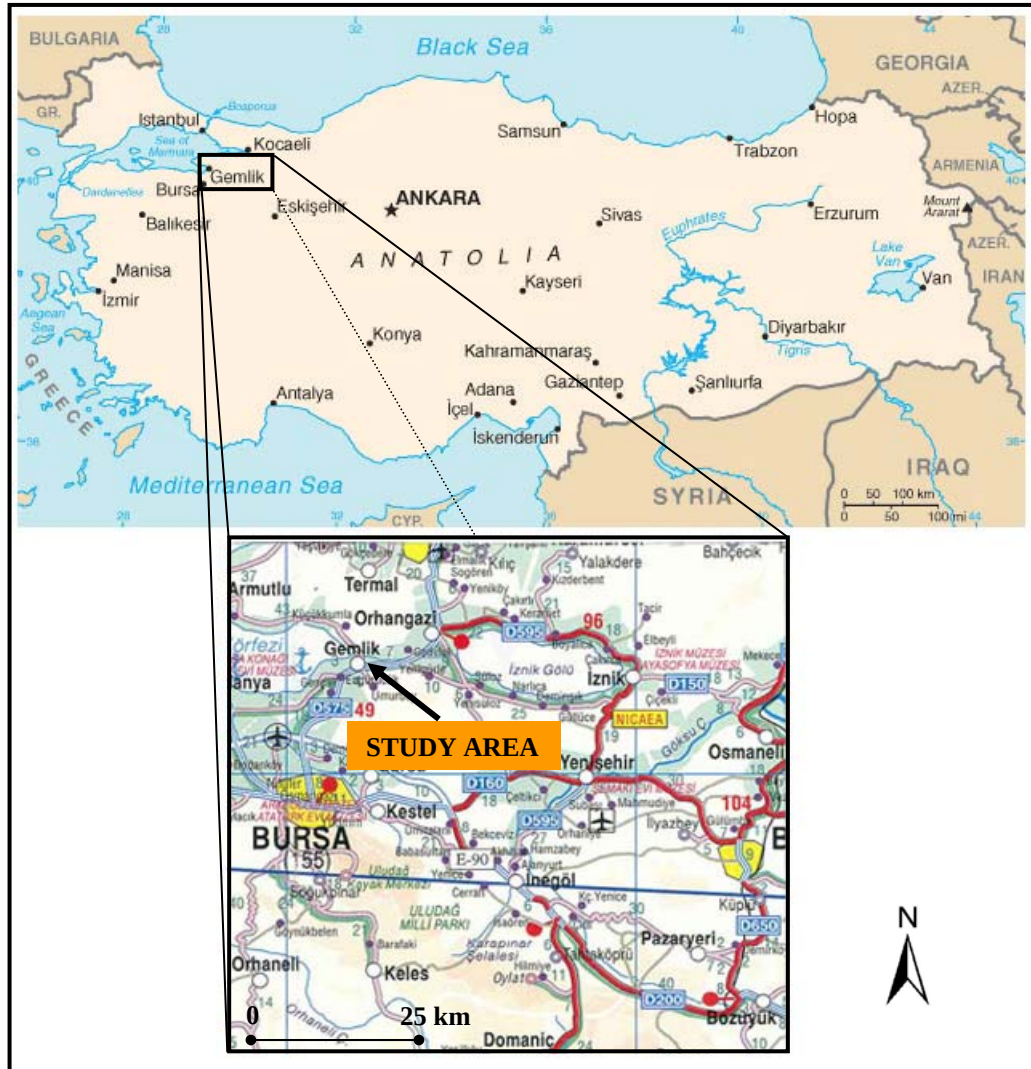


Figure 1.3: Geographical setting of the study area.

1.3 Background Information on Earthquake Codes used in This Study

In order to minimize damages and losses due to earthquakes, buildings must be designed resistant against seismic loads due to ground shaking. Therefore, the intensity of ground shaking, which may be encountered, must be estimated. The possible approaches to estimate ground motion can be considered as; (1) empirical relationships based on contemporary attenuation relationships, (2) various earthquake codes based on identified site parameters, (3) identification of geological/geotechnical units based on their properties such as equivalent shear wave velocity, (4) interpretation of strong and weak ground motion records as well as ambient noise measurements based spectral ratios, and (5) site response analyses based on 1D or advanced numerical methods (DRM, 2004).

Within the scope of this thesis, second approach is selected as the term of analysis to estimate the possible ground motion level and elastic response spectrum. There exist many earthquake codes established by the authorities in different countries. Two different earthquake codes are employed to estimate the possible ground motion in the Gemlik Basin. The first one, which is currently in effect in Turkey, is the “Specification for Structures to be Built in Disaster Areas”. This specification is commonly referred to as “Turkish Earthquake Code (TEC) 1998”. The second code to be employed in this study is the European standard titled “Design of Structures for Earthquake Resistance”. This standard is commonly referred as “Eurocode 8” or “EN-1998”.

In the light of these two codes, foundation soils in Gemlik will be classified and corresponding acceleration response spectra will be suggested by using the available geological, geophysical and geotechnical data. In the following sections of this chapter, general information on these two codes and procedures of analyses suggested will be introduced in detail.

1.3.1 Eurocode 8 (EN-1998)

1.3.1.1 General Information for EN-1998

In 1975, the Commission of the European Community decided on an action program in the field of construction, based on article 95 of the Treaty. The objective of the program was the elimination of technical obstacles to trade and the harmonization of technical specifications (EN-1998-1:2004).

In 1989, the Commission and the Member States of the EU and EFTA decided, on the basis of an agreement between the Commission and CEN, to transfer the preparation and the publication of the Eurocodes to CEN through a series of Mandates, in order to provide them with a future status of the European Standard (EN-1998-1:2004).

The Structural Eurocode program comprises the following standards generally consisting of a number of parts:

EN 1990 Eurocode : Basis of Structural Design

EN 1991 Eurocode 1 : Actions on structures

EN 1992 Eurocode 2 : Design of concrete structures

EN 1993 Eurocode 3 : Design of steel structures

EN 1994 Eurocode 4 : Design of composite steel and concrete structures

EN 1995 Eurocode 5 : Design of timber structures

EN 1996 Eurocode 6 : Design of masonry structures

EN 1997 Eurocode 7 : Geotechnical design

EN 1998 Eurocode 8 : Design of structures for earthquake resistance

EN 1999 Eurocode 9 : Design of aluminum structures

Eurocode standards recognize the responsibility of regulatory authorities in each Member State and have safeguarded their right to determine values related to regulatory safety matters at national level where these continue to vary from State to State (EN-1998-1:2004).

EN-1998 has been prepared by the Technical Committee CEN/TC 250 that is responsible for all structural Eurocodes. EN-1998 applies to the design and construction of buildings and civil engineering works in seismic regions. Its purpose is to ensure that in the event of earthquakes (EN-1998-1:2004):

- human lives are protected,
- damage is limited, and
- structures important for civil protection remain operational.

EN-1998 is composed of six parts. Contents of these parts can be summarized as in Table 1.1.

Table 1.1: Contents of EN-1998.

EN 1998-1 :	contains general rules, seismic actions and rules for buildings
EN 1998-2 :	contains specific provisions relevant to bridges
EN 1998-3 :	contains provisions for the seismic assessment and retrofitting of existing buildings
EN 1998-4 :	contains specific provisions relevant to silos, tanks and pipelines
EN 1998-5 :	contains specific provisions relevant to foundations, retaining structures and geotechnical aspects
EN 1998-6 :	contains specific provisions relevant to towers, masts and chimneys

EN-1998-1 and EN-1998-5 provide sufficient guides to classify the foundation soils and to obtain elastic ground acceleration response spectra.

1.3.1.2 Classification According to EN-1998

Within the scope of EN-1998, the earthquake motion at a given point on the surface is represented by an elastic ground acceleration response spectrum, henceforth called an “elastic response spectrum” (EN-1998-1:2004).

Elastic horizontal ground acceleration response spectra suggested by EN-1998 display a characteristic shape as in Figure 1.4. As it is obvious from the figure, soil factor (S), design ground acceleration on type A ground (a_g), characteristic periods (T_B , T_C and T_D) and damping correction factor (η) are the main parameters determining the recommended elastic response spectra. In the following pages, determination of these basic parameters will be explained in detail.

In the scope of structural design for earthquake resistance, level of seismic hazard, which may be encountered in the future, should be carefully defined for the site under consideration. For most of the applications of EN-1998, the seismic hazard is represented by the design ground acceleration on type A ground (a_g), which is expressed in terms of a reference peak ground acceleration (a_{gR}) and an importance factor (γ_I). Equation (1.1) is used to determine the design ground acceleration (a_g);

$$a_g = \gamma_I \cdot a_{gR} \quad (1.1)$$

The reference peak ground acceleration (a_{gR}) corresponds to the reference return period T_{NCR} of the seismic action for the no-collapse requirement (or equivalently the reference probability of exceedance in 50 years, P_{NCR}) chosen by the National Authorities (EN-1998-1:2004). The recommended values are $P_{NCR} = 10\%$ and $T_{NCR} = 475$ years.

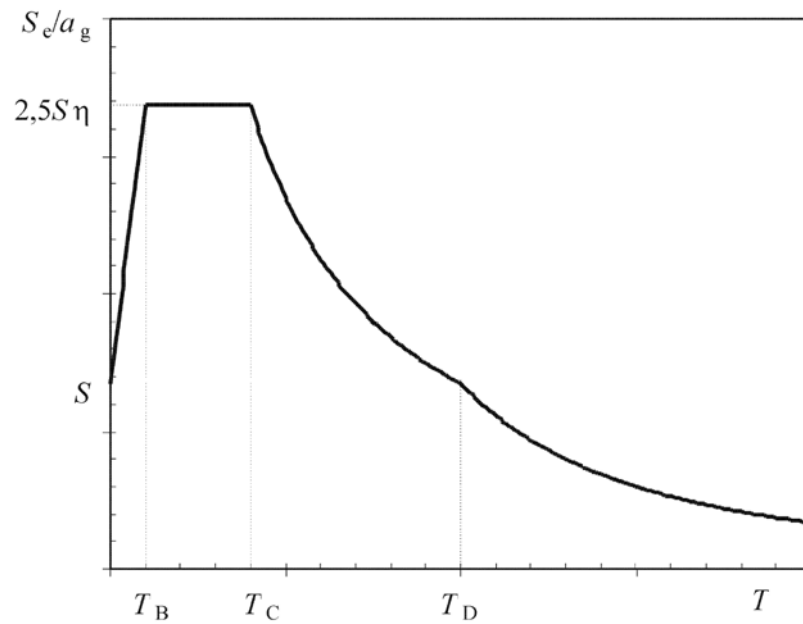


Figure 1.4: General outline of elastic response spectra suggested by EN-1998.

The importance factor (γ_I) is associated with the building importance classes which are defined in Table 1.2. The importance factor (γ_I) values assigned for each importance classes I, II, III and IV are equal to 0.8, 1.0, 1.2 and 1.4, respectively.

Table 1.2: Importance classes for buildings.

Importance class	Buildings
I	Buildings of minor importance for public safety, e.g. agricultural buildings, etc.
II	Ordinary buildings, not belonging in the other categories.
III	Buildings whose seismic resistance is of importance in view of the consequences associated with a collapse, e.g. schools, assembly halls, cultural institutions etc.
IV	Buildings whose integrity during earthquakes is of vital importance for civil protection, e.g. hospitals, fire stations, power plants, etc.

After the design ground acceleration (a_g) is calculated, the elastic response spectrum $S_e(T)$ (Figure 1.4) for the horizontal components of the seismic action is calculated by the following equations;

$$S_e(T) = a_g \cdot S \cdot \left[1 + \frac{T}{T_B} (\eta \cdot (2.5) - 1) \right] \quad 0 \leq T \leq T_B \quad (1.2.1)$$

$$S_e(T) = a_g \cdot S \cdot \eta \cdot (2.5) \quad T_B \leq T \leq T_C \quad (1.2.2)$$

$$S_e(T) = a_g \cdot S \cdot \eta \cdot (2.5) \left[\frac{T_C}{T} \right] \quad T_C \leq T \leq T_D \quad (1.2.3)$$

$$S_e(T) = a_g \cdot S \cdot \eta \cdot (2.5) \left[\frac{T_C T_D}{T^2} \right] \quad T_D \leq T \leq 4s \quad (1.2.4)$$

where;

$S_e(T)$ the elastic response spectrum;

T the vibration period of a linear single-degree-of-freedom system;

a_g the design ground acceleration on type A ground ($a_g = \gamma_I \cdot a_{gR}$);

T_B the lower limit of the period of the constant spectral acceleration branch;

T_C the upper limit of the period of the constant spectral acceleration branch;

T_D the value defining the beginning of the constant displacement response range of the spectrum;

S the soil factor;

η the damping correction factor with a reference value of $\eta = 1$ for 5% viscous damping.

As it can be seen from those equations, following the design ground acceleration (a_g), the Damping Correction Factor (η) is the second parameter affecting all parts of the spectrum. It is determined by using the Equation (1.3);

$$\eta = \sqrt{\frac{10}{5 + \xi}} \quad (1.3)$$

where; (ξ) is the viscous damping ratio of the structure (in percent). Damping correction factor results in a reference value of $\eta = 1$ for the most common viscous damping value of 5%.

Characteristic periods (T_B , T_C and T_D) and soil factor (S), which are the other main parameters describing the shape of the elastic response spectrum, depend upon the local ground conditions. These parameters stand for the influence of local ground conditions on the seismic action. EN-1998 defines seven different ground types (Table 1.3), according to the stratigraphic profile description, average shear wave propagation velocity within top most 30 meters, average SPT blow count and undrained shear strength of foundation soils. The site should be classified according to the value of the average shear wave velocity, V_{s30} , if this is available. Otherwise the value of N_{SPT} should be used. The average shear wave velocity, V_{s30} , should be computed in accordance with the Equation (1.4).

$$V_{s30} = \frac{30}{\sum_{i=1,N} \frac{h_i}{v_i}} \quad (1.4)$$

where h_i and v_i denote the thickness (in meters) and shear-wave velocity (at a shear strain level of 10^{-5} or less) of the i -th formation or layer, in a total of N , existing in the top 30 m (EN-1998-1:2004).

EN-1998 states that “the profile of the shear wave velocity (V_s) in the ground shall be regarded as the most reliable predictor of the site-dependent characteristics of the seismic action at stable sites”. It is also stated that the V_s profile may be estimated by empirical correlations using the in situ penetration resistance or other geotechnical properties. In addition to five ground types (A, B, C, D, E), two special ground types S_1 or S_2 are defined and special studies for the definition of the seismic action are required. For these types, and particularly for S_2 , the possibility of soil failure under the seismic action shall be taken into account (EN-1998-1:2004).

Table 1.3: Ground types suggested by EN-1998.

Ground type	Description of stratigraphic profile	Parameters		
		$v_{s,30}$ (m/s)	N_{SPT} (blows/30cm)	c_u (kPa)
A	Rock or other rock-like geological formation, including at most 5 m of weaker material at the surface.	> 800	–	–
B	Deposits of very dense sand, gravel, or very stiff clay, at least several tens of metres in thickness, characterised by a gradual increase of mechanical properties with depth.	360 – 800	> 50	> 250
C	Deep deposits of dense or medium-dense sand, gravel or stiff clay with thickness from several tens to many hundreds of metres.	180 – 360	15 - 50	70 - 250
D	Deposits of loose-to-medium cohesionless soil (with or without some soft cohesive layers), or of predominantly soft-to-firm cohesive soil.	< 180	< 15	< 70
E	A soil profile consisting of a surface alluvium layer with v_s values of type C or D and thickness varying between about 5 m and 20 m, underlain by stiffer material with $v_s > 800$ m/s.			
S_1	Deposits consisting, or containing a layer at least 10 m thick, of soft clays/silts with a high plasticity index ($PI > 40$) and high water content	< 100 (indicative)	–	10 - 20
S_2	Deposits of liquefiable soils, of sensitive clays, or any other soil profile not included in types A – E or S_1			

EN-1998 recommends two types of elastic response spectra; Type-1 and Type-2. If the earthquakes that contribute most to the seismic hazard defined for the site for the purpose of probabilistic hazard assessment have a surface-wave magnitude, M_s , not greater than 5.5, it is recommended that the Type-2 spectrum is adopted. For the five ground types A, B, C, D and E, the

recommended values of the parameters S , T_B , T_C and T_D are given in Table 1.4 for the Type 1 Spectrum and in Table 1.5 for the Type-2 Spectrum (EN-1998-1:2004).

Table 1.4: Parameters describing the Type-1 elastic response spectra.

Ground type	S	T_B (s)	T_C (s)	T_D (s)
A	1,0	0,15	0,4	2,0
B	1,2	0,15	0,5	2,0
C	1,15	0,20	0,6	2,0
D	1,35	0,20	0,8	2,0
E	1,4	0,15	0,5	2,0

Table 1.5: Parameters describing the Type-2 elastic response spectra.

Ground type	S	T_B (s)	T_C (s)	T_D (s)
A	1,0	0,05	0,25	1,2
B	1,35	0,05	0,25	1,2
C	1,5	0,10	0,25	1,2
D	1,8	0,10	0,30	1,2
E	1,6	0,05	0,25	1,2

After all parameters (a_g , η , S , T_B , T_C and T_D) mentioned above have been determined, the elastic response spectra can be constructed. Figures 1.5 and 1.6 illustrate the shapes of the recommended Type-1 and Type-2 spectra, respectively, normalized by a_g , for 5% damping.

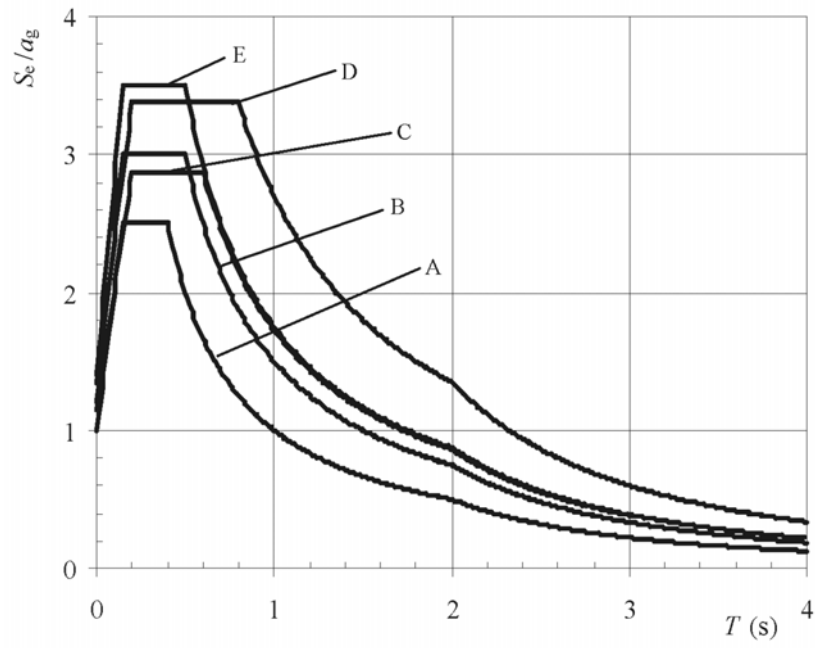


Figure 1.5: Recommended Type-1 elastic response spectra by EN-1998 for ground types A to E (5% damping).

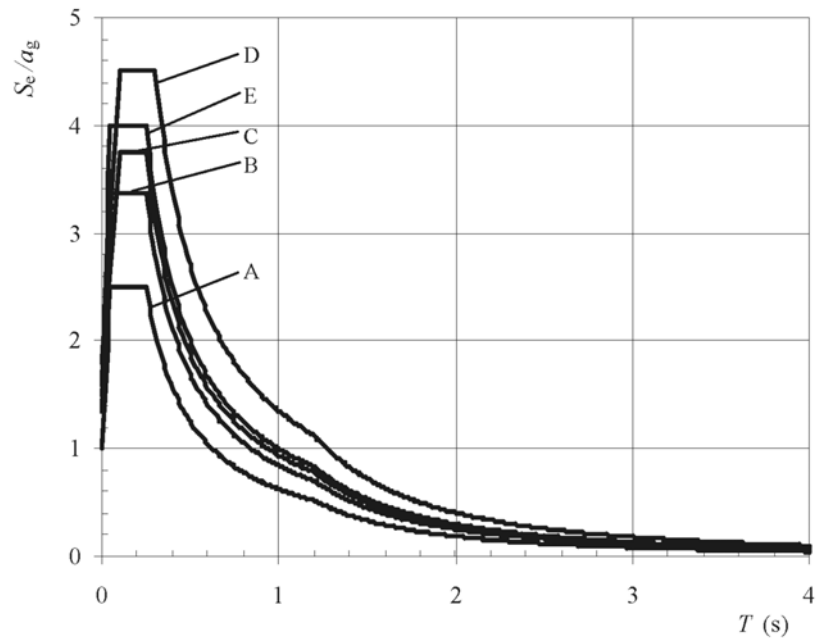


Figure 1.6: Recommended Type-2 elastic response spectra by EN-1998 for ground types A to E (5% damping).

1.3.2 Turkish Earthquake Code (TEC-1998)

1.3.2.1 General Information on TEC-1998

In Turkey, minimum requirements for the earthquake resistant design and the construction of buildings and building-like structures had been defined by the “Specification for Structures to be Built in Disaster Areas”. This specification was issued on 02.09.1997 and was put into effect on the date 01.01.1998. In the following parts of the thesis, it will be called as “Turkish Earthquake Code (TEC) 1998”.

Scope of the TEC-1998 is denoted as “Technical provisions to be followed for governmental and private buildings and building-like structures to be reconstructed, modified, enlarged, repaired or strengthened in the disaster areas, which had been fixed and declared according to the 2nd clause of the “law no: 7269” modified by the “law no: 1051”, shall be fulfilled by satisfying the fundamental principles of this specification according to the 3rd clause of the same law”. The clauses of TEC-1998 are administered by the Minister of Public Works and Settlement (TEC, 1998).

TEC-1998 is composed of three parts (Table 1.6). PART I is titled as “General Rules” and defines the scope of the specification and the areas where no structure can be built. PART II defines the fundamentals of flood and fire disaster prevention. Finally, PART III constitutes the major portion of the specification and determines the minimum requirements for earthquake resistant design. Due to the scope of this study, Chapters 5, 6 and 12 provide necessary information to classify the foundation soils and to obtain the corresponding acceleration response spectra. Chapter 12 defines the foundation soil groups and local site classes and Chapter 6 provides information to obtain elastic response spectrum. In the following subtitle, content of these chapters describing the mandatory instructions to derive the acceleration response spectra are explained in detail.

Table 1.6: Contents of Turkish Earthquake Code 1998.

PART - I GENERAL RULES
Chapter 1 : Scope of the Specification
Chapter 2 : Sites Where No Structure Can Be Built
PART - II FLOOD AND FIRE DISASTER PREVENTION
Chapter 3 : Flood Disaster Prevention
Chapter 4 : Fire Disaster Prevention
PART - III EARTHQUAKE DISASTER PREVENTION
Chapter 5 : Objective, General Principles and Scope
Chapter 6 : Analysis Requirements for Earthquake Resistant Buildings
Chapter 7 : Earthquake Resistant Design Requirements for Reinforced Concrete Buildings
Chapter 8 : Earthquake Resistant Design Requirements for Structural Steel Buildings
Chapter 9 : Earthquake Resistant Design Requirements for Timber Buildings
Chapter 10 : Earthquake Resistant Design Requirements for Masonry Buildings
Chapter 11 : Earthquake Resistant Design Requirements for Adobe Buildings
Chapter 12 : Foundation Soils and Earthquake Resistant Design Requirements for Foundations
Chapter 13 : Final Clauses

1.3.2.2 Classification According to TEC-1998

According to the Turkish Earthquake Code (1998), seismic loads, which may act on buildings during an earthquake, shall be calculated on the basis of the spectral acceleration coefficient $[A(T)]$. Spectral acceleration coefficient $[A(T)]$ corresponding to 5 % damped elastic design acceleration spectrum $[S(T)]$ normalized by the acceleration of gravity (g) is given by Equation (1.5).

$$A(T) = A_0 \cdot I \cdot S(T) \quad (1.5)$$

where;

$A(T)$: spectral acceleration coefficient

A_0 : effective ground acceleration coefficient

I : building importance factor

$S(T)$: spectrum coefficient

Here, the effective ground acceleration coefficient (A_0) stands for the local seismic condition for the site under consideration. Different values of this coefficient are employed according to the seismic zone in which the site is located (Table 1.7). The seismic zones cited in Table 1.7 correspond for the zones depicted in Seismic Zoning Map of Turkey (Figure 1.7). This map was prepared by the Ministry of Public Works and Settlement and issued by the decree of the Council of Ministers and published in 1996.

Table 1.7: Effective ground acceleration coefficient (A_0) (TEC, 1998).

<i>Seismic Zone</i>	<i>Eff. Ground Acc. Coeff. (A_0)</i>
1	0.4
2	0.3
3	0.2
4	0.1

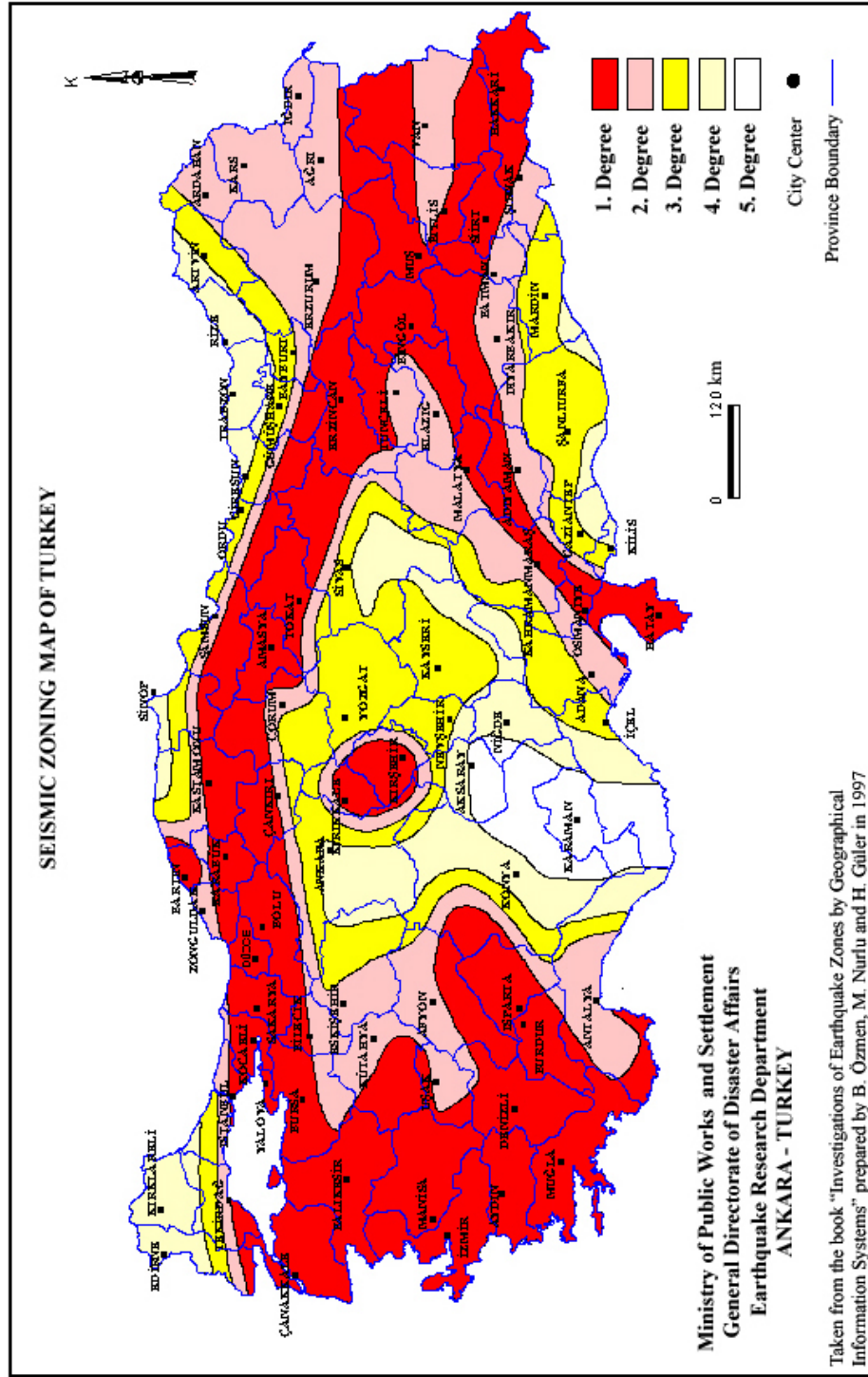


Figure 1.7: Seismic Zoning Map of Turkey (GDDA, 1997).

Building importance factor (I), which is another required parameter to calculate the spectral acceleration coefficient, is defined for different types of buildings (Table 1.8).

Table 1.8: Building importance factors for different buildings (TEC, 1998).

Purpose of Occupancy or Type of Building	Importance Factor (I)
<u>1. Buildings to be utilised after the earthquake and buildings containing hazardous materials</u> a) Buildings required to be utilised immediately after the earthquake (Hospitals, dispensaries, health wards, fire fighting buildings and facilities, PTT and other telecommunication facilities, transportation stations and terminals, power generation and distribution facilities; governorate, county and municipality administration buildings, first aid and emergency planning stations) b) Buildings containing or storing toxic, explosive and flammable materials etc.	1.5
<u>2. Intensively and long-term occupied buildings and buildings preserving valuable goods</u> a) Schools, other educational buildings and facilities, dormitories and hostels, military barracks, prisons, etc. b) Museums	1.4
<u>3. Intensively but short-term occupied buildings</u> Sport facilities, cinema, theatre and concert halls, etc.	1.2
<u>4. Other buildings</u> Buildings other than defined above. (Residential and office buildings, hotels, building-like industrial structures, etc.)	1.0

The third parameter used to calculate the spectral acceleration coefficient is the Spectrum Coefficient [S(T)]. Plot of this coefficient, which is a function of local site conditions and building natural period, presents a general outline as in Figure 1.8.

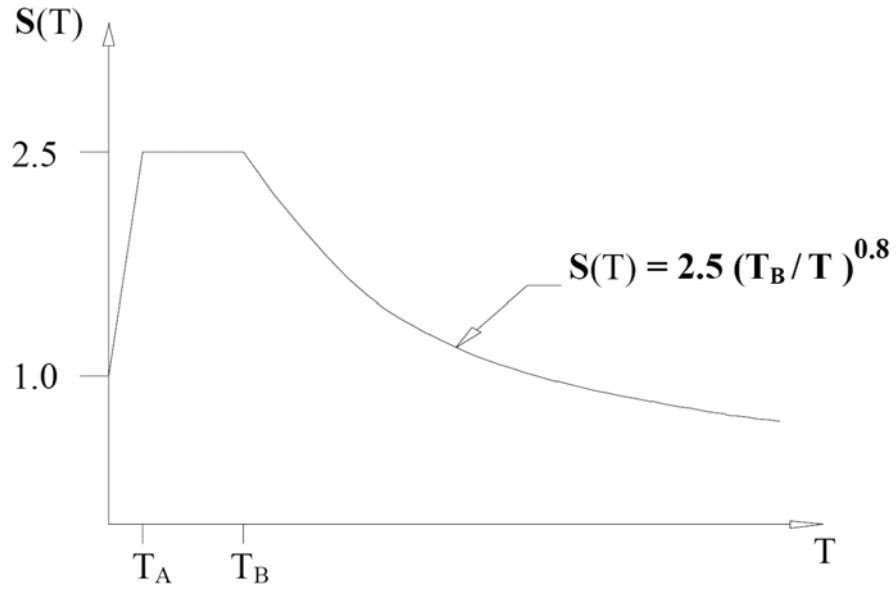


Figure 1.8: General outline of Spectrum Coefficient, S(T) (TEC-1998).

Exact values of the spectrum coefficient, S(T), are computed by the following equations;

$$S(T) = 1 + 1.5 \left(\frac{T}{T_A} \right) \quad 0 \leq T \leq T_A \quad (1.6.1)$$

$$S(T) = 2.5 \quad T_A < T \leq T_B \quad (1.6.2)$$

$$S(T) = 1.5 \left(\frac{T_B}{T} \right)^{0.8} \quad T > T_B \quad (1.6.3)$$

Here, T_A and T_B are the spectrum characteristic periods and (T) is the natural period of the building. Spectrum coefficient is constant and gets its highest value (2.5) between characteristic periods. Certain values for T_A and T_B are assigned for different site conditions (Table 1.9).

Table 1.9: Spectrum characteristic periods (TEC, 1998).

<i>Local Site Class</i>	T_A	T_B
Z1	0.10	0.30
Z2	0.15	0.40
Z3	0.15	0.60
Z4	0.20	0.90

Within the context of TEC-1998, local site classes (Z1, Z2, Z3 and Z4) are designated according to the thickness and the soil group of the topmost soil layer under the foundation. Four different soil groups (A, B, C and D) are defined in TEC-1998 (Table 1.10). Lithological description, standard penetration resistance, relative density, unconfined compressive strength and shear wave velocity of the topmost layer are the parameters to define the soil group. The values of soil parameters in Table 1.10 are to be considered as standard values given for guidance only in determining the soil groups (TEC, 1998).

After determining the soil group of topmost layer under the foundation, local site class is assigned in respect of the Table 1.11. In the case where the thickness of the topmost soil layer under the foundation is less than 3 meters, the subjacent layer may be considered as the topmost soil layer (TEC, 1998).

Table 1.10: Soil groups suggested by TEC-1998.

Soil Group	Description of Soil Group	Stand. Penetr. (N/30)	Relative Density (%)	Unconf. Compres. Strength (kPa)	Shear Wave Velocity (m/s)
(A)	1. Massive volcanic rocks, unweathered sound metamorphic rocks, stiff cemented sedimentary rocks	-	-	> 1000	> 1000
	2. Very dense sand, gravel....	> 50	85 - 100	-	> 700
	3. Hard clay, silty clay.....	> 32	-	> 400	> 700
(B)	1. Soft volcanic rocks such as tuff and agglomerate, weathered cemented sedimentary rocks with planes of discontinuity.....	-	-	500 - 1000	700 - 1000
	2. Dense sand, gravel.....	30 - 50	65 - 85	-	400 - 700
	3. Very stiff clay, silty clay.....	16 - 32	-	200 - 400	300 - 700
(C)	1. Highly weathered soft metamorphic rocks and cemented sedimentary rocks with planes of discontinuity	-	-	< 500	400 - 700
	2. Medium dense sand, gravel...	10 - 30	35 - 65	-	200 - 400
	3. Stiff clay, silty clay.....	8 - 16	-	100 - 200	200 - 300
(D)	1. Soft, deep alluvial layers with high water table.....	-	-	-	< 200
	2. Loose sand.....	< 10	< 35	-	< 200
	3. Soft clay, silty clay.....	< 8	-	< 100	< 200

Table 1.11: Local site classes suggested by TEC-1998.

Local Site Class	Soil Group and Topmost Layer Thickness (h_1)
Z1	Group (A) soils Group (B) soils with $h_1 \leq 15$ m.
Z2	Group (B) soils with $h_1 > 15$ m. Group (C) soils with $h_1 \leq 15$ m.
Z3	Group (C) soils with $15 \text{ m.} < h_1 \leq 50 \text{ m.}$ Group (D) soils with $h_1 \leq 10$ m.
Z4	Group (C) soils with $h_1 > 50$ m. Group (D) soils with $h_1 > 10$ m.

Consequently, all parameters (soil group, local site class, $S(T)$, I , A_0), which are required to figure out the elastic acceleration response spectrum, are determined in accordance with the standards mentioned above. Figure 1.9 illustrates possible spectral curves for different local site classes.

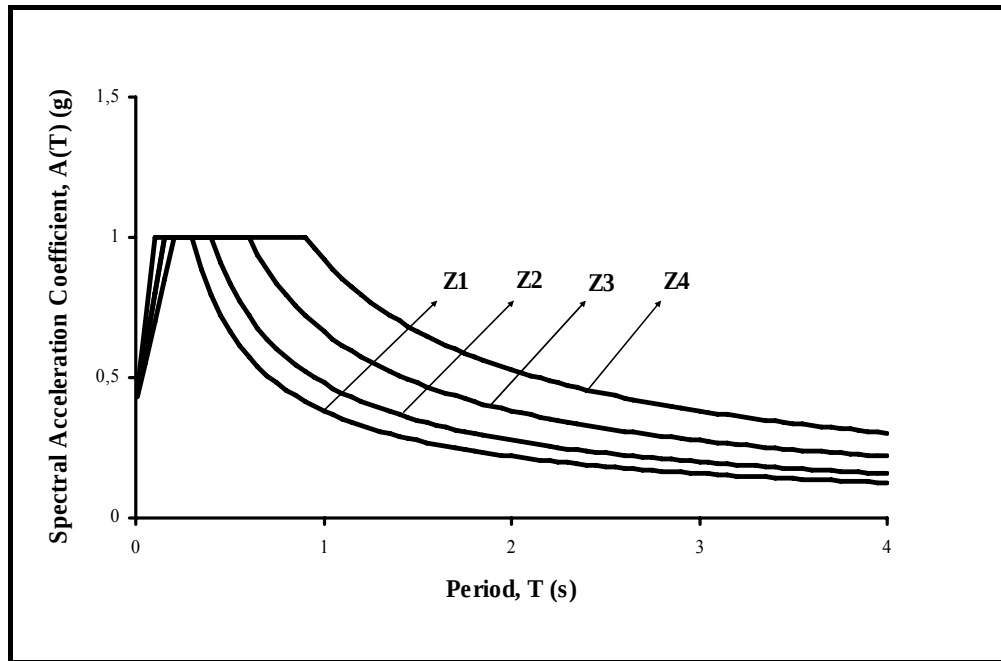


Figure 1.9: Recommended elastic acceleration response spectra for site classes Z1 to Z4 ($A_0 = 0.4$, $I = 1.0$, and 5% damping).

CHAPTER 2

GEOLOGY

2.1 Local Geology

Information on the regional geological setting of Gemlik and adjacent areas can be found in the literature (e.g. Bingöl, 1975; Okay and Monie, 1997; Okay and Tüysüz, 1999; Okay et al., 2000; Okay and Göncüoğlu, 2004). Geological structure in the environs of Gemlik is represented by basement rocks around the Quaternary deposits on which Gemlik settlement is located. The basement rocks in the area are composed of Triassic metabasic lava, metaspillite, radiolarite, chert with calc-schist and marble lenses; Early-Middle Jurassic micritic limestone; Middle Jurassic to Early Cretaceous meta-sandstone, metapelite, phyllite, slate, metashale, quartz-sericite schist, clayey schist, calc-schist and marble; Early Cretaceous recrystallized limestone; Early-Middle Eocene sandstone-siltstone and shale alternation with volcanic intercalations; and Quaternary alluvium, talus and beach sand deposits (Genç, 1986; Kaya and Kozur, 1987; Erendil et al., 1991; Bargu et al., 2000). Beyond the boundary conditions between these lithological units (i.e. conformable boundaries, unconformities, paleotectonic boundaries), present-day geological structure is mainly controlled by the Gemlik fault segment of the North Anatolian Fault System's southern strand. This fault segment determines the southern margin of Gemlik basin. Detailed information on neotectonic features are provided in the following subtitle.

The geological map for the study area and its near vicinity is shown in Figure 2.1. This geological map is compiled from Genç (1986), Kaya and Kozur (1987), Erendil et al. (1991), Bargu et al. (2000) and Koçyiğit (2005). However, it is vital to emphasize that spatial distribution of lithological units in the geological map (Figure 2.1) should be further checked for the upcoming detailed studies. Because, this map is a compilation and it is provided just to give an idea about the distribution of geological features in the area.

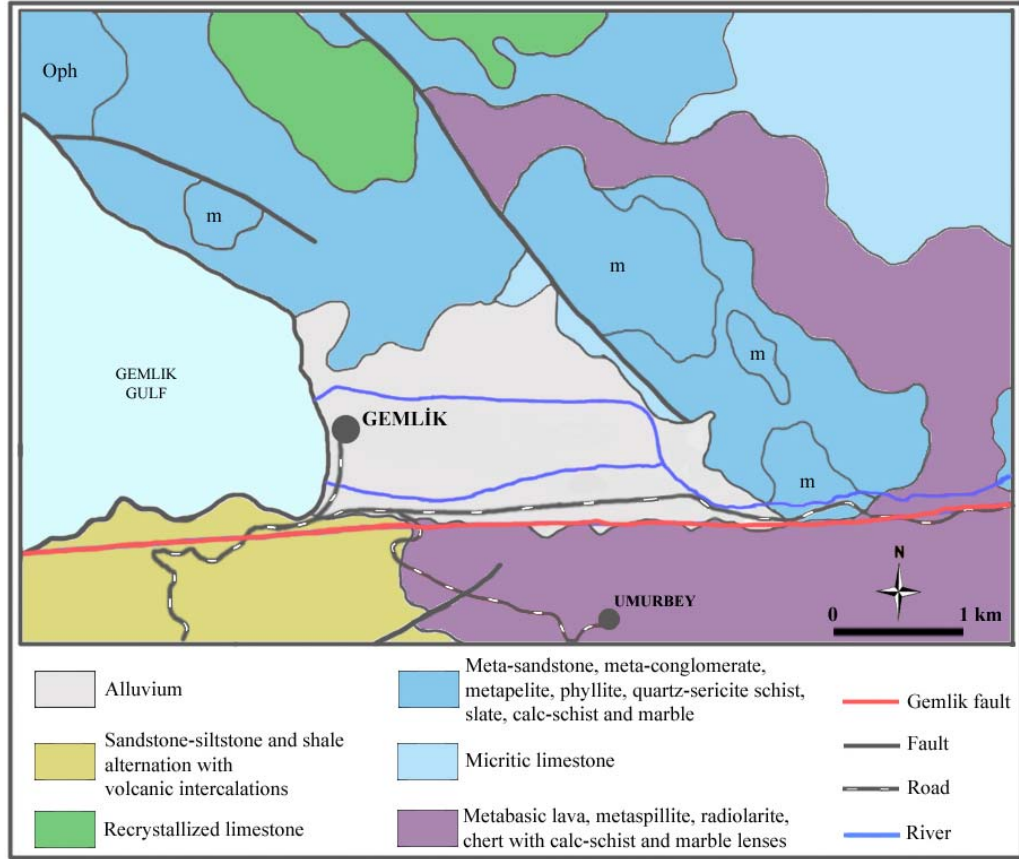


Figure 2.1: Geological map of the study area and its vicinity (compiled from Genç, 1986; Kaya and Kozur, 1987; Erendil et al., 1991; Bargu et al., 2000; Koçyiğit, 2005)

2.1.1 Basement Rocks

The oldest rocks in the study area crop out at the southern, southeastern and northeastern parts of the Gemlik Basin. These Triassic units are composed of metabasic lava, metaspillite and occasionally calc-schist and marble lenses, radiolarite and chert. They are named as Fındıklı formation by Bargu et al. (2000). This formation can be correlated with felsic-mafic metavolcanic rocks and graywacke within the upper levels of schist-marble unit of İznik Metamorphics, which is defined by Erendil et al. (1991). The general appearance of these rocks is dark green and brown. Sometimes greenish gray, purple and grayish purple outcrops are observed. Figures 2.2a and 2.2b illustrate graywacke in the area.



Figure 2.2: Typical views of the graywacke (a) north of Umurbey looking northwest, near to Gemlik Fault (b) in Umurbey settlement looking west.

Triassic units are overlain by Early-Middle Jurassic (Bargu et al., 2000; Erendil et al., 1991) micritic limestone and Middle Jurassic to Early Cretaceous (Kaya and Kozur, 1987; Erendil et al., 1991; Bargu et al., 2000) meta-sandstone, metapelite, phyllite, slate, metashale, quartz-sericite schist, clayey schist, calc-schist and marble to the northeast of the basin.

The Early-Middle Jurassic micritic limestone is named and defined by Kaya and Kozur (1987) as Kayalı limestone, which corresponds to the upper levels of the Aliçyayla limestone of Erendil et al. (1991). This limestone displays thin to medium-thick layers, has micritic texture, and is abundant in solution cavities and fractures (Bargu et al. 2000). The lower and the upper contacts are conformable with the Triassic and Middle Jurassic to Early Cretaceous units, respectively.

The Middle Jurassic to Early Cretaceous units crop out to the north and northwest of the Gemlik Basin. The units were first named by Kaya and Kozur (1987) as Gemlik formation. On the other hand, Erendil et al. (1991) define the units equivalent to the Gemlik formation as “Ophiolite Bearing Schist Unit”, which constitutes the upper levels of İznik Metamorphics. The Gemlik formation consists of predominantly gray meta-sandstone, metapelite, phyllite, slate, metashale, quartz-sericite schist, clayey schist, calc-schist and marble. Occasionally, marble blocks, meta-conglomerate, chert and metabasite are encountered (Bargu et al., 2000). In addition, carbonates and ophiolitic rocks, which are in lens or block nature, are observed in these olistostromal metamorphic units (Erendil et al., 1991). Figure 2.3 presents a typical view of schists in the area. Figures 2.4 and 2.5 also illustrate microscopic views of meta-conglomerate and calc-schist, respectively.

The Middle Jurassic to Early Cretaceous units are conformable with the overlying Early Cretaceous (Bargu et al. 2000) recrystallized limestone and the underlying Early-Middle Jurassic micritic limestone.

The Early Cretaceous recrystallized limestone is well exposed on Soğucak Hills to the north of the Gemlik Basin. It is composed of recrystallized limestone and appears with its thin to medium-thick layers, fractured and jointed structure, and livid color. Shale and chert intercalations are also observed. This limestone is conformable with the underlying Middle Jurassic to Early Cretaceous units.



Figure 2.3: A typical view of schists in Middle Jurassic to Early Cretaceous units, from northern highlands of Gemlik, looking north.



Figure 2.4: Photomicrograph of a meta-conglomerate sample from the Middle Jurassic to Early Cretaceous units (x4, XPL).



Figure 2.5: Photomicrograph of a calc-schist sample from the Middle Jurassic to Early Cretaceous units (x4, XPL).

To the south of the Gemlik Basin the Triassic units are unconformably overlain by Early-Middle Eocene (Genç, 1986; Bargu et al., 2000) units. These units are named as Derbent formation by Bargu et al. (2000). This formation corresponds to the Kurbandağı formation described by Genç (1986). Bargu et al. (2000) defines the units as sandstone-siltstone and shale alternation with volcanic intercalations. Similarly, Kurbandağı formation is composed of sandstone-claystone-sandy limestone alternation with andesitic lava and tuff intercalations (Genç, 1986). In the field, conglomerate is observed at the lower levels of these units. The Early-Middle Eocene units are covered by Quaternary deposits at the near vicinity of the study area.

Figure 2.6 illustrates a typical view of the Early-Middle Eocene units. In this figure, andesitic lava intercalation (right) appears within the sandstone-siltstone and shale alternation.



Figure 2.6: A typical view of the Early-Middle Eocene units at the southwest of the Gemlik Basin, looking east (andesitic lava intercalation (right) within the clastics alternation (left) can be easily seen).

2.1.2 Quaternary Deposits

Gemlik settlement is mainly located in the Gemlik Basin (Figure 2.7), which consists of Quaternary deposits including alluvium, talus and beach sand. Talus exposes at the foothills of the northern highlands. It is not observed on the sides of southern highlands. Beach sands do not spread over a wide area in the Gemlik Basin. Alluvium constitutes the main deposits of the Gemlik Basin. Geotechnical boreholes and water wells drilled in the basin show that the thickness of alluvium nearby the northern margin is relatively less than the thickness around the southern margin. This is probably due to the Gemlik Fault at the southern margin of the basin.



Figure 2.7: From SE to NW, Gemlik Basin (Picture was taken from the southern highlands, Umurbey).

2.2 Neotectonics and Seismicity

Active tectonics of Turkey is the manifestation of collisional intracontinental convergence -and tectonic escape- related deformation since the Early Pliocene (~5 Myr) (Bozkurt, 2001). This deformation is due to the interactions between four plates namely; Eurasian Plate, Arabian Plate, African Plate and Anatolian Platelet.

Turkey is in a geologically very complicated area, which is being deformed by the cooperation of three different neotectonic regimes (strike-slip neotectonic regime, extensional neotectonic regime and the active subduction and compressional neotectonic regime) and relevant structures. Major structures of the strike-slip neotectonic regime are the dextral North Anatolian (NAFS) and East Anatolian (EAFS) strike-slip fault systems along which the intervening Anatolian platelet has been escaping in WSW direction, and overthrusting the easily-subductable oceanic lithosphere of the East Mediterranean Sea (African Plate) along the South Aegean subduction zone (Pliny-Strabo and West Cyprus arcs) (Figure 2.8) (Koçyiğit, 2005). NAFS and EAFS are intercontinental strike-slip faults along which the Anatolian Plate, a wedge of amalgamated fragments of crust, moves westward away from the collision zone between

northward-moving African and Arabian plates, at a rate of ~ 20 mm/yr. This activity is the result of interactions between northward-moving African and Arabian Plates and the relatively stable Eurasian Plate (Bozkurt, 2001). About the northward movement of African and Arabian plates, present-day kinematic studies show that the Arabian Plate is moving in a NNW direction at a rate of 25 mm/yr, while the African Plate is also moving to the north but at a rate of only 10 mm/yr (Bozkurt, 2001).

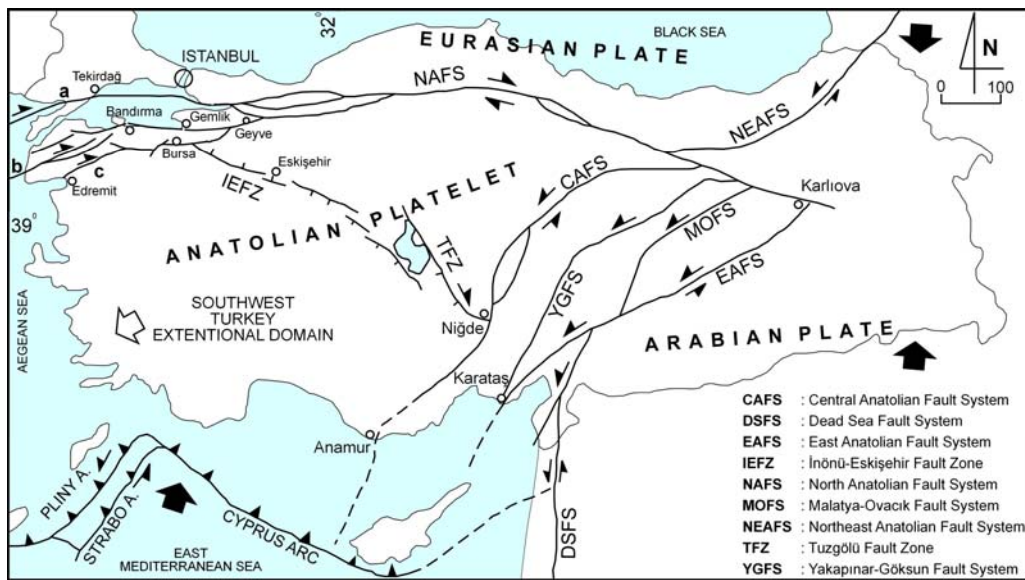


Figure 2.8: Simplified map showing major active fault systems in Turkey and its vicinity, (a) Northern strand of the NAFS (b) Southern Marmara strand of the NAFS (c) Havran-Edremit strand of the NAFS (Koçyiğit, 2005).

In addition to NAFS and EAFS, there are also three intraplate strike-slip fault systems (the Central Anatolian fault system, the Yakapınar-Göksun fault system and the Malatya-Ovacık fault system) which splay off from the North Anatolian Fault System (NAFS), bend in SSW direction, and then cut across the Anatolian platelet and deform it internally (Figure 2.8). In contrast to these strike-slip and the active subduction-compression neotectonic regimes, the southwestern Turkey is also being shaped by the extensional neotectonic

regime dominated by a series of multi-directional graben-horst systems and their margin-boundary active oblique-slip normal faults. Two of the regional structures comprising the well-identified transitional zones between the strike-slip and extensional neotectonic domains are the İnönü-Eskişehir Fault Zone (IEFZ) and the Tuzgölü Fault Zone (TFZ) (Figure 2.8) (Koçyiğit, 2005). Due to the location of the study area, the western part of NAFS is the main concern within the context of this thesis.

NAFS is about 2-110 km-wide, 1600 km-long simple shear system in the nature of continental transform fault boundary separating the Eurasian plate in the north from the Anatolian platelet in the south. It is located between Karlıova county in the east and Northern Aegean Sea in the west, and cuts across the northern part of Turkish main land (Figure 2.8). In the Sea of Marmara region, the NAFS bifurcates into three major strands, namely the Northern Marmara Strand (a in Figure 2.8), the Southern Marmara Strand (b in Figure 2.8), and the Yenişehir-Bursa strand (c in Figure 2.8), and thus it deforms a wider zone (~110 km in width) than its remaining part (Koçyiğit, 2005).

Bozkurt (2001) notes that the age and cause of dextral motion along NAFS is controversial and mentions four basic different views: (1) The right-lateral motion commenced by the Middle Miocene and it is the result of the westward motion of Anatolia away from the collision zone in eastern Turkey when Arabian and Eurasian Plates collided (McKenzie, 1970; Şengör, 1979a and 1979b). (2) Others claimed that NAFS did not initiate until the latest Miocene or Early Pliocene (e.g. Barka and Kadinsky-Cade, 1988; Koçyiğit, 1988; Koçyiğit, 1989; Barka and Gülen, 1989; Dirik, 1993; Barka et al., 2000). (3) There are also claims that the NAFS was initiated in the eastern Anatolia during the Late Miocene and propagated westwards reaching the Sea of Marmara region during the Pliocene (e.g. Şengör, 1979a; Barka, 1992; Tüysüz et al., 1998; Yaltrak et al., 2000 and Okay et al., 2000) (4) More recently, it is

speculated that the initiation of the NAFS is ~16 Myr or older in the east but less than 3 Myr in the west (Gautier, 1999).

There is no evidence that the NAFS became active in the late Middle Miocene – it is just a prediction from Şengör's model (Şengör, 1979a and 1979b). It is also untenable that the NAFS is as young as 3 Myr because it has too much slip to have developed since then given its known slip rate. However, there is now a lot of evidence that NAFS formed in the earliest Pliocene (~5 Myr) as suggested, for the first time, by Barka and Kadinsky-Cade (1988) (in Bozkurt, 2001).

Bozkurt (2001) also mentions a total offset along NAFS ranging from 85 ± 5 km to 20-25 km, which has been obtained from geological works (e.g. Seymen, 1975; Şengör, 1979a; Barka, 1981; Barka and Hancock, 1984; Koçyiğit, 1988; Koçyiğit, 1989; Barka, 1992; Armijo et al., 1999). The analysis of geological data suggests that the rate of motion on the NAFS is about 5-10 mm/yr (Barka, 1992), or 17 ± 2 mm/yr (Westaway, 1994), while the plate motions and seismological data suggest rates of 30-40 mm/yr (Taymaz et al., 1991). This discrepancy arises from the exaggerated slip rate by treating the intense seismicity on the NAFS during 1939-1967 as typical of all time. On the other hand, recent GPS data indicate present-day rates of about 15-25 mm/yr. The extrapolation of recent rates to Early Pliocene yields a total displacement of 75-125 km, which is in close agreement with the estimate of 85 ± 5 km (Bozkurt, 2001).

More recently, one year after the synthesis of Bozkurt (2001), Hubert-Ferrari et al. (2002) presented the results of detailed studies on morphology, displacement and slip rates along the *central and eastern* North Anatolian Fault. They claimed that “While the NAFS seems to have always been in the same place with deformation restricted to a narrow zone, the rate appears to have changed”. They reevaluated the total displacement of NAFS by using large river valleys (85 ± 15 km) and structural markers (Pontide Suture, 85 ± 25 km;

Tosya-Vezirköprü basins, 85 ± 10 km), which suggest a Neogene slip rate of 6,5 mm/yr over 13 Myr. On the other hand, at a smaller scale the morphology associated with small rivers is offset by 200 m along the NAFS. The age of these features can be correlated with the Holocene deglaciation and a slip rate of 18 ± 3.5 mm/yr is determined. This is consistent with a rate of 18 ± 5 mm/yr deduced independently from the ^{14}C dating of stream terrace offsets. Over the short term, GPS data gives a similar rate of 22 ± 3 mm/yr (Hubert-Ferrari et al., 2002).

If movement on NAFS initiated 13 Myr ago, shortly after the beginning of the Arabia/Eurasia collision, then the long term slip rate would be 6.5 mm/yr. This is one third of the more recent rate (Hubert-Ferrari et al., 2002). Three possible explanations can be reviewed: (1) Deformation was distributed in the earlier period and has only become localized more recently. This possibility seems to be precluded by the evidence for the strike-slip deformation being closely restricted to the fault zone and the absence of significant strike-slip deformation in the Pontides. If the fault rate had remained constant at around 20 mm/yr for the whole period other structures would have had to accommodate twice as much deformation as the NAFS. Such deformation would be observable. (2) Deformation has always been localized, but the age of the onset of faulting is overestimated at its eastern end. Thus a constant slip rate is possible if the fault initiated 4 to 5 Myr ago, 10 to 11 Myr after the beginning of the Arabia-Eurasia collision (15 Myr). This would imply that the fault initiated simultaneously at its eastern and western ends or propagated very rapidly from east to west. (3) The deformation has remained localized on the NAF since motion started on it, but the slip rate, was much less in the past than it is now. This change of rate may have been associated with the progressive change of the plate configuration as the NAFS growth. The westward propagation of the NAFS toward the Hellenic trench may have lead in recent geological times to a more stable plate configuration with the complete separation of the Anatolian-Aegean block from the rest of Eurasia (Hubert-Ferrari et al., 2002).

The Holocene slip-rate (18 ± 3.5 mm/yr) along the central and eastern parts of NAFS, suggested by Hubert-Ferrari et al. (2002), is also consistent with the GPS-oriented westward escape-rate of the Anatolian Platelet. In the Sea of Marmara Region, this slip-rate is shared by three major strands of NAFS.

Yaltırak and Alpar (2002) provide information on the age and slip rates of major strands of NAFS in the Sea of Marmara region. The comparison between the GPS data and the total offset reconstructed from the structural setting is an argument suggesting that the Thrace-Eskişehir Fault was cut through by the middle strand (southern strand according to Koçyiğit, 2005) of the North Anatolian Fault (Yaltırak and Alpar, 2002). They claim that the Armutlu and Mudanya-Bursa segments of the Thrace-Eskişehir Fault have been intersected and shifted by approximately 7-8 km. Based on the GPS slip vectors implying the velocity of the Armutlu Peninsula relative to the Mudanya Block is about 0.2 cm/yr (Straub et al., 1997) and considering that the fault between these two blocks is approximately 3.5 Myr or the same age as the northern strand of the North Anatolian Fault along the northern margins of the Gelibolu and Armutlu Peninsula, Yaltırak and Alpar (2002) calculates the total displacement as approximately 8 km, and correlates this displacement with the shift measured between the Armutlu and Mudanya-Bursa segments of Thrace-Eskişehir Fault on tectonic maps. It can also be thought that the Thrace-Eskişehir Fault was originally segmented before the North Anatolian Fault propagation. However, if this is the case, the Thrace-Eskişehir Fault should have started its activity in the late Pliocene (~ 3.5 Myr, Yaltırak and Alpar, 2002). On the contrary, the age of the Thrace-Eskişehir Fault to the south of Gemlik Bay is early Miocene-early Pliocene. Although its rate may be regionally variable with time, the overall movement of the North Anatolian Fault during its propagation can be considered as constant over an interval of 3.5 Myr. Thus, a minimum age of 2.6 Myr is calculated for the middle strand of the North Anatolian Fault in the Marmara Sea, using the maximum shift between the segments of the Thrace-Eskişehir Fault (i.e. 8.0 km) and maximum relative slip-rate between these

blocks (i.e. 0.2-0.3 cm/yr). In other words, the Gemlik Bay was included into the North Anatolian Fault System 2.6 Myr ago (Yaltırak and Alpar, 2002).

In summary, Yaltırak and Alpar (2002) claims that the age of NAFS middle strand (on which Gemlik is located) as 2.6 Myr, by comparing GPS-oriented 2-3 mm/yr slip-rate and displacement on the Thrace-Eskişehir Fault (~8 km) as a result of this slip-rate. In addition, Yaltırak (2000) suggests the distribution of westward motion of Anatolian Platelet (22 ± 3 mm/yr) on the northern, middle and southern strands as; 77.7 %, 9.0 % and 13.3 %, respectively. These percentages result in ~17 mm/yr slip-rate on the northern strand, ~2 mm/yr slip-rate on the middle strand and ~3 mm/yr slip-rate on the southern strand. On the other hand, Koçyiğit (2005) suggests an 8.5 mm/yr slip-rate on the Geyve-İznik Fault Zone (middle strand according to Yaltırak and Alpar, 2002) at Geyve pull-apart basin. He calculates this slip-rate by extrapolating the age of Geyve-İznik Fault Zone (~2.6 Myr) to the 22 km displacement on Sakarya antecedent river. According to Yaltırak's approach, the slip rate around Geyve pull-apart basin must be about 5 mm/yr (total of middle and southern strands). That is to say, these results obtained by different authors and different morphological and structural markers are in relatively good agreement.

After giving information on the age and geodynamics of the NAFS in the light of recent studies, thereafter, more specific data about the neotectonic and seismicity of the Gemlik area will be provided. Detailed neotectonic data is obtained from the report on active fault investigations conducted by Ali Koçyiğit in 2005 within the scope of MEER-A3 Project. As it has been mentioned in the previous parts, the NAFS bifurcates into three major strands in the Sea of Marmara region, namely; the northern Marmara strand (a in Figure 2.8), the southern Marmara strand (b in Figure 2.8), and the Yenişehir-Bursa strand (c in Figure 2.8), and thus it deforms a wider zone (~110 km in width) than its rest part (Koçyiğit, 2005). The southern Marmara strand continues in approximately WSW direction through the Gevye, Mekese, Çerkeşli, Kaynarca, Çamdibi, southern margin of Lake İznik, south of Gemlik,

Kurşunlu, Mudanya, Zeytinbağı and the Gulf of Bandırma, where it bends approximately 35° south and then runs in SW direction across the Biga Peninsula, and finally, enters into water of Northern Aegean Sea (b in Figure 2.8). The Beldibi-Bandırma and the Bandırma-Aegean Sea sections are named separately as the Gevye-İznik, and the Edincik-Ezine fault zones, respectively (Koçyiğit, 2005). The Gevye-İznik Fault Zone is about 0.5-5 km-wide, 250 km-long and WSW-trending right lateral mega shear zone. It consists of a number of 0.5-35 km long, parallel to obliquely-orientated, closely-spaced (a few hundreds m to a few km) fault segments in the nature of master fault (Y-shear), P-shear, synthetic and antithetic Riedel shears or secondary strike-slip faults and oblique-slip normal to reverse faults. Some major morphotectonic structures occur along the whole length of the Gevye-İznik fault zone. Some of them are the Gevye pull-apart basin, Çerkeşli-Kaynarca morphotectonic trough, İznik pull-apart basin and the Gemlik pull-apart basin. These strike-slip depressions are surrounded by the Armutlu Peninsula, which is in the nature of a mega pressure ridge, in the north, and the Avdandağ-Gemişdağ highlands or pressure ridges in the south (Koçyiğit, 2005). The Gemlik pull-apart basin is an eastward narrowing fault wedge-type of pull-apart basin. Its huge and westward widening part is occupied by the Gulf of Gemlik, whereas, its easternmost limited part is terrestrial in nature, and filled by thick, water-saturated Quaternary alluvial sediments composed mostly of marginal coarse-grained fan to talus sediments and depocentral fine-grained floodplain, marsh and beach deposits dominated by sand, silt and organic material rich mud. The Gemlik pull-apart basin is structurally controlled on its southern margin by the Gemlik fault segment of the Gevye-İznik fault zone. However, eastern and northern margins of the basin seem to be inactive, at least during Quaternary period. Therefore, development of the Gemlik basin is structurally asymmetric (Koçyiğit, 2005). Active faults around Gemlik are mentioned under four separate subtitles by Koçyiğit (2005), namely; (1) Gemlik Fault, (2) Gürle, Gençali and Kurşunlu Faults, (3) Narlıca, Şükrüye and Fevziye Faults, and (4) Çamdibi Fault (Figure 2.9).

2.2.1 Gemlik Fault

This is the southern margin-boundary fault of the Gemlik pull-apart basin (Figure 2.10). It is a 14 km-long (on the land), northerly steeply dipping, approximately E-W trending right lateral strike-slip fault (Figure 2.9). The Gemlik fault starts 2 km north of Karsak village in the east and continues westward across the Karsak stream and the Bursa-Yalova road up to the SE corner of the Gulf of Gemlik, where it follows a trace very close to the shore line, and then enters into sea somewhere at Tuzla Burnu (Figure 2.9). The attitude of the fault is measured to be N76°W, 74°NE (Koçyiğit, 2005).



Figure 2.10: From NW to SE, general view of the Gemlik settlement and the southern margin-boundary fault (Gemlik fault) (from Koçyiğit, 2005).

2.2.2 Gürle, Gençali and Kurşunlu Faults

The Gürle fault is about 12 km-long, northerly steeply dipping and E-W trending right lateral strike-slip fault in the nature of Y-shear (master fault)

(Figures 2.9 and 2.11). The attitude of the Gürle fault plane is N80°E, 50°NW on the slickensides observed in the field (Koçyiğit, 2005).



Figure 2.11: From N to S, general view of the Gürle fault and the Karsak restraining bend (from Koçyiğit, 2005).

The Gençali fault is again 12 km-long, E-W-trending and northerly steeply dipping strike-slip fault (Figure 2.9). This fault displays a very steep and northward facing fault scarp deeply carved and dissected by the transverse streams flowing into the Gulf of Gemlik (Figure 2.12). It also displays well-preserved slickenside, on which the attitude of the fault is measured to be N85°E, 82°NW (Koçyiğit, 2005).



Figure 2.12: From N to S, general view of the Gençali fault (from Koçyiğit, 2005).

The Kurşunlu fault is a 9 km-long, E-W-trending and northerly dipping right lateral strike-slip fault (Figure 2.9). It displays well-preserved slickensides with sliplines. Their stereographic plot reveals a strike-slip component (Figure 2.13) (Koçyiğit, 2005).

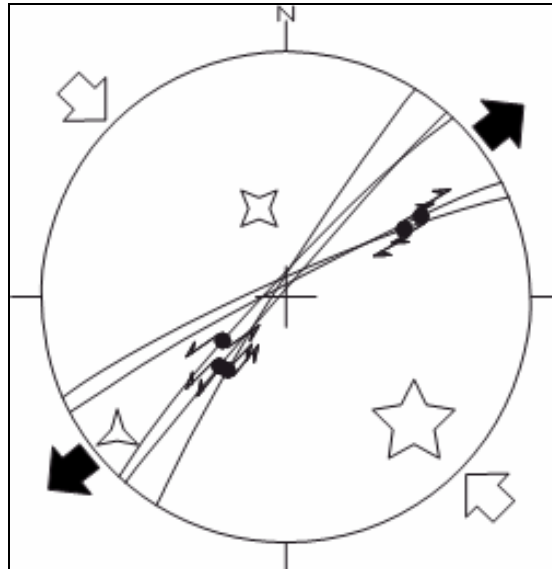


Figure 2.13: Stereographic plot of slip-plane data of the Kurşunlu fault on lower hemisphere of the Schmidt net (open arrows show local compression direction; from Koçyiğit, 2005).

The Gürle, Gençali and Kurşunlu faults are linked to each other with the intervening Karsak and Gençali restraining bends, and they all together have a total length of 39 km (Figure 2.9) (Koçyiğit, 2005).

2.2.3 Narlıca, Şükriye and Fevziye Faults

A strike-slip fault appears at 0.5 km north of the Demirşık village in the east, and then it runs towards west up to 1 km south of the Sölöz village in the west, where it bends south and bifurcates into three sub-branches. Southern two of these sub-branches rejoin after 4 km distance and then continues towards southwest, finally terminates in the near north of Seçköy village. Whereas, the northern sub-branch runs in again SW direction, but it bends and continues in west direction after 4 km distance, finally it also terminates nearby Katırlı village. The eastward and E-W-trending segment was named as the Narlıca fault, the southern sub-branch as the Şükriye and the northern sub-branch as the Fevziye fault segments, respectively (Figure 2.9). The Narlıca fault is 10 km-long, northerly steeply dipping and E-W-trending right lateral strike-slip fault located in the area between apex of Sölöz Delta in the west and near the north of Demirşık village in the east. The attitude of the Narlıca Fault measured on slickenside is E-W, 54°N. The Şükriye and the Fevziye faults are 20 km and 17 km long, respectively, and they cut across the older basement rocks and deform them. These two faults are also active based on their morphotectonic features. The total length of the Narlıca, Şükriye and Fevziye faults are 27 to 30 km (Koçyiğit, 2005).

2.2.4 Çamdibi Fault

This is the longest and continuous fault segment of the Geyve-İznik fault zone. It starts at 1.5 km west of the Demirşık village in the west and runs in ENE direction through Mustafalı, north of Göllüce, Dırazalı, Çamdibi, Hocaköy, Çiçekli, Kaynarca, Beşevler and up to 1.5 km west of the Çiçekli town, where it bifurcates into two sub-branches and terminates (Figure 2.9). The 37 km long,

northerly steeply dipping and ENE-trending Çamdibi fault displays very high (650 m), steep and northerly facing fault front (Figure 2.14). It also displays well-preserved slickenside, on which the attitude of the fault was measured to be $N41^{\circ}E$, $81^{\circ}NW$ (Koçyiğit, 2005).



Figure 2.14: From WNW to ESE, general view of the Çamdibi fault (Dırazali Section; from Koçyiğit, 2005).

Consequently, results of the active fault investigations conducted by Ali Koçyiğit from M.E.T.U. in 2005 within the scope of MEER-A3 Project have been presented. In addition to these investigations, Kurtuluş (1985) conducted high resolution seismic investigations to find out active fault traces in the Gulf of Gemlik. The results of this study indicate that active faults observed on land continue within the Gulf of Gemlik (Figure 2.15).

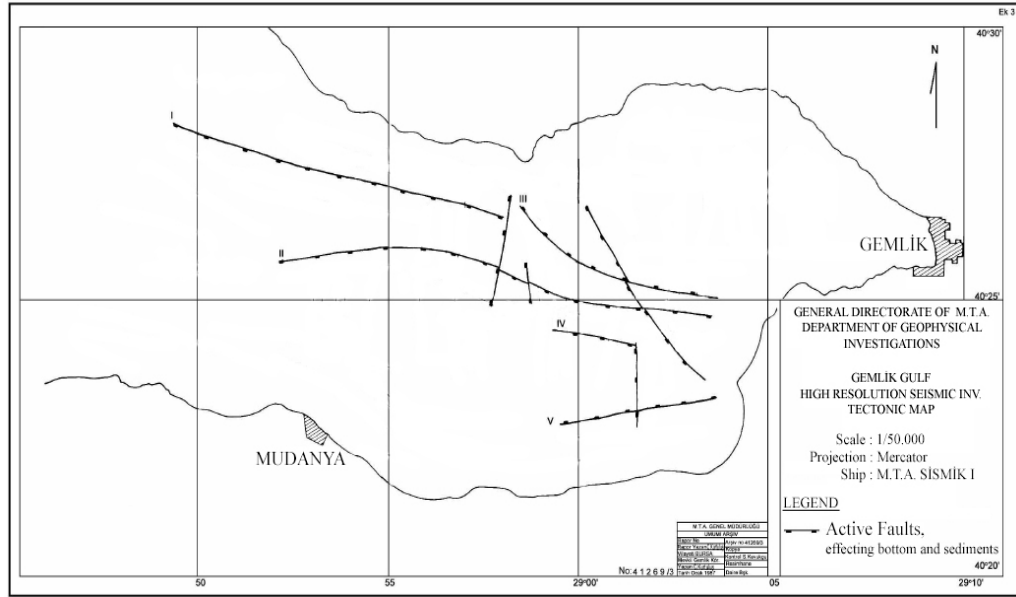


Figure 2.15: Tectonic map of the Gulf of Gemlik (from Kurtuluş, 1985).

Erdik et al. (2005) have conducted a seismic hazard assessment study within the scope of MEER-A3 Project to define the seismic hazard for pilot municipalities in the light of the most recent neotectonic and seismological data. The fault segmentation model used is presented in Figure 2.16. They identified 22 fault segments having potential to produce earthquakes that may affect Gemlik settlement.

The use of a time-dependent (renewal) probabilistic seismic-hazard model is thought to be needed for the assessment of probabilistic hazard in the Marmara region. In time-dependent models, the probability of earthquake occurrence increases with the elapsed time since the last major (or characteristic) earthquake on the fault that controls the regional earthquake hazard (Erdik et al., 2005). Within this context, Erdik et al. (2005) determined the characteristic earthquake parameters for all 22 segments (Table 2.1) and employed these parameters in time-dependent (renewal) probabilistic seismic-hazard analysis.

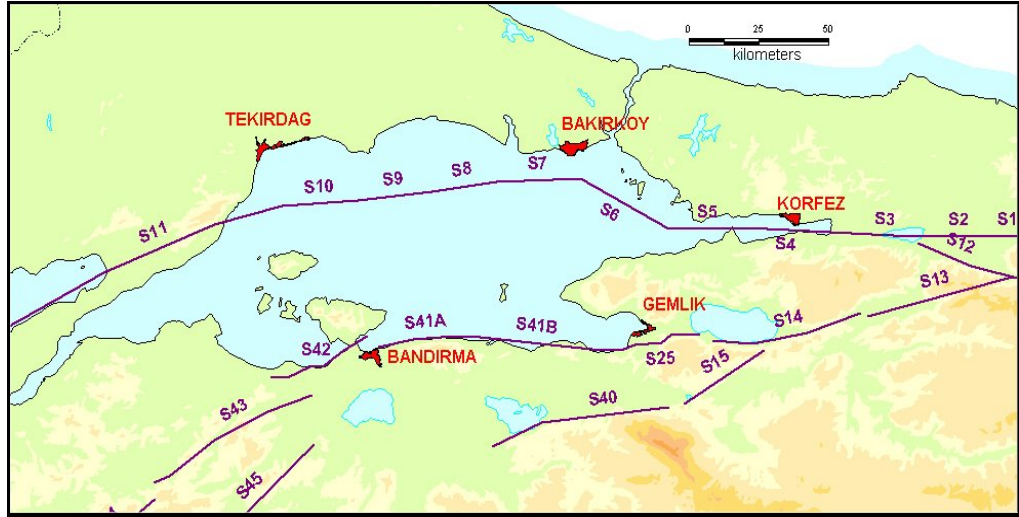


Figure 2.16: Revised fault segmentation model for time-dependent PSHA of the Marmara Region (Erdik et al., 2005).

Table 2.1: Renewal-model characteristic earthquake parameters for the segments (Erdik et al., 2005).

Segment	Last Char. Eq.	COV	Mean Recurrence Time	Char. Magnitude	Time since Last Char. Eq.	Time dependent (Renewal)	
						50year Prob.	Annual Rate
S1	1999	0.5	140	7,2	6	0.0344	0.0007
S2	1999	0.5	140	7,2	6	0.0344	0.0007
S3	1999	0.5	140	7,2	6	0.0344	0.0007
S4	1999	0.5	140	7,2	6	0.0344	0.0007
S5	1894	0.5	175	7,2	111	0.3723	0.0093
S6	1754	0.5	210	7,2	251	0.4095	0.0105
S7	1766	0.5	250	7,2	239	0.3374	0.0082
S8	1766	0.5	250	7,2	239	0.3374	0.0082
S9	1556	0.5	200	7,2	449	0.4191	0.0109
S10	-	0.5	200	7,2	1000*	0.3340	0.0081
S11	1912	0.5	150	7,8	93	0.4206	0.0109
S12	1967	0.5	250	7,4	38	0.0203	0.0004
S13	-	0.5	600	7,4	1000*	0.1771	0.0039
S14	-	0.5	600	7,4	1000*	0.1771	0.0039
S15	-	0.5	1000	7,2	1000*	0.0974	0.0020
S25	-	0.5	1000	7,2	1000*	0.0974	0.0020
S40	1855	0.5	1000	7,5	150	0.0006	0.00001
S41A			1000	7,2			0.0020
S41B	-	0.5	1000	7,3	1000*	0.0974	0.0020
S42	-	0.5	1000	7,2	1000*	0.0974	0.0020
S43	1737	0.5	1000	7,5	268	0.0086	0.0002
S44	-	0.5	1000	7,2	1000*	0.0974	0.0020

* Date of the last characteristic earthquake is unknown.

Based on the results obtained by Erdik et al. (2005), a peak ground acceleration value of 0.425g having 10% probability of exceedance in 50 years is expected at the Gemlik settlement. It should be noted that this PGA value is for bedrock conditions.

CHAPTER 3

DATA REQUIREMENTS

In order to conduct the necessary soil classification procedures for foundation soils according to TEC-1998 and EN-1998, basically, three types of data can be utilized. These data types are; geological, geophysical and geotechnical data. For both earthquake codes, primary classification of the site is based on geological data, which describe the stratigraphic profile. Furthermore, if classification will be implemented for an area (not just for a single point) and some maps will be prepared by interpolation techniques between data points (boreholes), geological data are vital to understand the spatial distribution of lithological units in the region. Shear wave propagation velocity, which is obtained by geophysical investigations, is another important parameter. In addition, standard penetration resistance, undrained shear strength and unconfined compressive strength, which are the other parameters needed for classification, are obtained through geotechnical investigations. On the other hand, some other mechanical properties of soils (i.e. unit weight, void ratio, internal friction angle, plasticity index etc.) may be used to estimate shear wave velocity, in the absence of sufficient geophysical data. By all means, utilization of all three types of data is advantageous to make more precise decisions.

Beyond these data types required for soil classification, seismological data is required to define the expected ground motion on bedrock (seismic action). In TEC-1998, seismic action is represented by the Effective Ground Acceleration Coefficient (A_0), which depends upon the seismic zones depicted in “Seismic Zoning Map of Turkey”. On the other hand, no seismic zoning map is provided by EN-1998. However, it is stated that the reference peak ground acceleration (a_{gR}) can be chosen by the National Authorities or from seismic hazard assessment studies. Fortunately, there exists an up-to-date probabilistic seismic hazard assessment study conducted by the Earthquake Engineering Department

of Kandilli Observatory and Earthquake Research Institute within the scope of MEER Project A3 Component. This study can be used to define the seismic action for Gemlik and its vicinity.

For all types of required data mentioned above, two studies, which had been conducted within the administrative boundaries of the Gemlik Municipality, are the main data sources. The first one was carried out by Bargu et al. (2000). Geological, geophysical and geotechnical investigations were conducted within the scope of this study, entitled “Geological, Geophysical and Geotechnical Investigation Report for Gemlik (BURSA)”. The second one was executed during the project entitled “Marmara Earthquake Emergency Reconstruction (MEER) Project, A3 Component: Microzonation and Hazard Vulnerability Studies for Disaster Mitigation in Pilot Municipalities” in 2005.

Within the following subtitles, available data for Gemlik will be introduced and the parameter estimation procedures, where required data are not available, will be explained in detail.

3.1 Seismological Data

As mentioned above, seismological data is required to define the expected ground motion on bedrock (seismic action). Effective Ground Acceleration Coefficient (A_0) in TEC-1998 and the reference peak ground acceleration (a_{gR}) in EN 1998 stand for the seismic action for the site under consideration. TEC-1998 provides the necessary information for seismic action. However, EN-1998 does not provide seismic action maps for specific regions. Instead, EN-1998 commends to employ the reference peak ground acceleration (a_{gR}) corresponding to 10% probability of exceedance in 50 years.

The report, prepared by Erdik et al. (2005) from the Earthquake Engineering Department of Kandilli Observatory and Earthquake Research Institute within the context of the MEER-A3 project, provides the reference peak ground

acceleration (a_{gR}) corresponding to 10% probability of exceedance in 50 years for Gemlik.

Erdik et al. (2005) conducted probabilistic seismic hazard assessment analysis for pilot municipalities of MEER-A3 Project. The tectonic model developed and used by Erdik et al. (2003) for the seismic hazard assessment of Marmara region had been reevaluated by Erdik et al. (2005) with the help of the report prepared by Koçyigit (2005) and entitled “The active fault investigation in pilot municipalities and their neighborhood”. The revised fault segmentation model used by Erdik et al. (2005) is presented in Figure 3.1.

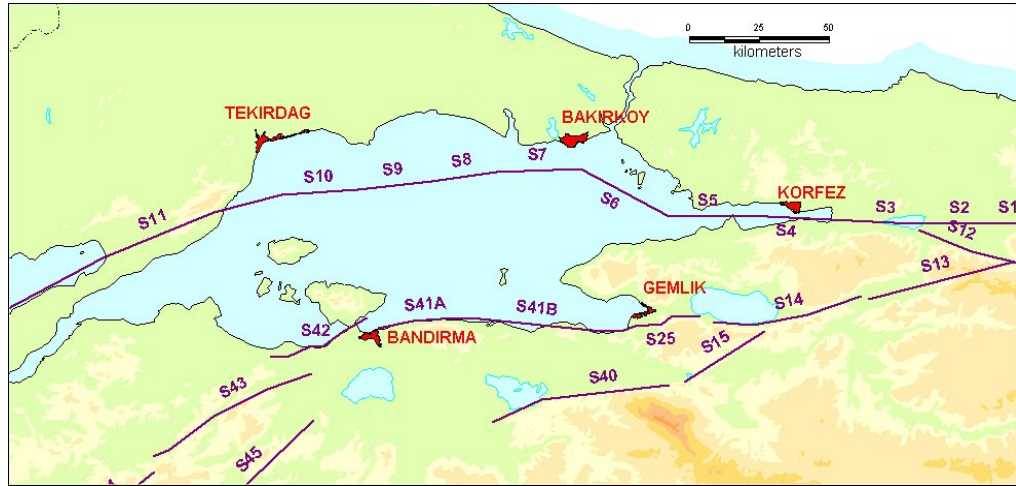


Figure 3.1: Revised fault segmentation model for time-dependent probabilistic seismic hazard assessment of the Marmara Region (Erdik et al., 2005).

For the five pilot municipalities, the analysis was conducted by Erdik et al. (2005) for return periods of 72, 475 and 2475 years corresponding to 50%, 10% and 2% probability of exceedance in 50 years, respectively, and the results are presented for the bedrock conditions. As it is obvious from Figure 3.2, the reference peak ground acceleration (a_{gR}) corresponding to 10% probability of exceedance in 50 years for Gemlik can be regarded as 0.425g.

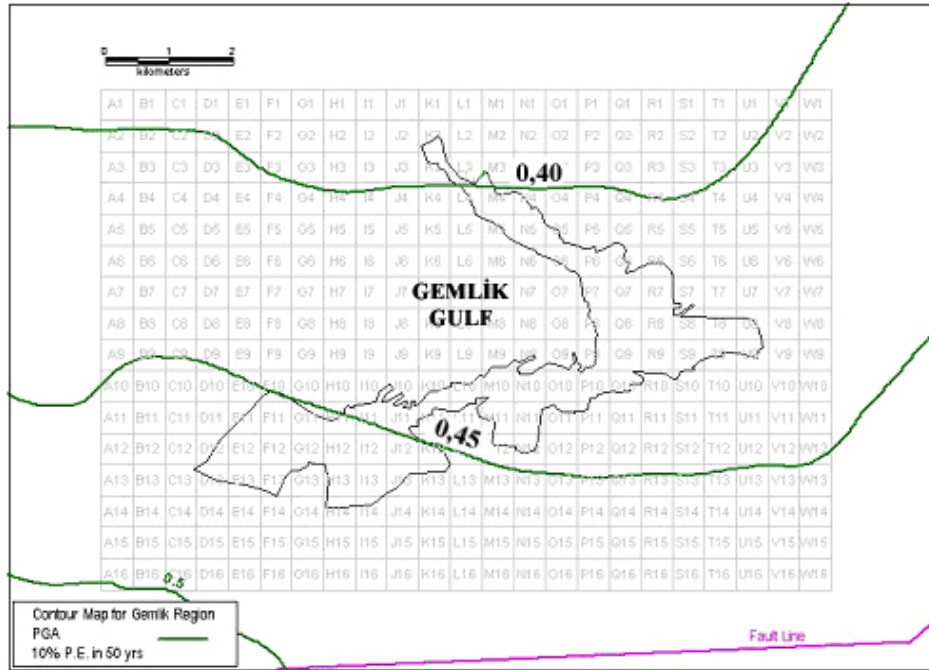


Figure 3.2: PGA contour map for Gemlik region at NEHRP B/C Boundary for 10% probability of exceedance in 50 years (Erdik et al., 2005).

3.2 Geological Data

The study carried out by Bargu et al. (2000) provides 1/2000 scale maps containing development plan of the city and topographical, geological, and engineering geological data. Such kind of maps is really important to know the topography and the exact spatial distribution of soil and rock units in the study area. By combining 1/2000 scale maps, topographical and geological maps are produced.

Topographical thematic map is presented in Figure 3.3. In order to make the visualization of the topographical outline easier, 3-D surface view of the study area is given in Figure 3.4. Geological map of the study area is presented in Figure 3.5.

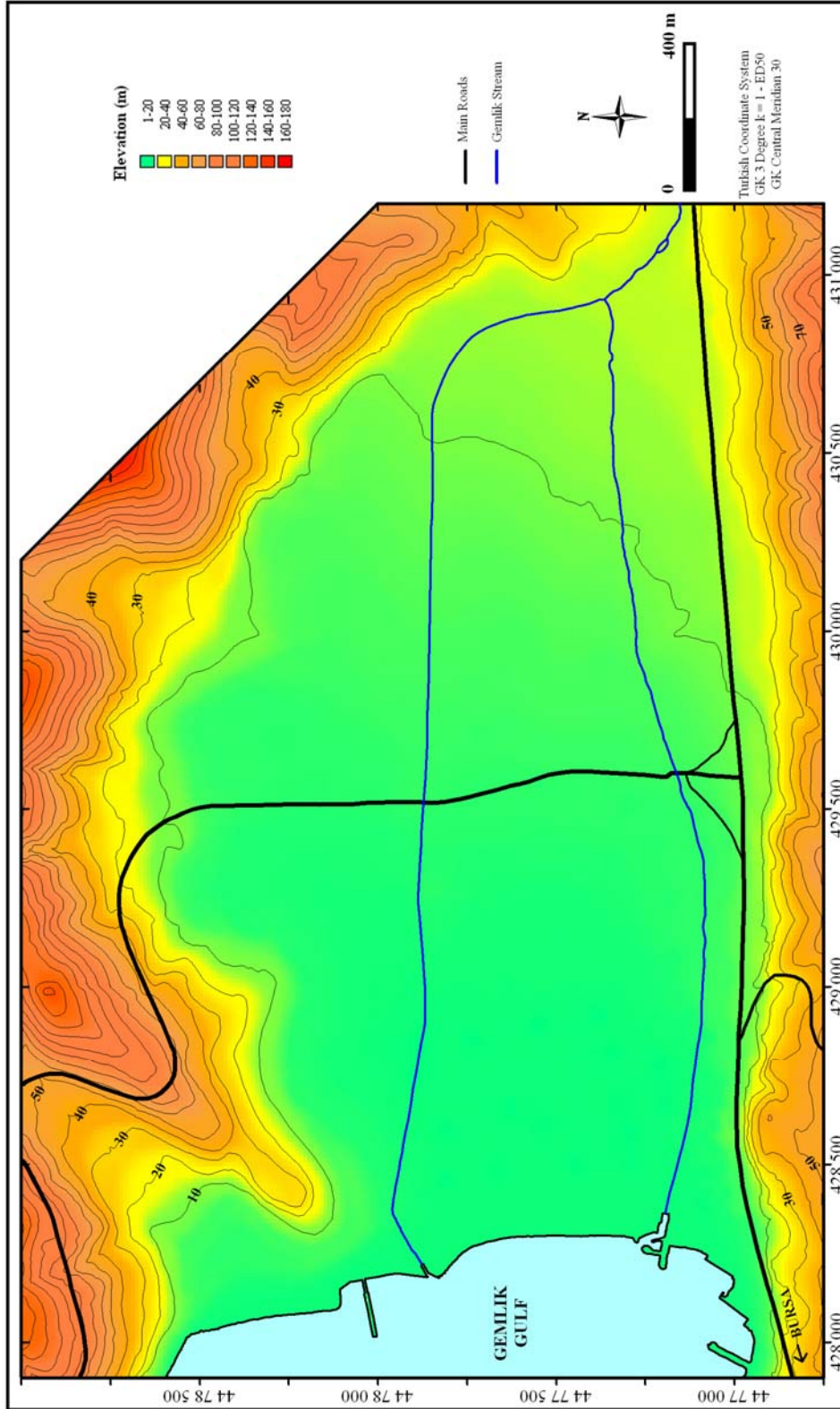


Figure 3.3: Topographical thematic map of the study area.

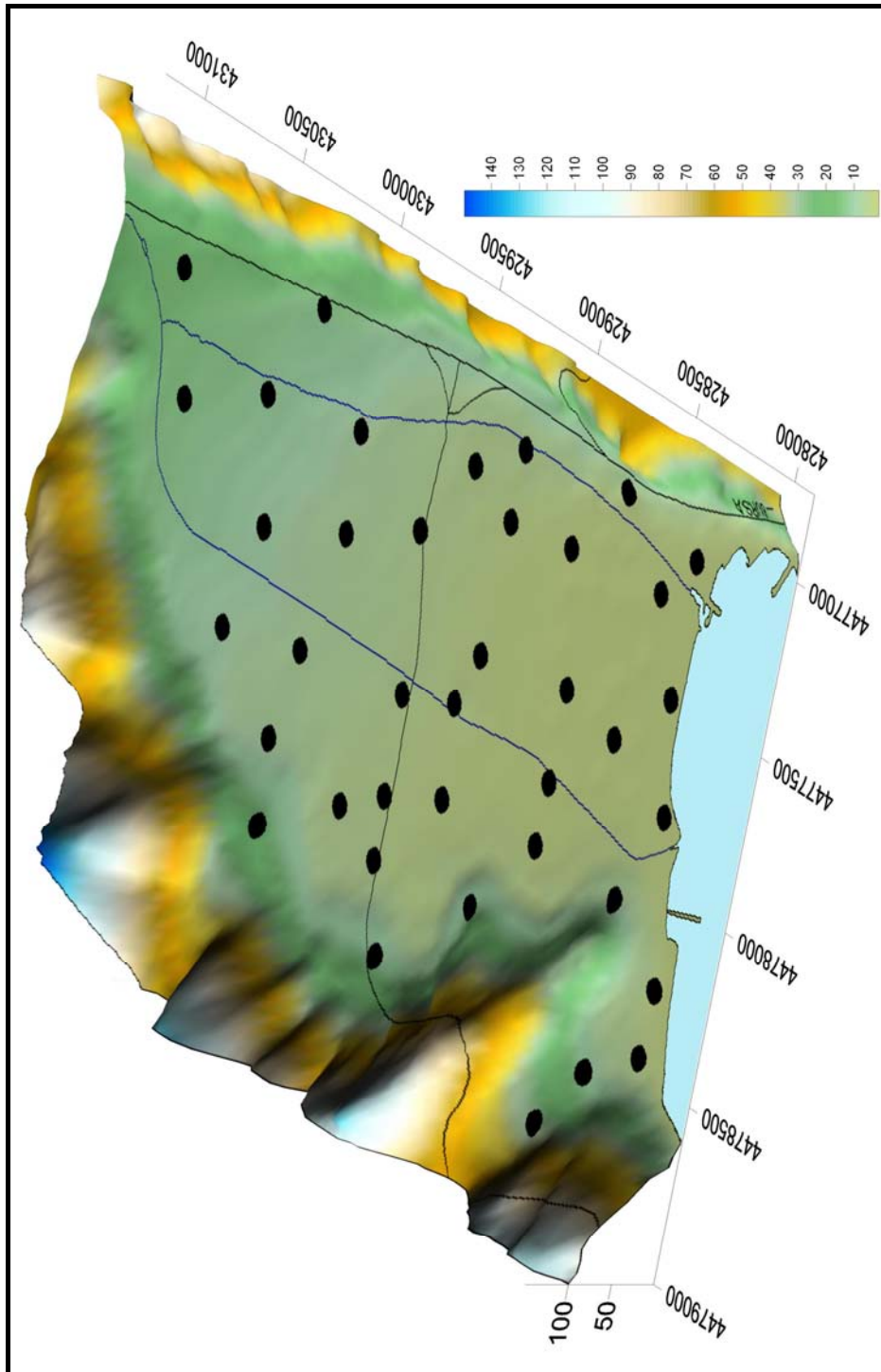


Figure 3.4: 3-Dimensional surface view of the study area.

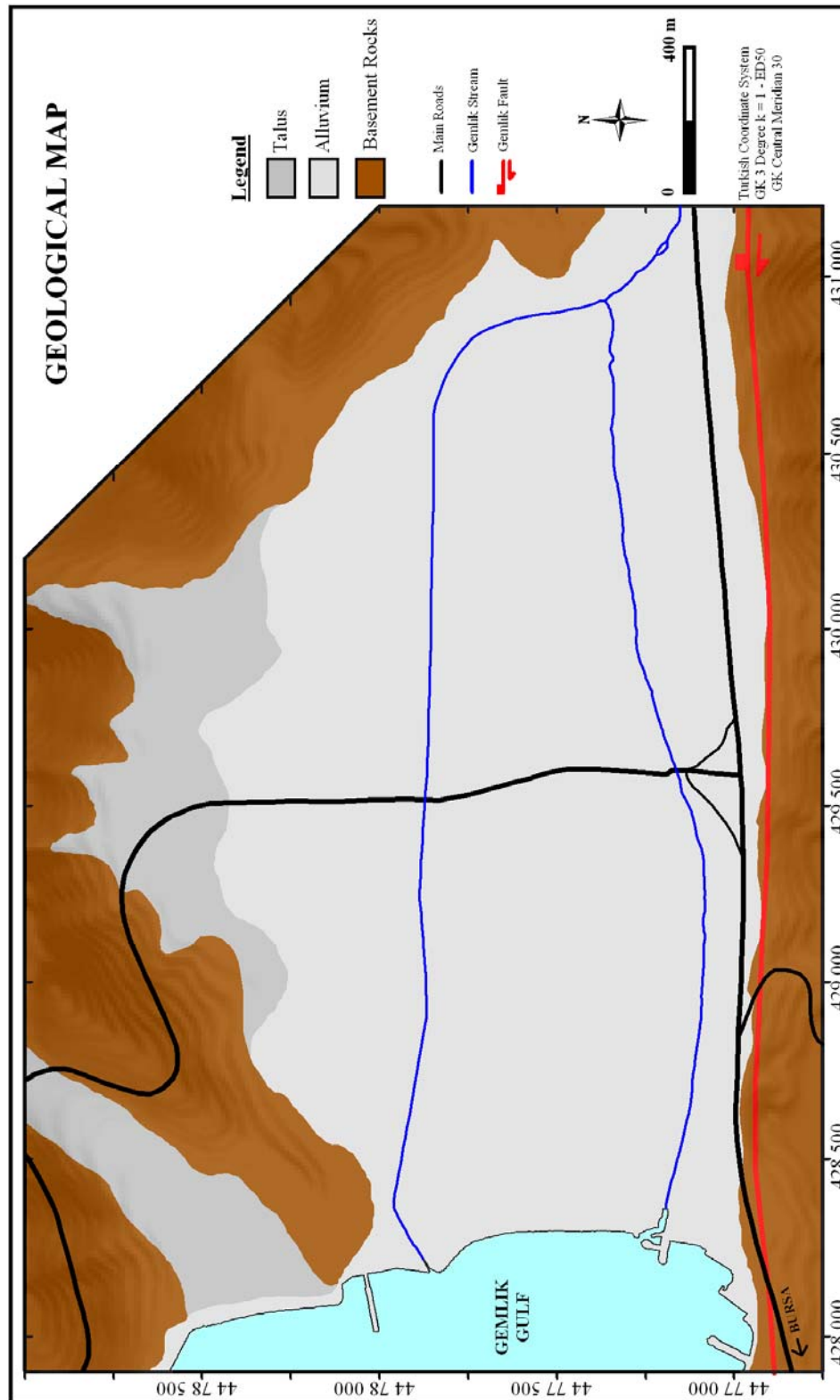


Figure 3.5: Geological map of the study area with relief shading.

3.3 Geotechnical Data

In order to classify the foundation soils in the Gemlik Basin according to TEC-1998 and EN-1998, three types of geotechnical data are utilized, namely SPT blow count, undrained shear strength and unconfined compressive strength.

Within the context of MEER-A3 project, 49 boreholes were drilled to obtain geotechnical data, of which 29 boreholes fall into the study area.

In addition to these boreholes, Bargu et al. (2000) utilized geotechnical data obtained from 49 boreholes. However, 25 boreholes (out of 49) fall into the study area. Unfortunately, 15 boreholes (out of 25) are not taken into account because they are very close to those of MEER-A3 project.

Geotechnical data obtained from 39 boreholes (29 from MEER-A3 and 10 from Bargu et al., 2000) were decided to be utilized in the scope of this thesis. Borehole logs are available in Appendix A. Boreholes from MEER-A3 project are labeled by “S” whereas the others are “SE”. Table 3.1 provides relevant information for these boreholes such as; coordinate, elevation, depth of boreholes and depth of groundwater level. Locations of these boreholes are also plotted on the geological map of the study area (Figure 3.6).

Table 3.1: Coordinates, depth, elevation and groundwater level of boreholes.

	Borehole ID	X (Easting)	Y (Northing)	Z (m)	Depth (m)	GWL (m)
1	S - 4	428721.15	4477043.36	3.60	30	3.4
2	S - 21	428360.14	4477111.95	1.95	30	2.0
3	S - 22	428935.96	4477280.96	2.30	30	3.0
4	S - 23	429221.14	4477104.44	5.00	30	6.0
5	S - 24	429227.23	4477314.01	2.75	30	2.5
6	S - 25	429621.34	4477480.78	5.60	30	2.0
7	S - 26	428350.82	4477501.14	1.20	30	0.8
8	S - 27	428273.25	4477809.68	1.10	30	0.75
9	S - 28	428402.66	4478091.81	6.75	17	1.6
10	S - 29	428828.74	4477646.97	1.95	30	4.0
11	S - 30	428825.38	4477910.85	2.20	30	2.5
12	S - 31	429313.63	4477863.39	4.10	30	2.2
13	S - 32	429554.43	4477925.34	3.50	30	2.2
14	S - 33	429543.39	4478207.28	4.10	30	2.0
15	S - 34	429529.56	4478389.69	4.20	30	4.0
16	S - 35	430036.14	4478471.17	15.60	30	18.0
17	S - 36	430105.81	4478250.51	6.70	30	1.75
18	S - 37	430409.68	4478041.65	7.50	30	2.5
19	S - 38	430314.59	4477722.90	7.80	30	2.5
20	S - 39	429947.82	4477608.65	5.95	30	1.5
21	S - 40	429970.20	4477324.80	6.95	30	1.9
22	S - 41	430407.38	4477377.98	10.50	30	3.0
23	S - 42	430225.40	4477070.31	11.20	30	4.5
24	S - 43	430881.21	4477190.13	14.80	30	9.3
25	S - 44	430770.54	4477525.24	12.50	30	5.0
26	S - 45	428160.86	4478455.36	3.40	30	2.5
27	S - 46	428365.88	4478571.37	13.20	30	-
28	S - 50	429031.56	4478340.51	11.70	20	-
29	S - 51	429286.45	4478125.00	2.37	55	0.6
30	SE - 4	428825.99	4478090.18	2.00	20	1.0
31	SE - 5	428155.92	4478259.90	2.00	18	1.2
32	SE - 11	428494.55	4477249.54	1.20	20	0.3
33	SE - 12	428570.85	4477696.74	1.80	19	1.0
34	SE - 14	429734.76	4478306.69	3.60	18	0.5
35	SE - 15	430047.56	4477975.70	6.20	22	0.8
36	SE - 17	429432.93	4477228.25	4.00	13	0.7
37	SE - 19	429243.72	4477697.26	2.50	28.5	1.1
38	SE - 36	428472.59	4478752.28	27.00	19.5	-
39	SE - 44	429410.35	4478620.20	14.00	15	-

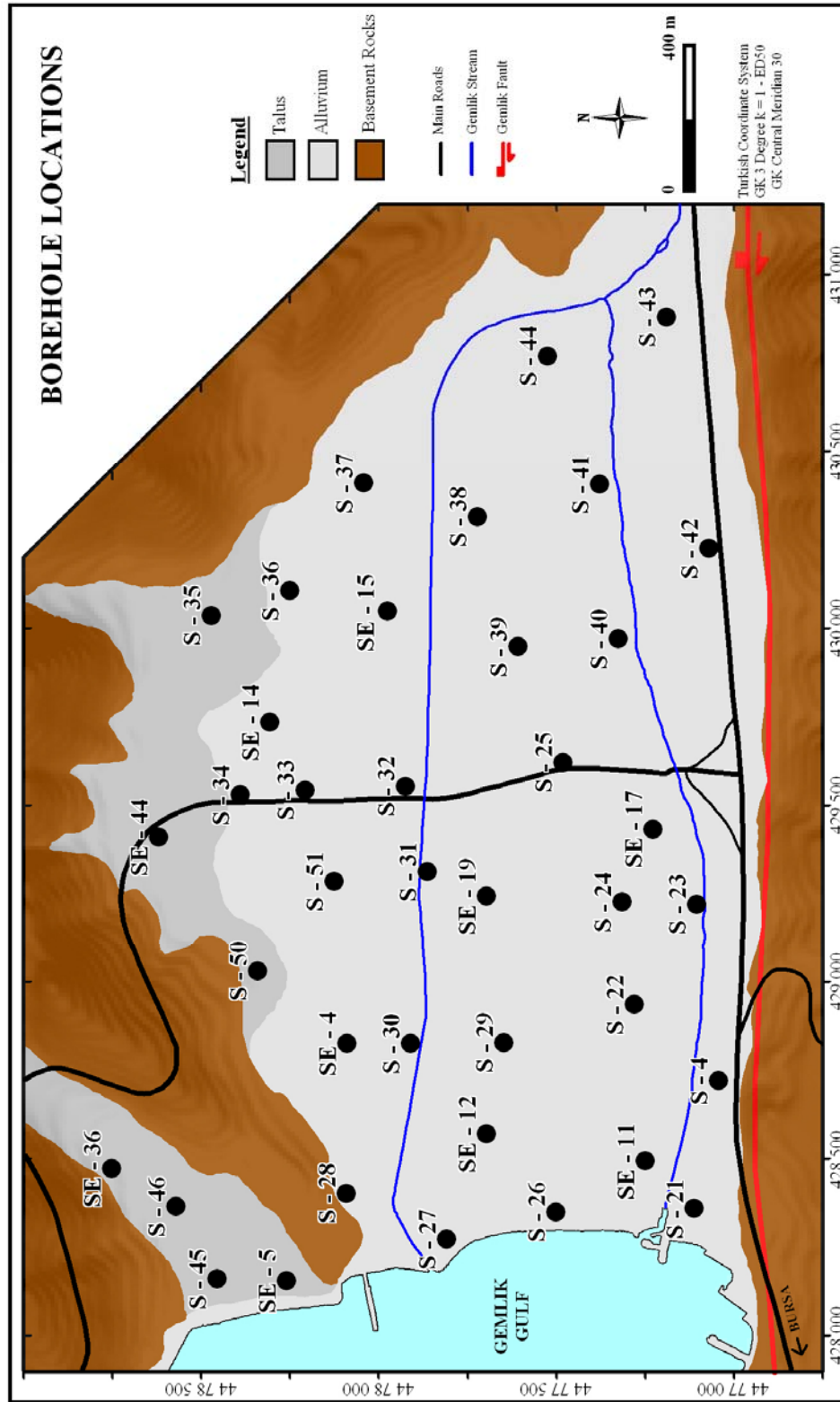


Figure 3.6: Borehole locations.

Within the context of geotechnical investigations for MEER-A3 Project, 544 Standard Penetration Tests had been conducted at each 1.5 meters along the boreholes (29 boreholes). Laboratory tests had been performed on 171 SPT samples to determine the water content, Atterberg Limits and particle size distribution. Based on the test results, the soils were classified according to Unified Classification System. In addition to disturbed samples, 144 undisturbed samples were also taken. On the undisturbed samples, 144 water content, 144 Atterberg Limits, 144 particle size distribution, 124 unit weight, 55 specific gravity, 62 hydrometer tests, 18 direct shear, 45 triaxial, 43 unconfined compression and 54 consolidation tests were performed.

In 10 boreholes drilled during the investigations conducted by Bargu et. al. (2000), 67 SPTs had been performed and 8 undisturbed samples had been taken. On the SPT and undisturbed samples, 21 water content, 22 Atterberg limit and 22 particle size distribution measurements had been done. Undisturbed samples (8 sample) had been taken and 6 water content and 6 Atterberg limit determinations and 1 particle size distribution test had been carried out on those samples.

As it has been mentioned previously, three types of data, namely SPT blow counts, undrained shear strength values and unconfined compressive strength values are utilized for TEC 1998 and EN-1998. As a whole, 611 SPT values and 43 unconfined compressive strength values are available from 39 boreholes. Laboratory test results and SPT blow counts utilized in this thesis are presented in Appendix B.

3.4 Geophysical Data

Shear wave propagation velocity through the foundation soils is one of the required parameters for soil classification according to both TEC 1998 and EN 1998. Within the context of MEER-A3 Project, seismic refraction surveys were carried out at each borehole location (for 29 locations) to obtain shear wave

velocity profile. In these tests, subsurface geometry was assumed to be composed of five layers and shear wave velocity values were calculated for all five layers. Table 3.2 presents the results of seismic refraction surveys. Unfortunately, no seismic refraction survey results were available at the locations of boreholes drilled within the scope of the study conducted by Bargu et al. (2000). At these ten locations, SPT values and soil descriptions will be utilized for classification.

In order to determine the ground type according to EN-1998, average shear wave velocity within topmost 30 meters must be known. Although shear wave velocity values are available from MEER-A3 Project, seismic refraction surveys do not provide sufficient information for this requirement. Penetration depth of these tests is about 10-12 meters.

As it was mentioned at the beginning of this chapter, utilization of more data results in more precise decisions. At this point of view, estimation of shear wave velocity down to 30 meters depth will be advantageous.

Das (1983) noted that some correlations for shear modulus of granular and cohesive soils under low amplitude vibration are available in the literature. These correlations are employed to estimate the shear wave velocity profiles down to 30 meters depth in the light of geotechnical data. Unfortunately, sufficient amount of geotechnical data is not available from the study carried out by Bargu et al. (2000). Therefore, shear wave velocity estimation will be made only for the locations where geotechnical data is available from MEER-A3 Project.

Table 3.2: Results of seismic refraction surveys conducted during MEER-A3.

Borehole ID	Layers				
	1 st	2 nd	3 rd	4 th	5 th
S-4	1.04	2.34	3.97	6.00	-
	129	121	143	168	260
S-21	2.78	6.24	10.58	16.00	-
	177	156	147	198	305
S-22	1.04	2.34	3.97	6.00	-
	165	171	147	128	229
S-23	1.04	2.34	3.97	6.00	-
	134	128	135	161	259
S-24	1.04	2.34	3.97	6.00	-
	116	110	117	142	223
S-25	1.21	2.73	4.63	7.00	-
	134	127	151	156	247
S-26	1.39	3.12	5.29	8.00	-
	165	159	160	174	279
S-27	1.04	2.34	3.97	6.00	-
	213	242	212	148	228
S-28	1.73	3.90	6.61	10.00	-
	390	378	387	265	451
S-29	1.21	2.73	4.63	7.00	-
	89	112	165	178	202
S-30	1.56	3.51	5.95	9.00	-
	126	123	151	162	252
S-31	1.21	2.73	4.63	7.00	-
	144	132	146	185	283
S-32	1.04	2.34	3.97	6.00	-
	130	125	120	140	231
S-33	1.21	2.73	4.63	7.00	-
	108	106	109	116	187
S-34	1.73	3.90	6.61	10.00	-
	323	245	375	406	500
S-35	2.26	5.07	8.60	13.00	-
	269	277	378	328	512
S-36	2.43	5.46	9.26	14.00	-
	125	127	183	215	324
S-37	1.56	3.51	5.95	9.00	-
	160	115	179	242	340
S-38	3.12	7.02	11.90	18.00	-
	145	155	172	187	303
S-39	2.43	5.46	9.26	14.00	-
	99	158	173	204	290
S-40	1.21	2.73	4.63	7.00	-
	187	174	229	268	411
S-41	2.95	6.63	11.24	17.00	-
	154	159	202	203	302
S-42	1.39	3.12	5.29	8.00	-
	206	166	222	254	300
S-43	1.39	3.12	5.29	8.00	-
	181	214	356	380	556
S-44	3.82	8.59	14.55	22.00	-
	177	210	221	244	392
S-45	2.43	5.46	9.26	14.00	-
	257	289	431	434	689
S-46	2.08	4.68	7.94	12.00	-
	217	263	385	341	388
S-50	0.87	1.95	3.31	5.00	-
	611	610	529	322	889
S-51	1.39	3.12	5.29	8.00	-
	141	145	145	126	185
* For each borehole, the first row stands for depth to the bottom of layer (m.) and the second row for shear wave velocity (m/s).					

Hardin and Richart (1963) have reported the results of several resonant column tests conducted in dry Ottawa sands. This study resulted in the following equations for granular soils;

$$V_s = (19.7 - 9.06e)(\sigma'_0)^{1/4} \quad \text{for} \quad \sigma'_0 \geq 95.8 \text{ kN} / \text{m}^2 \quad (3.1)$$

$$V_s = (11.36 - 5.35e)(\sigma'_0)^{0.3} \quad \text{for} \quad \sigma'_0 < 95.8 \text{ kN} / \text{m}^2 \quad (3.2)$$

Lawrence (1965), Hardin and Black (1968), and Humphries and Wahls (1968) have reported results of laboratory tests for shear modulus of cohesive soils. The experimental studies of Hardin and Black (1968) and those of Humphries and Wahls (1968) were conducted by resonant column devices. Lawrence (1965) conducted his tests on cylindrical specimens and measured the travel time for high-frequency shear pulses to determine the V_s . These tests indicate that, for normally consolidated clays of modest sensitivity, Equation (3.3) can be used to predict the shear modulus reasonably. Within 54 consolidation test results, no over-consolidated clay sample is encountered. Hence, all clays in the Gemlik basin are assumed to be normally consolidated. Equation (3.3) mentioned in Das (1983) was first suggested by Hardin and Black (1968).

$$G = \frac{3230(2.97 - e)^2}{1 + e} (\sigma'_0)^{1/2} \quad (3.3)$$

Shear wave velocity can be easily calculated by using the Equation (3.4);

$$V_s = \sqrt{\frac{G}{\rho}} \quad (3.4)$$

where;

G: shear modulus and ρ : density.

In the equations given above, (e) is void ratio of the soil sample and (σ'_0) is average effective confining pressure at the depth of the soil sample. One has to

be careful that the unit of (σ'_0) is N/m^2 in the Equations (3.1) and (3.2). On the other hand, the unit of mean effective stress is kN/m^2 in Equation (3.3).

It is important to point out that for a soil specimen subjected to a stress condition such that $\sigma'_1 \neq \sigma'_2 \neq \sigma'_3$ (where σ'_1 , σ'_2 and σ'_3 are the major, intermediate, and minor effective principal stresses, respectively), the average effective confining pressure is,

$$\sigma'_0 = \frac{1}{3} (\sigma'_1 + \sigma'_2 + \sigma'_3) \quad (3.5)$$

Vertical effective stress at the sampling depth is assumed to be the major effective principal stress, (σ'_1). In order to make calculations easier, horizontal effective stresses are assumed to be equal in all directions. Hence, σ'_2 and σ'_3 are equal to each other.

During the shear wave velocity estimation procedures, characteristic values of necessary parameters (i.e. void ratio, unit weight) are assigned for the soil types specified in borehole logs.

Unit weights of soils encountered through the boreholes must be known to calculate the vertical effective stress distribution. Typical unit weight values of soils are available in the literature. Table 3.3 and Table 3.4 present the typical soil unit weight values suggested by Terzaghi and Peck (1967) and Coduto (2001), respectively. In addition, during the geotechnical investigations within the scope of MEER-A3 Project, laboratory tests were conducted on 124 undisturbed samples taken from 29 boreholes to obtain unit weight values of the Gemlik soils. Different types of soils are grouped according to their descriptions on borehole logs and unit weight measurements for these soil types are plotted in Figure 3.7. Grouping is made on the basis of particle size. Three main classes are defined as fine, intermediate and coarse. Soils having similar particle size are combined (i.e. silty clay and clayey silt). Clays are also divided into three classes as soft clays, medium stiff clays and stiff clays.

Table 3.3: Porosity, void ratio, and unit weight of typical soils in natural state (from Terzaghi and Peck, 1967).

Description	Porosity, n (%)	Void Ratio, e	Water content, w (%)	Unit Weight, γ (kN/m ³)	
				γ_d	γ
1 Uniform Sand, loose	46	0.85	32	14.0	18.5
2 Uniform Sand, dense	34	0.51	19	17.2	20.5
3 Mixed-grained Sand, loose	40	0.67	25	15.6	19.5
4 Mixed-grained Sand, dense	30	0.43	16	18.2	21.2
5 Glacial till, very mixed-grained	20	0.25	9	20.8	22.8
6 Soft glacial Clay	55	1.20	45	-	17.4
7 Stiff glacial Clay	37	0.60	22	-	20.3
8 Soft slightly organic Clay	66	1.90	70	-	15.5
9 Soft very organic Clay	75	3.00	110	-	14.0
10 Soft Bentonite	84	5.20	194	-	12.5

Table 3.4: Typical unit weights for various soils (from Coduto, 2001).

Soil Type and Unified Soil Classification		Typical Unit Weight, γ (kN/m ³)			
		γ_{dry}		γ_{sat}	
		min.	max.	min.	max.
(GP)	Poorly-graded gravel	17.5	20.5	19.5	22.0
(GW)	Well-graded gravel	17.5	22.0	19.5	23.5
(GM)	Silty gravel	16.0	20.5	19.5	22.0
(GC)	Clayey gravel	16.0	20.5	19.5	22.0
(SP)	Poorly-graded sand	15.0	19.5	19.0	21.0
(SW)	Well-graded sand	15.0	21.0	19.0	23.0
(SM)	Silty sand	12.5	21.0	17.5	22.0
(SC)	Clayey sand	13.5	20.5	17.5	21.0
(ML)	Low plasticity silt	11.5	17.5	12.5	20.5
(MH)	High plasticity silt	11.5	17.5	11.5	20.5
(CL)	Low plasticity clay	12.5	17.5	11.5	20.5
(CH)	High plasticity clay	12.5	17.5	11.0	19.5

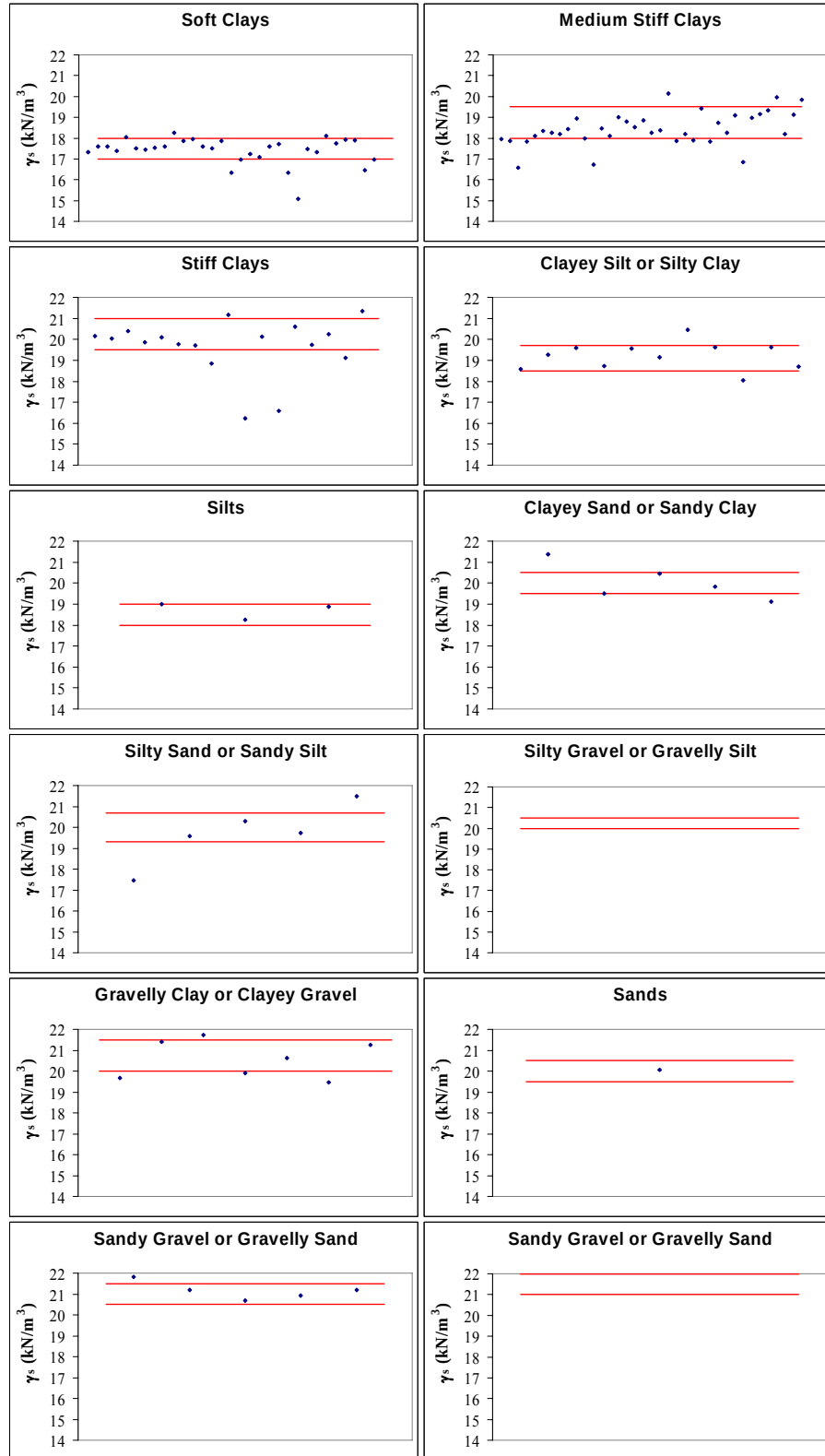


Figure 3.7: Unit weight ranges for different soils in Gemlik alluvial basin.

In accordance with the available data from the literature and the geotechnical investigations, unit weight ranges for Gemlik soils are determined. It is observed that there is well agreement between the values from the literature and the geotechnical investigation results. Finally, unit weight ranges for Gemlik soils are determined and presented in Table 3.5.

Table 3.5: Suggested unit weight ranges for Gemlik alluvial deposits.

SOIL TYPE			Unit Weight, γ_{sat} (kN/m ³)
FINES	Clays	Soft	17.0 - 18.0
		Medium	18.0 - 19.5
		Stiff	19.5 - 21.0
	Clayey Silt or Silty Clay		18.5 - 19.7
	Silt		18.0 - 19.0
INTERMEDIATE	Clayey Sand or Sandy Clay		19.5 - 20.5
	Silty Sand or Sandy Silt		19.3 - 20.7
	Silty Gravel or Gravelly Silt		20.0 - 20.5
	Gravelly Clay or Clayey Gravel		20.0 - 21.5
COARSE	Sand		19.5 - 20.5
	Sandy Gravel or Gravelly Sand		20.5 - 21.5
	Gravel		21.0 - 22.0

After the determination of vertical effective stress in accordance with the unit weight values presented above, horizontal stresses must be calculated to obtain

the average effective confining pressure. This can be done by utilization of a well-known expression;

$$\sigma'_h = K_0 \cdot \sigma'_v \quad (3.6)$$

where;

σ'_h : effective horizontal stress

σ'_v : effective vertical stress

K_0 : at-rest earth pressure

As it is obvious from this formula, at-rest earth pressure must be determined to obtain effective horizontal stress. For granular soils, at-rest earth pressure can be calculated by using the Equation (3.7) (Jaky , 1944);

$$K_0 = 1 - \sin\phi' \quad (3.7)$$

For fine grained normally-consolidated soils, the expression suggested by Massarsch (1979) can be used.

$$K_0 = 0.44 + 0.42 \left[\frac{PI(\%)}{100} \right] \quad (3.8)$$

Internal friction angle (ϕ) of granular soils in the Gemlik Basin are assigned according to the Table 3.6, which is available in Das (2005). Expression suggested by Massarsch (1979) is based on the plasticity index of the soil. Sufficient amount of Plasticity Index measurements are available to assign the characteristic values through the soil profile.

Table 3.6: Typical values of ϕ for granular soils (Das, 2005).

Type of Soil	Internal Friction Angle, ϕ (deg)
Sand: round grains	
Loose	27 to 30
Medium	30 to 35
Dense	35 to 38
Sand: angular grains	
Loose	30 to 35
Medium	35 to 40
Dense	40 to 45
Gravel with some sand	34 to 48
Silts	26 to 35

In this way, the average effective confining pressure is computed. The other necessary variable to predict the shear wave velocity is the void ratio of the soil.

Initial void ratio values are available from consolidation tests conducted on 54 undisturbed soil samples. Void ratio (e) can be estimated by using saturated unit weight and water content of the sample. Sufficient amount of data are available from geotechnical investigations to predict the void ratio values. The Equation (3.9) is employed.

$$e = \frac{w_n \gamma_{sat}}{\gamma_w - w_n (\gamma_{sat} - \gamma_w)} \quad (3.9)$$

where;

w_n : natural water content

γ_{sat} : saturated unit weight

γ_w : unit weight of water

Measured and estimated void ratio values belonging 54 undisturbed soil samples are plotted in Figure 3.8. This figure shows that the expression above results in coherent predictions. Thus, this formula is applicable for all sampling points where water content and unit weight measurements are available.

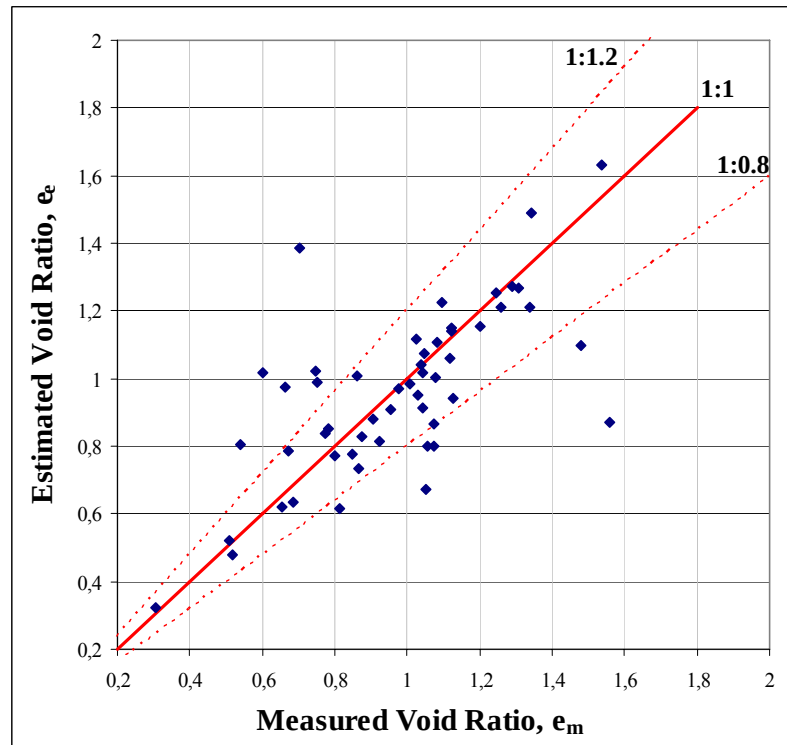


Figure 3.8: Plot of estimated vs. measured void ratio.

As soon as the void ratio and the average effective confining pressure are estimated, shear wave velocity can be calculated in accordance with the Equations (3.1), (3.2) and (3.3). Figure 3.9 illustrates estimated and measured shear wave velocity profiles for selected three borehole locations.

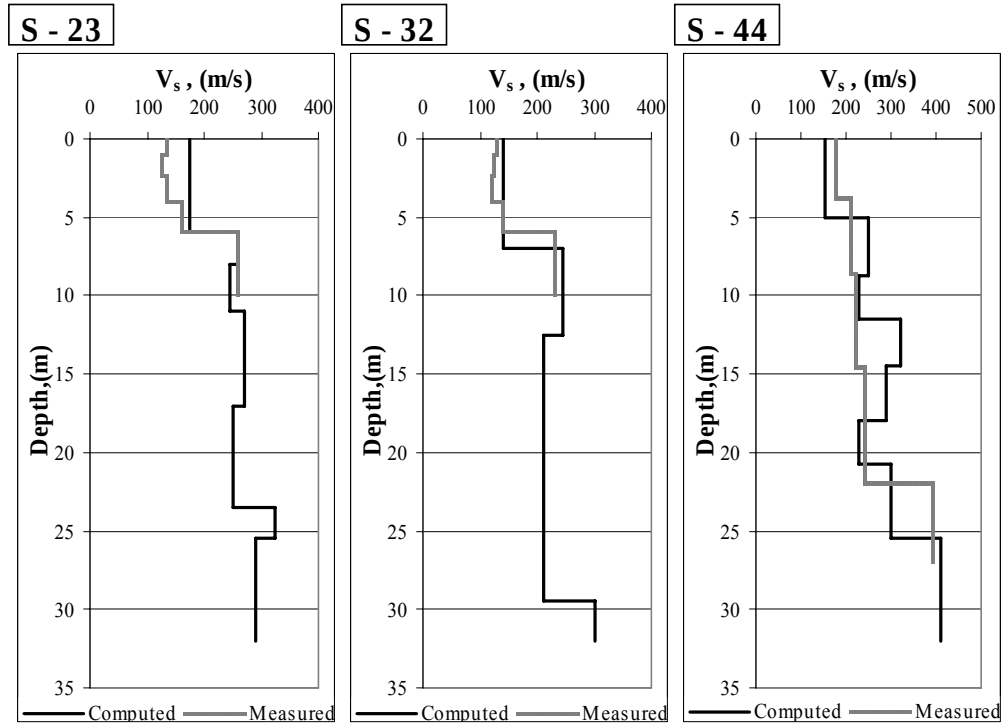


Figure 3.9: Examples for estimated and measured shear wave velocity profiles.

In conclusion, content of the available data for this study has been presented in this chapter. All data utilized for parameter estimation and classification are presented in Appendices. Descriptions of stratigraphic profiles are available in borehole logs presented in Appendix A. Laboratory test results are in Appendix B. The other parameters (SPT blow count and shear wave velocity) utilized for classification are presented in Appendix C for each borehole location.

CHAPTER 4

SOIL CLASSES AND CORRESPONDING RESPONSE SPECTRA

Up to now, classification procedures according to TEC-1998 and EN-1998 have been introduced and available data for classification have been presented in detail. In this chapter, foundation soils at 39 locations in the Gemlik Basin will be classified in the light of available data and the elastic response spectra, corresponding to the site classes, will be calculated.

4.1 Classification

Throughout this section, detailed explanations for classification at each location will be provided. Before that, it is worthwhile to mention some points on which attention must be paid during classifications.

It is vital to emphasize that there exist some common points and constraints for each location. As it has been stated, within the scope of this thesis, all classifications and calculations are carried out for ordinary buildings. Foundation depth for ordinary buildings is assumed to be about 3 meters for all sites. The second constraint concerning the soil class determination is about S_1 and S_2 ground types defined in EN-1998. S_1 is defined as “Deposits consisting, or containing a layer at least 10 m thick, of soft clays/silts with a high plasticity index ($PI > 40$) and high water content”. According to the Atterberg Limit Test results, only two samples (out of 337) have a plasticity index (PI) greater than 40 (Figure 4.1). Therefore, based on the available data it is assumed that no S_1 type ground is located in the Gemlik Basin. S_2 type grounds are also excluded from the scope of this thesis.

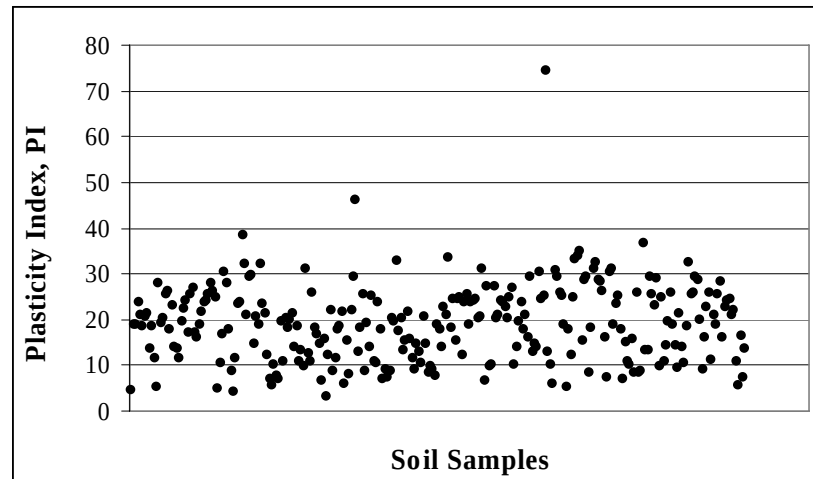


Figure 4.1: Plasticity Index (PI) distribution of the Gemlik soils.

During the classification, some extraordinary parameter values may be encountered. For this reason, available data are divided into two groups according to their reliability. This will facilitate making decisions in such cases. First order reliable data is named “Primary Data” and the second order reliable data is named “Secondary Data”;

Primary Data:

- Soil descriptions supported by Unified Classification System classes
- Representative SPT-blow count of the soil layer
- Measured shear wave velocity

Secondary Data:

- Stiffness and/or density of the soil
- Estimated shear wave velocity
- Non-representative SPT-blow count
- Unconfined compressive strength and/or undrained shear strength

Soil descriptions in borehole logs contain information about the major particle size, proportions and nature of minor constituents, color, stiffness and/or density of the soil layer. If the soil description is supported by the UCS classes obtained from laboratory test results, it is assumed to be reliable enough and included in Primary Data group. However, stiffness and density descriptions are highly dependent on the observations made by the site engineer. For this reason, some abnormal stiffness and density descriptions, which are not coherent with the other mechanical properties of the soil, may be encountered. Hence, stiffness and density descriptions may be included in Secondary Data group.

SPT-blow count is another important parameter for classification. If similar SPT-blow counts appear through the same soil layer, those similar values can be accepted as the representative SPT-blow count for that soil layer. However, sometimes, SPT tests may have been performed on minor constituents of the soil layer (i.e. a thin clay layer in gravel deposits). Such non-representative values should not be taken into account.

Although the shear wave velocity estimation procedure employed in this thesis results in good agreement with the measured ones, in-situ measurements must be preferred instead of estimated velocity values. In the case where all parameters collocate except the measured shear wave velocity and if computed (estimated) value is suitable, the estimated value will be utilized.

Unconfined compressive strength and/or undrained shear strength measurements are not available in sufficient amount (only 43). Due to the lack of data, it is nearly impossible to determine representative strength values for soil layers. However, they may be useful in some circumstances. Therefore, strength parameters are decided to be in the Secondary Data group.

Lastly, in the case of hesitation between two site classes (or ground types), it is preferred to suggest both of them and take the average of the corresponding response spectrum.

S-4, clay and clayey silt deposits ($N_{30} < 10$, $V_s \approx 130$ m/s) are encountered down to 9.7 meters depth. Gravelly sand ($N_{30} \approx 10-20$, $V_s \approx 260$ m/s) having 3.3 meters thickness underlies the clayey deposits. Below these deposits, down to the bottom of borehole, a hard gravelly clay, having SPT-blow counts greater than 50 and average shear wave velocity of 300 m/s, takes place. **(1)** The computed $V_{s,30}$ is about 209 m/s. In the light of this information, ground type is “C” according to EN-1998. **(2)** Clay and clayey silt deposits down to 9.7 meters depth constitutes the topmost soil layer. Below the assumed foundation depth (3 meters), this layer appears to be group (D) soil having a thickness of 6.7 meters. Thus, local site class is determined to be “Z3”, according to TEC-1998.

S-21, within this borehole, very loose to loose sandy gravel deposits ($N_{30} < 10$, $V_s < 200$ m/s) continues down to 5 meters depth. These sandy gravel deposits are underlain by loose to medium dense sand/silty-sand ($N_{30} \approx 14-20$, $V_s < 230$ m/s). Rest of the soil profile is composed of soft to stiff clay ($N_{30} \approx 4-10$, $V_s \approx 200-300$ m/s). **(1)** The computed $V_{s,30}$ is about 210 m/s. SPT blow count can be regarded as below 15. Description of stratigraphic profile and SPT blow count corresponds to D type ground. Although $V_{s,30}$ is a little above the C-D boundary, ground type can be regarded as “D”. **(2)** Topmost sandy gravel layer is a group (D) soil. However, layer thickness below the foundation would be less than 3 meters. In such cases, TEC-1998 suggests to choose subjacent layer as the topmost soil layer. The subjacent layer appears to be loose to medium dense sand/silty-sand. This layer is determined to be a group (C) soil having a thickness of 9.0 meters. However, there exists a dilemma whether the underlying soft to stiff clay is group (C) or (D) soil. If this clay is assumed to be group (D) soil, the local site class would be “Z2”. If the other is the case, a group (C) soil having thickness of greater than 15 meters would appear. Due to this dilemma, local site class is assigned as “Z2-Z3”.

S-22, loose sand ($N_{30} < 10$, $V_s < 200$ m/s) having thickness of 8 meters is underlain by 4.5 meters thick medium dense sand ($N_{30} \approx 24-30$, $V_s \approx 230$ m/s). Down to the depth of 17.7 meters, loose to medium dense silty sand ($N_{30} \approx 15-$

25, $V_s \approx 290$ m/s) takes place. Below these, medium stiff to stiff clay ($N_{30} < 10$, $V_s \approx 200$ m/s) appears down to the bottom of borehole. **(1)** The computed $V_{s,30}$ is about 192 m/s. SPT blow count is generally lower than 15. However, there exist approximately 9 meters thick deposits having SPT blow counts higher than 15. $V_{s,30}$ is also very close to the C-D boundary. At this point of view, ground type will be “C-D”, according to EN-1998 classification. **(2)** Clearly, loose sand ($N_{30} < 10$, $V_s < 200$ m/s) layer is the topmost soil layer and has thickness of 8 meters. It is group (D) soil having 5 meters thickness under the foundation. Hence, the local site class is “Z3”.

S-23, medium stiff to stiff clay ($N_{30} < 15$, $V_s < 200$ m/s) continues down to 6.0 meters depth. Two meters thick gravelly-sand/sandy-gravel layer ($N_{30} \approx 15-20$, $V_s \approx 260$ m/s) underlies the clayey deposits. Down to 17.0 meters depth, loose to medium dense sand/silty-sand soil layer ($N_{30} < 10$, $V_s \approx 260$ m/s) appears. Between 17.0 and 25.0 meters, soft to medium stiff clay ($N_{30} < 8$, $V_s \approx 250$ m/s) is observed. Finally, stiff to very stiff terrestrial clay ($N_{30} \approx 15-30$, $V_s \approx 290$ m/s) takes place. **(1)** The computed $V_{s,30}$ is about 230 m/s. Average SPT blow count is about 13. These values are around the C-D boundary. Soil descriptions are also coherent with both C and D ground types. Due to these uncertainties, Ground type is decided to be “C-D”, according to EN-1998. **(2)** Determination of a representative SPT blow count for the topmost layer (medium stiff to stiff clay) is difficult. Measured and estimated shear wave velocity are in good agreement and lower than 200 m/s. In addition, the stiffness description is contradictory. Due to the agreement in shear wave velocity, classification of this layer can be made on the basis of this parameter. The soil group is decided to be “D”. With its 3 meters thickness, this topmost soil layer results in “Z3” local site class.

S-24, medium dense gravelly-sand/sandy-gravel and stiff sandy clay layers ($N_{30} \approx 11-20$, $V_s \approx 230$ m/s) constitute the uppermost 8.0 meters of this profile. This is underlain by a 9.0 meters thick loose to medium dense sand ($N_{30} \approx 10-25$, V_s

≈ 210 m/s). Between 17.0 and 28.0 meters, medium stiff clay ($N_{30} < 8$, $V_s \approx 240$ m/s) takes place. Close to the bottom of the borehole (28.0-30.0 meters), very dense sandy-gravel ($N_{30} > 20$, $V_s \approx 340$ m/s) is observed. **(1)** The computed $V_{s,30}$ is about 210 m/s. Average SPT blow count is about 12. Soil description is concordant with D type ground. Estimated shear wave velocity values are slightly higher than the measured ones. Hence, $V_{s,30}$ may be lower than 210 m/s. At this point of view, ground type can be regarded as “D”. **(2)** Down to the 17.0 meters depth, the profile consists of group (C) soils. However, medium stiff clay between 17 and 28 meters depth may be either group (C) or group (D) soil. If this clay layer is regarded as group (C) soil, the local site class would be “Z3”. If the other is the case, local site class would be “Z2”. Due to this uncertainty, the local site class is decided to be “Z2-Z3”.

S-25, there exists a 4.0 meters thick silt/sandy silt ($N_{30} < 8$, $V_s \approx 140$ m/s) layer. Loose to medium dense sandy gravel ($N_{30} < 10$, $V_s < 200$ m/s) layers are encountered down to depth of 8.5 meters. Between the depths of 8.5 meters and 11.5 meters, 3.0 meters thick medium dense silty gravel ($N_{30} \approx 10-30$, $V_s < 260$ m/s) layer appears. Loose gravelly sand ($N_{30} \approx 10$, $V_s < 260$ m/s) layer appears between 11.5 m and 13.0 m. Below 13.0 meters depth, soft to medium stiff clay and clayey silt layers ($N_{30} < 8$, $V_s \approx 220$ m/s) continue down to 29.5 meters depth. **(1)** The computed $V_{s,30}$ is about 195 m/s. Average SPT blow count is about 8 (90% is lower than 15). By considering these two parameters and the soil description, ground type is decided to be “D”. **(2)** Down to 8.5 meters depth, the profile contains group (D) soils. Clearly, the local site class is “Z3”.

S-26, 3.5 meters thick medium dense gravel ($N_{30} \approx 10-15$, $V_s \approx 170$ m/s) layer is underlain by a 9.5 meters thick loose to medium dense gravelly sand ($N_{30} \approx 10-17$, $V_s \approx 200-300$ m/s). Down to 20.5 meters, loose to medium dense fine sand and medium stiff silt ($N_{30} \approx 5-15$, $V_s \approx 240$ m/s) take place. The rest of the profile is composed of medium stiff clay ($N_{30} < 8$, $V_s < 200$ m/s). **(1)** The computed $V_{s,30}$ is about 198 m/s. SPT blow counts are lower than 15. Ground is

classified as type “D”, according to EN-1998. **(2)** The profile presents group (C) soils down to 19.0 meters depth. This configuration of topmost soil layer corresponds to the local site class “Z3”.

S-27, the uppermost part of this soil profile consists of 3.5 meters artificial fill. Down to 10.0 meters depth, very loose to loose fine-sand/silt and sand layers ($N_{30} < 8$, $V_s \approx 200$ m/s) are observed. This layer is followed by a very soft to medium stiff silt ($N_{30} < 8$, $V_s \approx 130$ m/s) having a thickness of 6.0 meters. Below 16.0 meters depth, soft clayey silt, medium stiff to stiff clay and soft to medium stiff clay ($N_{30} < 10$, $V_s \approx 175$ m/s) appear. **(1)** The computed $V_{s,30}$ is about 158 m/s. All SPT blow counts are smaller than 15. The site obviously rests on “D” type ground, according to EN-1998. **(2)** Group (D) soils take place through the whole profile down to 30.0 meters. The local site class is obviously “Z4”.

S-28, 12 meters thick Talus ($N_{30} > 50$, $V_s \approx 350$ m/s) consisting of fine to coarse schist gravels, schist blocks, gray to greenish brown colored clay and some sand, rests on gray to greenish brown colored, slightly to moderately weathered schist. Measured shear wave velocity of the schist is 541 m/s. **(1)** The measured $V_{s,15}$ is about 379 m/s. In respect to assumption of linear increase in shear wave velocity with depth, $V_{s,30}$ can be approximated by 540-560 m/s. The most suitable ground type is seemed to be “E”. **(2)** Topmost soil layer is group (A) or (B) soil with a thickness of 9.0 meters. Both cases result in local site class “Z1”.

S-29, medium stiff silty-clay and clay layers ($N_{30} < 8$, $V_s < 200$ m/s) appear down to 5.8 meters depth. There exists a negligible gravelly sand layer having thickness of 0.7 meters. Below this negligible layer, soft to medium stiff clay ($N_{30} < 8$, $V_s \approx 200$ m/s) continues down to the bottom of the borehole. **(1)** The computed $V_{s,30}$ is about 178 m/s. SPT blow counts does not exceed the value of 8. According to these values and the description of stratigraphic profile, ground type is obviously “D”. **(2)** Topmost soil layer for this locality consists of group

(D) soil having a thickness greater than 10 meters. Hence, local site class is “Z4”.

S-30, medium stiff to stiff clay ($N_{30} < 8$, $V_s < 200$ m/s) is observed down to 6.0 meters depth. Medium dense gravelly sand ($N_{30} \approx 10-30$, $V_s \approx 200-300$ m/s) layer underlies the clay and continues down to 10.2 meters depth. Soft to medium stiff clay ($N_{30} < 8$, $V_s < 200$ m/s) appears at the rest of the borehole. **(1)** The computed $V_{s,30}$ is about 176 m/s. Average SPT blow count is about 8 and 85% of the SPT have values smaller than 15. Ground type is “D”, according to EN-1998. **(2)** Topmost soil layer is medium stiff to stiff clay. Due to being group (D) soil having 3.0 meters thickness, local site class can be accepted as “Z3”. If the subjacent layer (4.0 meters thick gravelly sand) is taken into account, the site class will be “Z2”. Hence, suggested local site class is “Z2-Z3”.

S-31, soft to medium stiff terrestrial and marine clay ($N_{30} < 8$, $V_s < 200$ m/s) constitutes the topmost 5.5 meters thick layer. Between 5.5 meters and 11.0 meters depth, loose to dense sandy-gravel/gravelly-sand and sand layers ($N_{30} \approx 10-20$, $V_s \approx 200-300$ m/s) appear. Below 11.0 meters depth, soft to medium stiff clayey-silt/silt and clay deposits ($N_{30} < 8$, $V_s \approx 200$ m/s) appear down to the bottom of the borehole. **(1)** The computed $V_{s,30}$ is about 190 m/s. Most of the SPT blow counts (90%) are below 15. Due to these values of the parameters and the soil description, the ground type is decided to be “D”, according to EN-1998. **(2)** Down to 5.5 meters depth, group (D) soils are observed. However, this layer can not be accepted as the topmost soil layer because its thickness is lower than 3.0 meters, under the foundation. So, the subjacent layer of group (C) soil is the topmost soil layer with a thickness of 5.5 meters. Hence, the local site class is “Z2”.

S-32, silty clay and clay layers ($N_{30} < 8$, $V_s < 200$ m/s) take place down to 6.5 meters depth. 6.0 meters thick gravelly silty sand ($N_{30} \approx 15-30$, $V_s \approx 200-300$ m/s) underlies these clayey layers. The stratigraphic profile, down to the depth

of 29.5 meters, consists of soft to medium stiff clay ($N_{30} < 8$, $V_s \approx 210$ m/s). At the bottom of the borehole, medium dense sandy gravel ($N_{30} > 10$, $V_s \approx 300$ m/s) is observed. **(1)** The computed $V_{s,30}$ is about 185 m/s. Most of SPT values (70%) are below 15. This location rests on “D” type ground, according to EN-1998. **(2)** The top most soil layer is a group (D) soil with a thickness of 3.5 meters. According to TEC-1998, the local site class is obviously “Z3”.

S-33, throughout the whole depth of this borehole, SPT blow counts do not exceed the value of 8. Similarly, shear wave velocity does not exceed 200 m/s. **(1)** The computed $V_{s,30}$ is about 165 m/s. SPT blow count is lower than 15. Hence, the subsurface is composed of “D” type ground. **(2)** Group (D) soils are observed along the whole profile down to the bottom of the borehole. The local site class is obviously “Z4”, according to TEC-1998.

S-34, for this location, there exist a contradiction between the estimated and measured shear wave velocity. Shear wave velocity seems to be underestimated with respect to the measured values. However, the estimated values are in good agreement with the SPT blow counts and the soil descriptions. To be on the safe side, SPT blow counts are taken into account for classification. Soft to stiff silty clay and clay deposits ($N_{30} < 8$) appears all along the borehole. **(1)** The ground type is accepted as “D”, according to EN-1998. **(2)** The whole profile consists of group (D) soils. Therefore, the local site class is “Z4” according to TEC-1998.

S-35, talus/terrestrial alluvium, which is composed of brown to greenish brown clay, fine to coarse (angular) schist originated gravels and fine to coarse grained sand, is observed down to 13.0 meters depth. However, this layer is divided into two layers due to the difference in SPT and the shear wave velocity values. The first layer ($N_{30} \approx 10-15$, $V_s \approx 250$ m/s) has 5.0 meters thickness. The second layer ($N_{30} > 35$, $V_s \approx 340$ m/s) continues down to 13.0 meters depth. Below this talus, hard/very dense gravelly-clay/clayey-gravel deposits, which displays representative values of $N_{30} > 35$ and $V_s \approx 400-500$

m/s, take place down to the bottom of the borehole. **(1)** The computed $V_{s,30}$ is about 322 m/s and 50% SPT blow counts is higher than 50. By considering also the stratigraphic profile descriptions, the ground is classified as “B”. **(2)** The first talus layer is a group(C) soil. However, it can not be regarded as the topmost soil layer. As the soil descriptions and the SPT blow counts are taken into account, the rest of the profile is composed of group (A) soils. So, the local site class is “Z1”.

S-36, below 2.7 meters depth, medium stiff to stiff clay ($N_{30} \approx 4-11$, $V_s < 200$ m/s) takes place down to 9.0 meters depth. Medium dense gravelly sand ($N_{30} \approx 10-25$, $V_s \approx 230$ m/s) appears between 9.0 meters and 13.0 meters depth. Soft to medium stiff clay ($N_{30} < 8$, $V_s \approx 180$ m/s) underlies this gravelly sand. Below 17.5 meters depth, stiff to hard gravelly clay ($N_{30} \approx 16-34$, $V_s \approx 310$ m/s) continues down to the bottom of the borehole. **(1)** The computed $V_{s,30}$ is about 210 m/s. Average SPT blow count is about 15. The ground type is decided to be “C-D”. **(2)** Topmost soil layer is the medium stiff to stiff clay, which is a group (D) soil. This layer is 6.0 meters thick. Hence, the local site class is “Z3”.

S-37, soft to medium stiff clay and clayey silt deposits ($N_{30} < 8$, $V_s < 200$ m/s) appear down to 16.0 meters depth. Medium dense/very stiff silty sand and silt ($N_{30} \approx 25$, $V_s < 260$ m/s) continue down to 20.5 meters depth. 5.0 meters thick stiff to very stiff clay ($N_{30} \approx 15$, $V_s < 240$ m/s) rests on 4.0 meters thick hard/very dense gravelly-clay/clayey gravel ($N_{30} > 50$, $V_s \approx 310$ m/s). At the bottom of the borehole, completely weathered schist ($N_{30} > 50$, $V_s \approx 430$ m/s) is encountered. **(1)** The computed $V_{s,30}$ is about 200 m/s. Half of the SPT blow counts are lower than 15 and the others are between 15 and 50. The ground type is determined to be “C-D”. **(2)** Group (D) soils continue down to 16.0 meters depth. Hence, the local site class is “Z4”.

S-38, 5.5 meters thick stiff/medium dense gravelly-silty-clay/clayey-silty-gravel deposits ($N_{30} \approx 10$, $V_s < 200$ m/s) are underlain by 1.5 meters thick loose sandy gravel. Between 7.0 meters and 13.2 meters depth, medium stiff clay

($N_{30} \approx 8-16$, $V_s \approx 185$ m/s) appears. Down to 17.5 meters depth, medium dense to dense sandy-gravel/gravelly-sand layer ($N_{30} \approx 10-30$, $V_s \approx 200-300$ m/s) takes place. This layer is underlain by 3.0 meters thick hard gravelly silt ($N_{30} \approx 35-45$, $V_s \approx 320$ m/s). Stiff to very stiff silty clay ($N_{30} \approx 8-16$, $V_s \approx 240$ m/s) is located between the depths of 20.5 meters and 23.8 meters. A 2.4 meters thick very dense clayey gravel ($N_{30} > 50$, $V_s \approx 290$ m/s) underlies the stiff silty clay. At the bottom of the borehole, stiff to very stiff clayey silt ($N_{30} \approx 8-16$, $V_s \approx 270$ m/s) is observed. **(1)** The computed $V_{s,30}$ is about 222 m/s. Average SPT blow count is about 22, which is resulted from SPT values between 15 and 50. Hence, the ground type is “C”, according to EN-1998. **(2)** Almost entire soil profile is composed of group (C) soils. The local site class is “Z3”.

S-39, very soft to stiff clay ($N_{30} \approx 8-16$, $V_s < 200$ m/s) takes place down to 9.5 meters depth. Between 9.5 meters and 24.0 meters depth, medium dense silty-sand/sand deposits ($N_{30} \approx 10-22$, $V_s \approx 200-300$ m/s) are located. Below these thick sandy deposits, very stiff gravelly clay/clay ($N_{30} \approx 20-26$, $V_s \approx 280$ m/s) continues down to 28.5 meters depth. Finally, medium dense to very dense sandy-gravel/gravelly-sand ($N_{30} > 50$, $V_s \approx 340$ m/s) is encountered at the bottom of the borehole. **(1)** The computed $V_{s,30}$ is about 207 m/s. Although the average SPT blow count is about 17, most of the blow counts are about 15 or above 15. Hence, the site rests on ground type of “C”. **(2)** The topmost layer is composed of group (D) soils with a thickness of 6.5 meters. Obviously, the local site class is “Z3”.

S-40, down to 5.3 meters depth, soft to medium stiff clay ($N_{30} < 8$, $V_s < 200$ m/s) rests on 12.0 meters thick medium dense gravelly sand ($N_{30} \approx 10-30$, $V_s \approx 200-300$ m/s). A medium stiff clay layer ($N_{30} \approx 8-16$, $V_s < 240$ m/s) of 3.0 meters thick underlies the gravelly sand layer. Between 20.5 meters and 26.0 meters depth, medium dense gravelly sand ($N_{30} \approx 18-25$, $V_s \approx 330$ m/s) layer appears. At the bottom of the borehole, hard gravelly clay ($N_{30} \approx 30-35$, $V_s \approx 340$ m/s) is encountered. **(1)** The computed $V_{s,30}$ is about 227 m/s. Although the

average SPT blow count is about 18, most of blow counts are about 15 or above 15. Therefore, ground type is “C”, according to EN-1998. **(2)** Except the soft to medium stiff clay layer, the stratigraphic profile is composed of group (C) soils down to the depth of 26.0 meters. For this reason, the local site class is determined to be “Z3”.

S-41, soft to medium stiff silty-sandy-gravelly clay ($N_{30} < 10$, $V_s < 200$ m/s) continues down to 7.7 meters depth. Below this layer down to 18.6 meters depth, medium stiff clay ($N_{30} \approx 10$, $V_s \approx 200$ m/s) appears. A thin layer (2.2 meters) of dense gravelly sand underlies the clay. Stiff to very stiff clay ($N_{30} \approx 13-16$, $V_s \approx 260$ m/s) appears between 20.8 meters and 24.9 meters depth. Finally, dense to very dense gravelly-clayey-sand/sandy-clayey-gravel ($N_{30} > 40$, $V_s \approx 340$ m/s) appears at the bottom of the borehole. **(1)** The computed $V_{s,30}$ is about 210 m/s. Although the average SPT blow count is about 18, the profile down to 19.0 meters depth presents SPT blow counts lower than 15. It is reasonable to suggest the ground type as “C-D”. **(2)** The topmost layer composed of soft to medium stiff silty-sandy-gravelly clay layer is a group (D) soil. However, the subjacent layer of medium stiff clay presents such properties that it is near the boundary between the groups (C) and (D). If it is group (C) soil, the local site class would be “Z3”. Otherwise, the local site class would be “Z4”. Due to this dilemma, the local site class is decided to be “Z3-Z4”.

S-42, the soil profile starts with 4.2 meters thick loose clayey sand ($N_{30} < 10$, $V_s \approx 200$ m/s). Medium dense sandy gravel ($N_{30} \approx 10-30$, $V_s \approx 240$ m/s) appears down to 7.5 meters depth. Between 7.5 meters and 13.8 meters depth, medium stiff to stiff clay ($N_{30} \approx 6-15$, $V_s \approx 220-300$ m/s) is observed. This layer is underlain by hard clay ($N_{30} \approx 38$, $V_s \approx 275$ m/s) having thickness of 3.7 meters. Between 17.5 meters and 20.0 meters depth, loose to medium dense sandy gravel ($N_{30} \approx 20$, $V_s \approx 315$ m/s) is observed. A medium stiff silty clay layer ($N_{30} < 8$, $V_s \approx 195$ m/s) continues down to 23.5 meters depth. Very stiff sandy clay ($N_{30} \approx 22-23$, $V_s \approx 300$ m/s) is located between 23.5 meters and 29.0

meters depth. Finally, very dense gravel ($N_{30} > 50$, $V_s \approx 370$ m/s) takes place at the bottom of the borehole. **(1)** The computed $V_{s,30}$ is about 232 m/s. The average SPT blow count is about 19. The ground type is determined to be “C”, according to EN-1998. **(2)** For this locality, group (C) soils continue down to 13.8 meters depth, which results in “Z2” local site class.

S-43, there exists a disagreement between the estimated and measured shear wave velocity values. The measured values are seemed to be more coherent with the other properties of soils. So, the measured shear wave velocity values are taken into account down to depths where they are available. At the topmost part of the profile, 5.5 meters thick stiff to very stiff sandy silt deposits ($N_{30} \approx 10-16$, $V_s \approx 200-400$ m/s) appear. A 6.0 meters thick medium dense to dense sandy gravel layer ($N_{30} \approx 30$, $V_s \approx 380-560$ m/s) underlies the sandy silt deposits. Below this sandy gravel layer, 1.9 meters thick medium dense gravelly sand and 1.4 meters thick hard clay/clayey silt ($N_{30} \approx 14-16$) layers are observed. Between 14.8 meters and 16.3 meters depth, medium dense gravel ($N_{30} \approx 66$) layer is located. A very thin hard gravelly-sandy-clay layer is observed under the layer composed of gravel deposits. Medium dense to very dense gravelly-sand/sandy-gravel deposits ($N_{30} \approx 16-17$) are observed between 17.5 meters and 23.5 meters depth. Stiff to very stiff clay/sandy-clay ($N_{30} \approx 10-20$) deposits are settled down to 27.5 meters depth. Finally, dense sandy gravel ($N_{30} \approx 30-40$) is encountered at the bottom of the borehole. **(1)** The computed $V_{s,30}$ is about 266 m/s. As it has been mentioned at the beginning of this paragraph, shear wave velocity values are seemed to be underestimated. If an approximation is employed by assuming a linear increase in shear wave velocity with depth, $V_{s,30}$ would be found about 570 m/s. In addition, the average SPT blow count is about 29. Most probably, the ground type is “B-C”, according to EN-1998. **(2)** The profile is highly dominated by group (C) soils down to the depth of 27.5 meters. Hence, local site class is “Z3” according to TEC-1998.

S-44, there exist medium stiff to stiff clay and sandy clay deposits ($N_{30} < 10$, $V_s < 200$ m/s) down to 5.2 meters depth. Dense silty-gravel/gravelly-silt layer ($N_{30} \approx 30-40$, $V_s \approx 210-250$ m/s) is observed between 5.2 meters and 8.3 meters depth. Stiff clay ($N_{30} \approx 11-12$, $V_s \approx 220-230$ m/s) underlies down to 11.5 meters depth. A 2.8 meters thick dense gravelly sand ($N_{30} \approx 30-50$, $V_s \approx 320$ m/s) is observed. Stiff to very stiff clay ($N_{30} \approx 20-25$, $V_s \approx 290$ m/s) takes place under the gravelly sand down to 20.2 meters depth. Hard gravelly clay ($N_{30} > 50$, $V_s \approx 300-400$ m/s) is located between 20.2 meters and 25.0 meters depth. Finally, all deposits mentioned above rest on highly-completely weathered schist ($N_{30} > 50$, $V_s \approx 410$ m/s). **(1)** The computed $V_{s,30}$ is about 241 m/s. Predominantly, the profile presents SPT blow count ranging between 15 and 50. So, the ground type is decided to be “C”. **(2)** Group (B) soils continue down to 20.2 meters depth. The local site class is obviously “Z2”.

S-45, talus in the form of gravelly-sand/sandy-gravel ($N_{30} \approx 20-30$, $V_s \approx 200-300$ m/s) continues down to 7.0 meters depth. Down to 23.8 meters, medium dense clayey sand ($N_{30} \approx 10-25$, $V_s \approx 300-400$ m/s) appears. After a thin (1.2 meters) very stiff silty clay deposit, medium dense gravelly sand ($N_{30} \approx 20-30$, $V_s \approx 320$ m/s) layer goes down to 29.5 meters depth. Finally, very stiff clay ($N_{30} \approx 25$, $V_s \approx 320$ m/s) is encountered at the bottom of the borehole. **(1)** The computed $V_{s,30}$ is about 271 m/s. The average SPT value is about 20. The ground type is clearly “C”. **(2)** Group (C) soils appear all along the borehole. According to TEC-1998, the local site class is obviously “Z3”.

S-46, talus/colluvium ($N_{30} > 50$, $V_s \approx 400-690$ m/s) constitutes the topmost 20.5 meters of the soil profile. A 4.5 meters thick schist block is encountered below the talus and very stiff to hard gravelly clay ($N_{30} > 25$) continues down to the bottom of the borehole. **(1)** The measured $V_{s,20}$ is about 413 m/s. Most likely, $V_{s,30}$ is greater than this value. SPT blow counts are predominantly higher than 50. In the light of these parametric values and the descriptions, the profile is determined to be a “B” type ground. **(2)** Group (B) soils appear along

the whole depth of the borehole. So, the local site class is “Z2”, according to TEC-1998.

S-50, the site basically rests on occasionally highly weathered schist ($N_{30} > 50$, $V_s > 800$ m/s), except the 2.5 meters talus at the topmost. **(1)** It is obvious that the ground type is “A”. **(2)** The ground is composed of group (A) soil. Hence, the local site class is “Z1”.

S-51, the upper most part of the profile consists of medium dense sandy gravel ($N_{30} \approx 20$, $V_s \approx 180$ m/s). Down to the bottom of the borehole, very soft to soft silt, silty clay and clay ($N_{30} < 8$, $V_s \approx 200$ m/s) take place. **(1)** The computed $V_{s,30}$ is about 147 m/s and the SPT blow counts are lower than 15. The ground type is clearly “D”. **(2)** The profile is completely composed of group (D) soils. Hence, the local site class is “Z4”.

Hereafter, all locations (10 boreholes) will be classified with respect to the SPT blow counts and soil description because no shear wave velocity measurements are available at these locations.

SE-4, gravel and sandy gravel deposits ($N_{30} \approx 7-17$) appears down to 7.0 meters depth. Below, 2.0 meters thick sand layer underlies. Down to the bottom of the borehole (19.0 meters depth), sandy silt and clayey silt deposits with trace gravel ($N_{30} < 8$) are observed. **(1)** Due to low SPT blow counts (<15), the ground type is “D” according to EN-1998. **(2)** Group (C) soils constitute the topmost 9.0 meters of the profile, therefore the local site class is “Z2”.

SE-5, gravel deposits ($N_{30} \approx 14-17$) are observed at upper 10.0 meters part of the profile. The rest of the profile consists of sandy-gravelly silt ($N_{30} \approx 10-11$) deposits. **(1)** SPT blow counts are seemed to be lower than 15. According to EN-1998, the ground type is “D”. **(2)** Due to group (C) soils all along the borehole profile (18.0 meters), the local site class is “Z3”, according to TEC-1998.

SE-11, clayey and sandy silt deposits ($N_{30} < 8$) appear down to 5.5 meters depth. Below this depth, sandy gravel ($N_{30} \approx 14-17$) is observed through the rest of the borehole (down to 20.0 meters). **(1)** With respect to these SPT values, the site may be classified as “C-D”, according to EN-1998. **(2)** Sandy gravel ($N_{30} \approx 14-17$) appears to be the topmost soil layer and this type of ground results in “Z3” local site class.

SE-12, excluding the uppermost 4.7 meters thick silty clay and clay layers, the profile is composed of 5.5 meters thick sand and 8.8 meters thick organic clay (marsh clay) ($N_{30} < 8$). **(1)** The site rests definitely on “D” type ground. **(2)** Below the depth of 4.7 meters, the profile is composed of group (D) soils. This kind of subsurface geometry is defined as “Z4” in TEC-1998.

SE-14, the subground is predominantly made up of high plastic clays ($N_{30} < 8$) with traces of fossil shells. **(1)** According to EN-1998, the ground type is determined as “D”. **(2)** The whole profile (18.0 meters) is seemed to be composed of group (D) soils. Hence, the local site class is “Z4”.

SE-15, the upper most part of the profile appears to be organic clay with a thin sand layer ($N_{30} < 8$), down to 7.6 meters depth. Between 7.6 meters and 14.0 meters depth, gravelly sand ($N_{30} \approx 28-30$) underlies these very soft deposits. A 3.0 meters thick sand ($N_{30} \approx 17$) with trace of gravel appears down to 19.5 meters depth. Finally, clay containing fossil shell remains is encountered at the bottom of the borehole (22.0 meters depth). **(1)** The profile is dominated by deposits having SPT blow counts greater than 15. The ground type can be regarded as “C”. **(2)** Topmost soil layer, which is formed by group (D) soils, has a thickness of 4.7 meters. This configuration determines the local site class as “Z3”, according to TEC-1998.

SE-17, organic clay ($N_{30} \approx 8-16$) constitutes the topmost 7.5 meters of the stratigraphic profile. This layer is underlain by 5.5 meters thick sandy gravel ($N_{30} \approx 26-52$). **(1)** According to EN-1998, the ground type is “C”. **(2)** The

topmost soil layer is group (C) soil with a thickness of 4.5 meters. Hence, the local soil class is “Z2”.

SE-19, silty clay (no SPT is available) continues down to 5.0 meters depth. Below the silty clay, 10.5 meters thick gravelly sand ($N_{30} \approx 10-30$) appears. High plasticity clay ($N_{30} < 8$) with some fossil shell remains exist from 15.5 meters depth to the bottom of the borehole (28.5 meters). **(1)** The ground type is found to be “C-D”, according to EN-1998. **(2)** The topmost soil layer is composed of group (C) soils having thickness of about 12.0 meters. It is obvious that the local site class is “Z2”.

SE-36, gravelly-sandy clay ($N_{30} \approx 3-22$) appears down to 9.0 meters depth. Gravelly sand ($N_{30} \approx 20-25$) underlies the clay and it is continuous down to the bottom of the borehole (19.7 meters). **(1)** The profile is seemed to have SPT blow counts ranging between 15 and 50. Therefore, the ground type is determined as “C”, according to EN-1998. **(2)** Gravelly-sandy clay ($N_{30} \approx 3-22$) may correspond to group (C) soil. The subjacent gravelly sand is also a group (C) soil. Thus, the local site class is “Z3”.

SE-44, the profile is defined as gravelly-sandy-clayey silt ($N_{30} \approx 16-55$) throughout the borehole. **(1)** Due to having such SPT blow counts, the site can be classified as “C”, according to EN-1998. **(2)** Down to 10.0 meters depth, the soil profile consists of group (C) soils. Thus, the local site class can be regarded as “Z2”.

Table 5.1 presents the results of soil classification corresponding to all 39 localities.

Table 4.1: Assessment of site classes according to TEC-1998 and EN-1998.

	Borehole ID	X (Easting)	Y (Northing)	TEC 1998	EN-1998
1	S - 4	428721.15	4477043.36	Z3	C
2	S - 21	428360.14	4477111.95	Z2-Z3	D
3	S - 22	428935.96	4477280.96	Z3	C-D
4	S - 23	429221.14	4477104.44	Z3	C-D
5	S - 24	429227.23	4477314.01	Z2-Z3	D
6	S - 25	429621.34	4477480.78	Z3	D
7	S - 26	428350.82	4477501.14	Z3	D
8	S - 27	428273.25	4477809.68	Z4	D
9	S - 28	428402.66	4478091.81	Z1	E
10	S - 29	428828.74	4477646.97	Z4	D
11	S - 30	428825.38	4477910.85	Z2-Z3	D
12	S - 31	429313.63	4477863.39	Z2	D
13	S - 32	429554.43	4477925.34	Z3	D
14	S - 33	429543.39	4478207.28	Z4	D
15	S - 34	429529.56	4478389.69	Z4	D
16	S - 35	430036.14	4478471.17	Z1	B
17	S - 36	430105.81	4478250.51	Z3	C-D
18	S - 37	430409.68	4478041.65	Z4	C-D
19	S - 38	430314.59	4477722.90	Z3	C
20	S - 39	429947.82	4477608.65	Z3	C
21	S - 40	429970.20	4477324.80	Z3	C
22	S - 41	430407.38	4477377.98	Z3-Z4	C-D
23	S - 42	430225.40	4477070.31	Z2	C
24	S - 43	430881.21	4477190.13	Z3	B-C
25	S - 44	430770.54	4477525.24	Z2	C
26	S - 45	428160.86	4478455.36	Z3	C
27	S - 46	428365.88	4478571.37	Z2	B
28	S - 50	429031.56	4478340.51	Z1	A
29	S - 51	429286.45	4478125.00	Z4	D
30	SE - 4	428825.99	4478090.18	Z2	D
31	SE - 5	428155.92	4478259.90	Z3	D
32	SE - 11	428494.55	4477249.54	Z3	C-D
33	SE - 12	428570.85	4477696.74	Z4	D
34	SE - 14	429734.76	4478306.69	Z4	D
35	SE - 15	430047.56	4477975.70	Z3	C
36	SE - 17	429432.93	4477228.25	Z2	C
37	SE - 19	429243.72	4477697.26	Z2	C-D
38	SE - 36	428472.59	4478752.28	Z3	C
39	SE - 44	429410.35	4478620.20	Z2	C

4.2 Response Spectra

After determining the site conditions, elastic response spectra are calculated based on the parameters corresponding to site classes. For the equations of spectra suggested by TEC-1998 and EN-1998, the building importance factors are assigned to be equal to 1.0. The reference peak ground acceleration for EN-1998 is assigned as 0.425g. The effective ground acceleration coefficient (A_0) in TEC-1998 is equal to 0.4 because Gemlik is located in the first degree seismic zone. The other parameters regarding the site conditions are assigned with respect to the site classes determined in the previous section. For EN-1998, Type-1 spectra is selected because the earthquakes that contribute most to the seismic hazard defined for Gemlik have a surface-wave magnitude, M_s , greater than 5.5. Consequently, elastic response spectra at 39 borehole locations have been calculated and presented in Appendix D.

CHAPTER 5

DISCUSSIONS

Soil classes and elastic response spectra have been determined for 39 borehole locations in the Gemlik Basin. In this chapter, the results obtained by means of TEC-1998 and EN-1998 are discussed in detail. Some maps are obtained by interpolating the concerned parameters between the data points (borehole locations). The GIS software “MapInfo Professional Version 7.8” has been employed to carry out the interpolations. At this stage, it is of use to mention some key points regarding these maps. Due to the lack of geophysical and geotechnical data, rock sites in the study area are classified as “Z1” and “A”. It should be noted that these interpolated maps are provided just to give an idea about the spatial distribution of the concerned parameter. Some illogical (unnatural) results may be encountered on some parts of these maps (i.e. sharp transition between rock and soil sites). For this reason, the reader should prefer to concentrate on the near vicinity of data points while examining these maps because the most precise values appear on those data points. Under no circumstances, the provided maps should not be used for design purposes.

First of all, local site class and ground type distribution in the Gemlik Basin are illustrated in Figures 5.1 and 5.2 with respect to TEC-1998 and EN-1998, respectively.

Elastic response spectra suggested by both earthquake codes are presented in Appendix D. Also, spectral ordinates corresponding to some specific periods (i.e. 0.01 s, 0.2 s, 0.4 s, 0.6 s, 0.8 s, 1.0 s, 1.5 s, and 2.0 s) are presented by means of interpolated maps in Appendix E. On the whole, there are two main points to be emphasized for the maps in Appendix E. First, the differences observed in the plots in Appendix D can also be noted in the maps presented in Appendix E. Second, according to TEC-1998, there is almost no variation in spectral acceleration values in the Gemlik Basin for the periods of 0.01, 0.2 and

0.4 seconds. On the other hand, variation is observed on the values obtained from EN-1998.

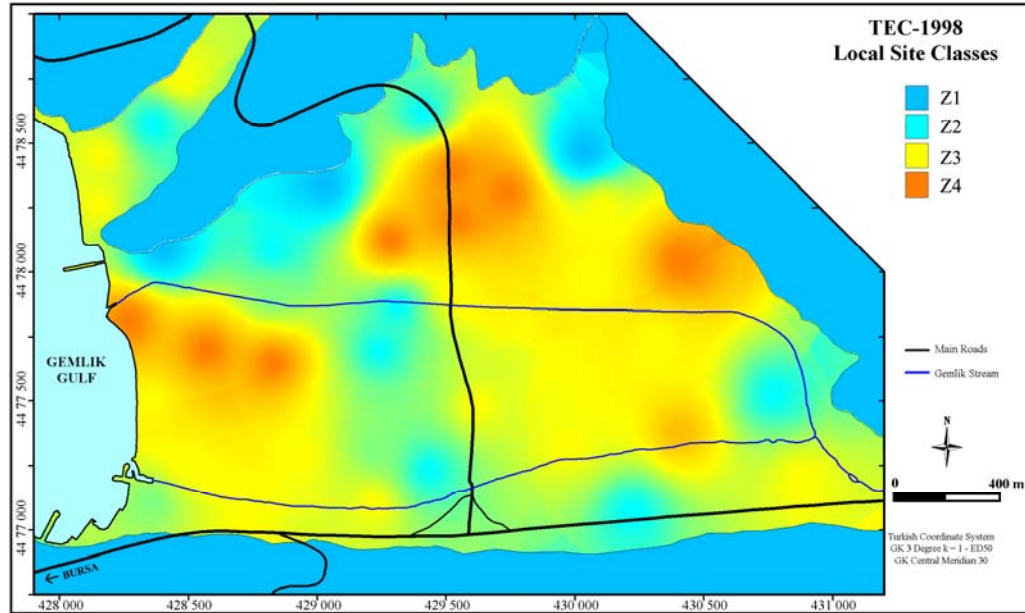


Figure 5.1: Spatial distribution of local site classes of TEC-1998.

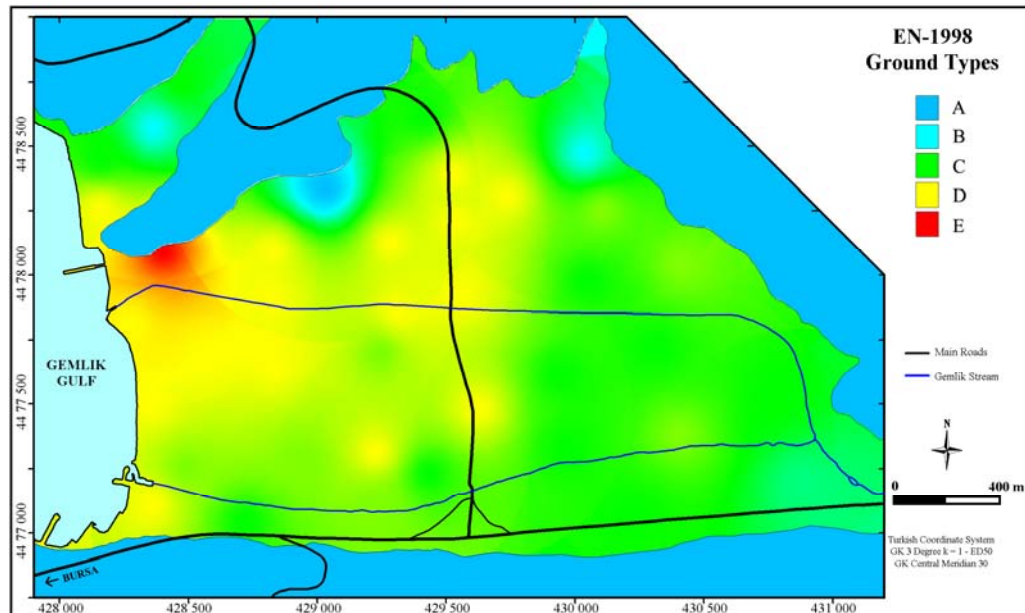


Figure 5.2: Spatial distribution of ground types of EN-1998.

As the elastic response spectra in Appendix D and the maps in Appendix E are examined, it can be easily concluded that EN-1998 results in higher spectral ordinates. There exist three possible reasons for this difference between spectral ordinates of TEC-1998 and EN-1998;

- The difference between the spectral ordinates may be due to the defined level of seismic risk for the site. Seismic risk is defined by the reference peak ground acceleration (a_{gR}) in EN-1998 and by A_0 in TEC-1998.
- The difference may be sourced from the parameters standing for soil amplification.
- Finally, the variation may be due to the difference between the soil classification procedures of the codes.

Throughout the response spectra calculations, different values have been utilized for the parameters a_{gR} and A_0 , which define the seismic risk for the site. The reference peak ground acceleration (a_{gR}) has been assigned as 0.425 g. Erdik et al. (2005) calculated this value by considering the seismotectonic characteristics of NAFS. On the other hand, EN-1998 is an earthquake code established by considering the seismotectonic characteristics of Europe. For a probabilistic estimation of the seismic hazard, it is essential to constrain as much as possible how the energy of the seismic waves attenuates when propagating from the source to the site. A number of predictive relationships derived from regression analysis of strong motion data are available for peak horizontal ground acceleration. These relationships were derived empirically from recorded accelerograms belonging to earthquakes in different parts of the world. If Erdik et al. (2005) had performed time-dependent probabilistic seismic hazard analysis by using the same fault segmentation model as in Figure 2.16 and the same characteristic earthquake parameters as in Table 2.1 but a different attenuation relationship reflecting the attenuation characteristics of seismic waves through European lithosphere, they might have probably obtain a different PGA value.

Erdik et al. (2005) used the average of the results obtained from Boore et al. (1997), Sadigh et al. (1997) and Campbell (1997) for the computation of peak ground acceleration and claimed that these three relationships can be used for Turkey. However, if they performed the analyses for a site located in Europe, they would have to use a different attenuation relationship derived for Europe (i.e. Ambraseys et al., 1996). At this point of view, it is important to compare the relationship suggested by Ambraseys et al. (1996) with the ones used by Erdik et al. (2005). Figure 5.3 illustrates the comparison of these relationships for different magnitude and distance pairs. The solid lines correspond to the average of Sadigh et al. (1997), Boore et al. (1997) and Campbell (1997) where the dashed lines stand for the Ambraseys et al. (1996).

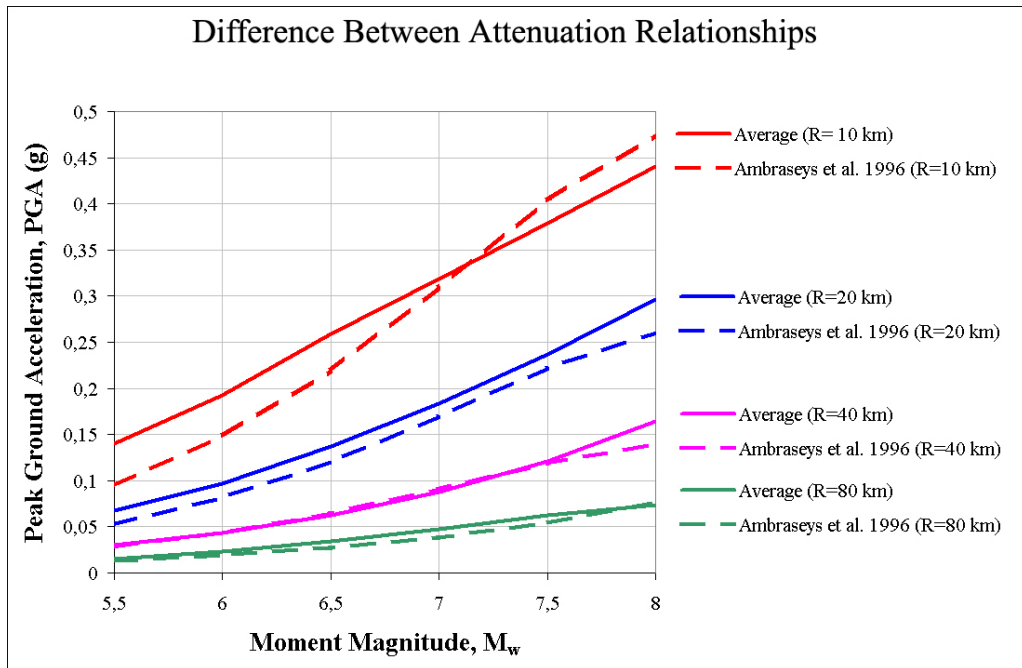


Figure 5.3: Plot of attenuation relationships, which can be used for Turkey (Average of Sadigh et al. 1997, Boore at al. 1997 and Campbell, 1997) and used for Europe (Ambraseys et al. 1996).

As it is obvious from Figure 5.3, Ambraseys et al. (1996)'s relationship results in lower PGA values. This situation implies that Erdik et al. (2005) would

probably obtain a reference peak ground acceleration lower than 0,425g if they had used the relationship of Ambraseys et al. (1996). Application of lower reference peak ground acceleration results in smaller difference between the spectral ordinates suggested by EN-1998 and TEC-1998.

Beyond the estimation of peak ground acceleration, Erdik et al. (2005) claim that the average of Sadigh et al. (1997) and Boore et al. (1997) relationships can be used to estimate the spectral ordinates. The plot of average of these two relationships and the plot of Ambraseys et al. (1996) are presented in Figure 5.4. It is worthwhile to emphasize that similar difference between spectral ordinates of TEC-1998 and EN-1998 is observed on the spectral ordinates obtained from the attenuation relationships mentioned above. This observation also supports the idea that different seismic characteristics of Turkey and Europe result in different elastic response spectra.

In addition to the difference due to attenuation characteristics, it should be kept in mind that any mathematical methods used to estimate the characteristics of the nature may contain some errors (i.e. due to epistemic uncertainty and aleatory variability). Thus, the reference peak ground acceleration suggested by Erdik et al. (2005) should not be accepted as an absolute (exact) value.

Because of the reasons explained above, it is useful to check the difference after assigning a_{gR} as 0.4 g into the expressions of EN-1998. The elastic response spectra are re-calculated by using the same value for (a_{gR}) and (A_0). Even the same value (0.4 g) is assigned; a significant level of difference is still observed between the spectral ordinates of EN-1998 and TEC-1998 (Figure 5.5). This figure implies that the difference is not only sourced from the defined level of seismic action for bedrock conditions. Hence, the parameters representing soil amplification on the bedrock motion must be checked.

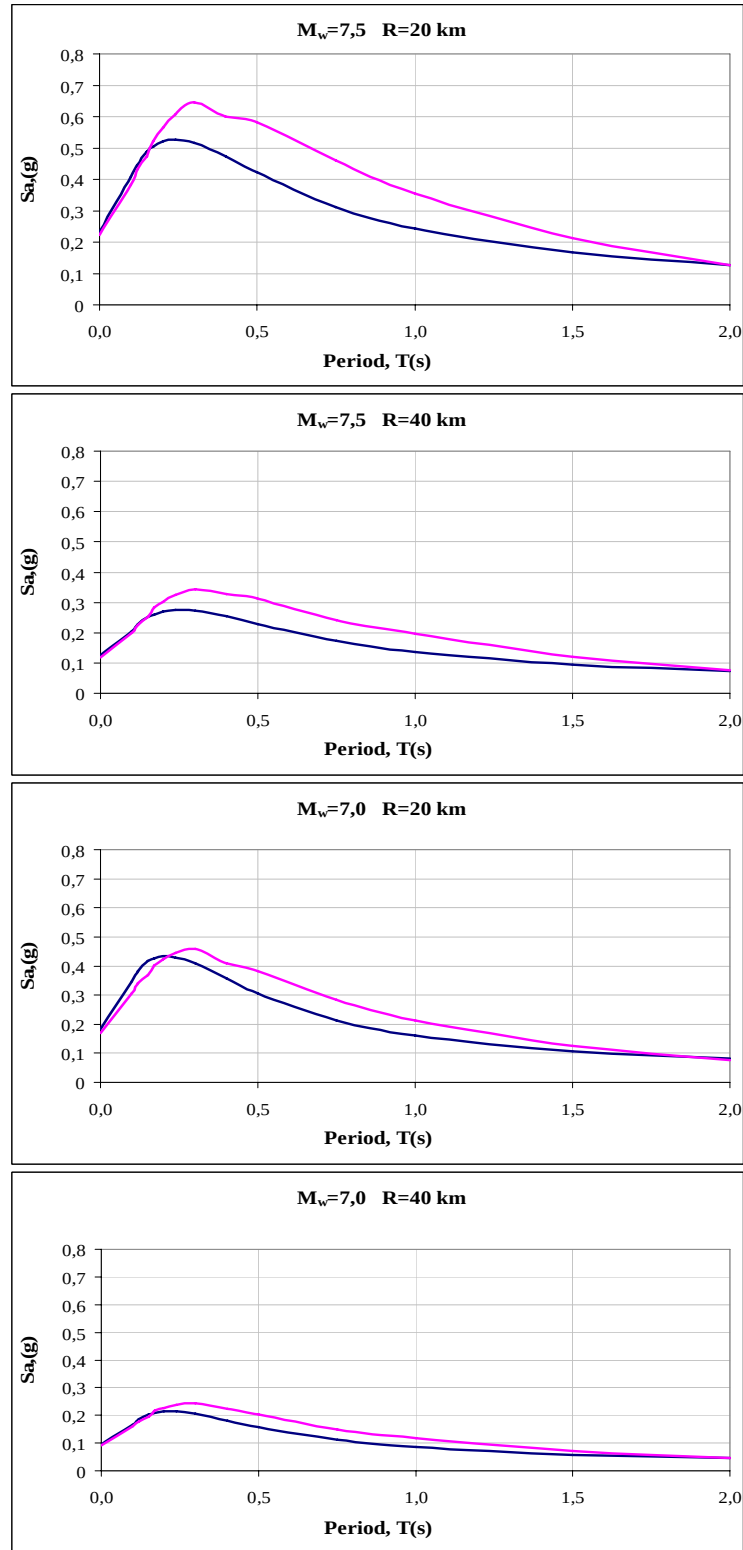


Figure 5.4: Response spectra obtained from the average of Sadigh et al. (1997) and Boore et al. (1997) (blue lines), and from Ambraseys et al. (1996) (pink lines).

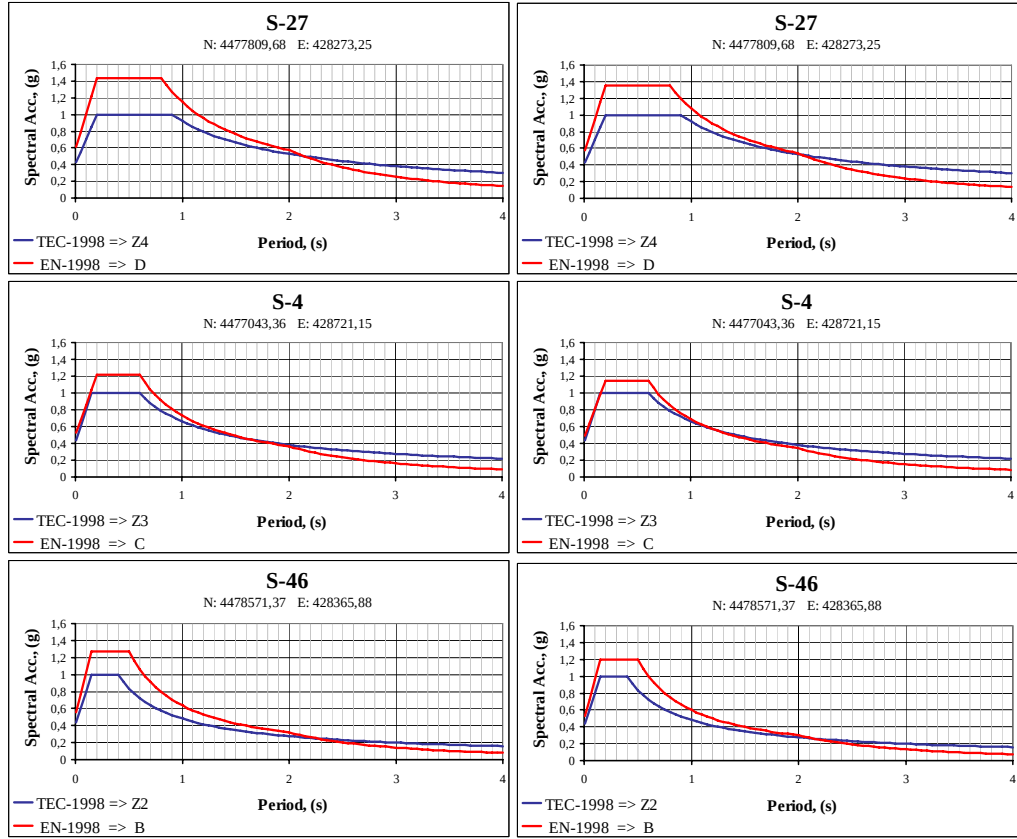


Figure 5.5: Change in spectra (Left: the original spectra, Right: after the application of the reference peak ground acceleration as 0.4 g).

The second possible source of the difference between spectral ordinates of EN-1998 and TEC-1998 may be due to the soil amplification values. Aydan et al. (2000a; 2000b) compared the normalized acceleration response spectra obtained from the Kocaeli Earthquake of August 17, 1999 and the Düzce-Bolu Earthquake of November 12, 1999 with the design spectra of TEC-1998. They concluded that the soil amplification level in TEC-1998 should be increased for some regions with the use of strong motion records obtained in recent earthquakes. They also state that similar type structural responses were observed in the Erzincan Earthquake of March 13, 1992, the Dinar Earthquake of October 1, 1995, Adana-Ceyhan Earthquake of June 27, 1998, the Kocaeli Earthquake of August 17, 1999 and the Düzce-Bolu Earthquake of November 12, 1999. At this point of view, the normalized acceleration response spectra

for these earthquakes (and additionally Bingöl Earthquake of May 1, 2003) are plotted in this study. The normalized spectra calculated for ten strong motion records of these six earthquakes are presented in Appendix F. The related design spectra of EN-1998 and TEC-1998 are also plotted on these graphs. Based on these plots, it can be concluded that EN-1998 seems to suggest more reliable values. Figure 5.6 illustrates the normalized spectra of all ten records and design spectra of TEC-1998. It is obvious that amplification values of TEC-1998 should be reevaluated.

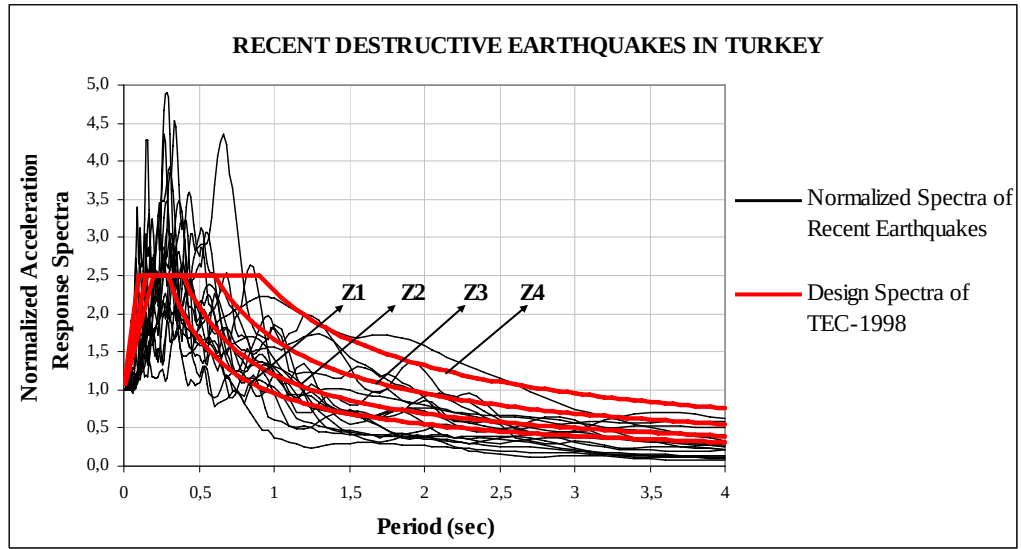


Figure 5.6: Plot of normalized acceleration response spectra of recent destructive earthquakes and the design spectra of TEC-1998.

In addition to the attenuation characteristics and soil amplification values, the difference between the response spectra suggested by TEC-1998 and EN-1998 is caused by unusual differences between the site classes at some locations. Although they are not exactly equivalent to each other, site classes of both earthquake codes correspond to similar physical and mechanical soil properties (i.e. $A \approx Z1$, $B \approx Z2$, $C \approx Z3$ and $D \approx Z4$). The difference between spectral ordinates corresponding to similar site classes is assumed to be acceptable

(usual) difference. However, unusual differences are sometimes encountered. For example, a site may be classified as “D” type ground according to EN-1998, but the same site may have a local site class of “Z2” according to TEC-1998. In order to distinguish the usual and unusual differences in Gemlik Basin, a representative parameter $[D_{(area)}]$ is introduced. $[D_{(area)}]$ is simply the ratio of the area difference between the TEC-1998 and EN-1998 spectra to the area under the TEC-1998 spectrum (Figure 5.7) and is expressed in percentage.

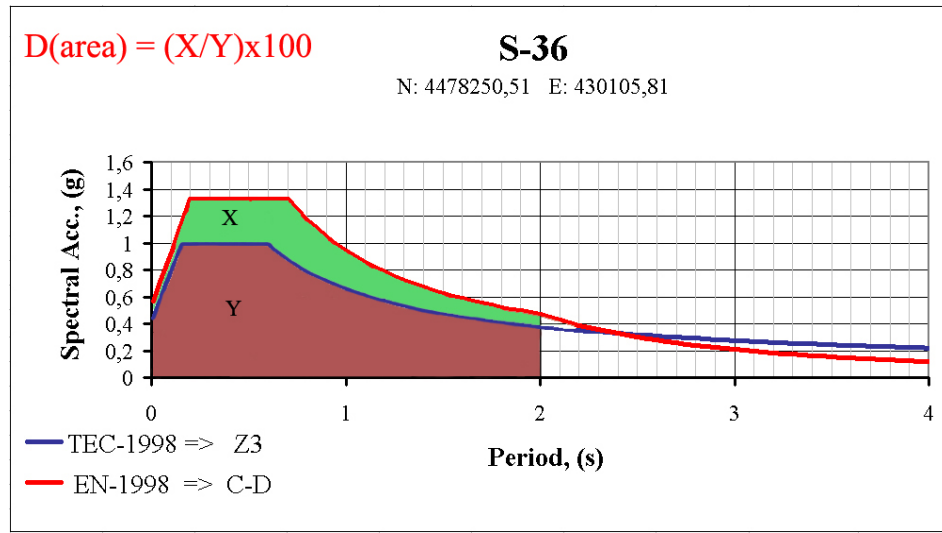


Figure 5.7: Illustration of $[D_{(area)}]$.

Simply, the area under the curves is found by taking the integral of the concerned spectrum functions suggested by TEC-1998 and EN-1998. The expression of $[D_{(area)}]$ is as follows;

$$D_{(area)} = \left[\frac{\int_0^2 S_e(T) d(T) - \int_0^2 A(T) d(T)}{\int_0^2 A(T) d(T)} \right] \times 100 \quad (5.1)$$

where;

$D_{(area)}$: Percent of area difference,

$S_e(T)$: Function of Elastic Response Spectrum of EN-1998,

$A(T)$: Function of Elastic Response Spectrum of TEC-1998.

Here, it should be noted that $[D_{(area)}]$ is not introduced to compare the codes, it is just to reveal the problematic soil profiles, the ones having unusual difference, in the Gemlik Basin.

For the usual differences, $[D_{(area)}]$ gets the values of 10%, 31%, 13% and 31% for A-Z1, B-Z2, C-Z3 and D-Z4, respectively. So, the threshold value for usual differences may be regarded as 35%. $[D_{(area)}]$ smaller than 35% implies usual differences. $[D_{(area)}]$ values greater than 35% indicates problematic soil profiles in terms of classification. In order to better understand the spatial distribution of unusual differences in the Gemlik Basin, $[D_{(area)}]$ is mapped (Figure 5.8).

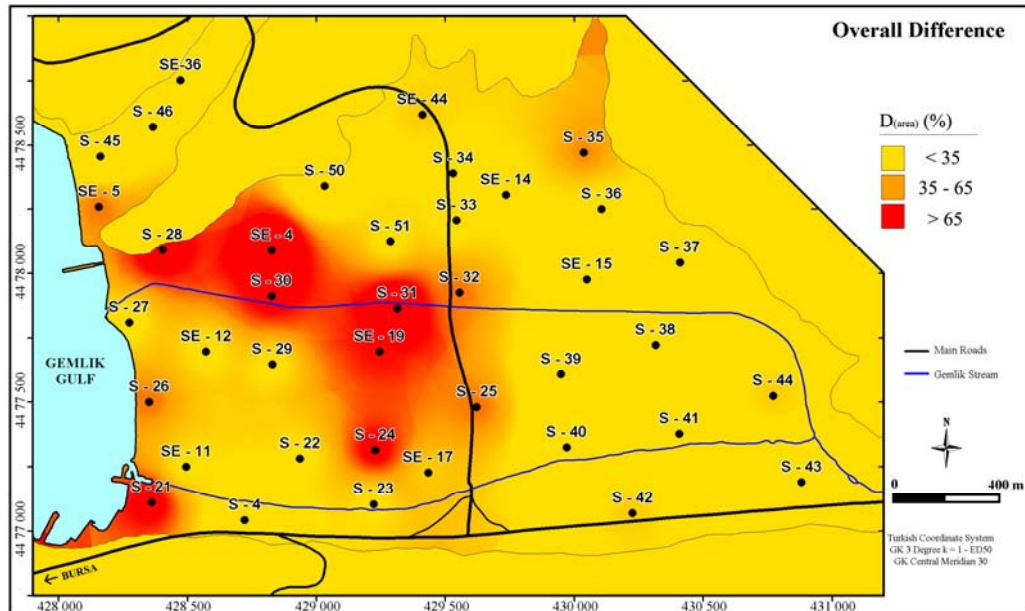


Figure 5.8: Spatial distribution of $[D_{(area)}]$.

Figure 5.8 implies that unusual differences are encountered at 12 locations namely; SE-4, SE-5, SE-19, S-21, S-24, S-25, S-26, S-28, S-30, S-31, S-32 and S-35. The reason for these unusual differences at these locations can be explained as;

- The soil profile at some locations is predominantly composed of group (D) soils according to TEC-1998. However, group (C) soil layers are encountered between the depths 6.5 meters and 11.0 meters. Because of these group (C) soil layers, the topmost soil layer is decided to be group (D) soil having thickness about 4.0-5.0 meters. This decision results in a local site class which does not represent the ground conditions for that locality. On the other hand, EN-1998 seems to be more logical as it evaluates the stratigraphic profile as a whole down to 30.0 meters depth. Unusual differences due to non-representative soil layers are observed at the locations S-25, S-30, S-31 and S-32.
- The second reason for unusual differences is due to the soil profiles where relatively stronger material is underlain by weaker ones. Generally, group (C) soil layers are underlain by group (D) soils (i.e. S-21, S-26, SE-4, SE-5 and SE-19). If the thickness of group (C) soil is less than 15.0 meters, the local site class is determined to be “Z2”. As the thickness of stronger material (group “C” soil) decreases, the weaker material properties become more dominant through the profile. In such cases, TEC-1998 results in better site conditions. On the contrary, EN-1998 results in worse site conditions because the weaker material properties become dominant.
- EN-1998 introduces an “E” type ground. This type of ground stands for the cases where alluvial deposits having thickness between 5.0 meters and 20.0 meters rest on rock. There is no such a distinction in TEC-1998. For example, according to TEC-1998, it does not matter whether a 12.0 meters thick group (B) soil rests on rock or on group (D) soil.

Both conditions will result in local site class of “Z1”. On the other hand, if group (B) soil rests on rock, EN-1998 would determine the ground type as “E”. If group (B) soil is underlain by group (D) soil, EN-1998 may result in ground type of “D”. Then, spectral ordinates would be very different. In the study area, such kind of contradictions may be encountered near to the northern margin of the basin where talus is observed. Talus may cover either rock or soft alluvial deposits. Unfortunately, there are no boreholes that can illustrate such kind of contradictions. Only, S-28 illustrates the condition that a 12.0 meters thick group (B) soil rests on rock. At this location, unusual difference is due to a new site definition (E type ground) introduced by EN-1998.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

In this study, soils in the Gemlik Basin are evaluated in terms of TEC-1998 and EN-1998. This evaluation is based on geological, geophysical and geotechnical data from 39 borehole locations in the basin. The results have been plotted graphically and spatially. Differences aroused between these earthquake codes have been discussed in detail.

As a result of this study the following conclusions and recommendations would be drawn:

- (i) EN-1998 provides more conservative estimates relative to TEC-1998 in the Gemlik Basin.
- (ii) EN-1998 suggests different PGA values as the ground type changes. On the other hand, TEC-1998 proposes same PGA values for different local site classes. The approach of EN-1998 seems to be more rational because changes in site conditions must also affect the PGA values.
- (iii) At some locations, the difference between spectral ordinates suggested by EN-1998 and TEC-1998 reaches 100 %. The source of this difference has been investigated by means of three main approaches.
 - The first reason for the difference may be due to the defined seismic action. Even the same reference peak ground acceleration value (0.4g) is assigned in EN-1998 and TEC-1998; a significant level of difference is still observed between the spectral ordinates. This implies that defined seismic action is not the main source of the difference.

- The second reason may be due to different soil amplification values suggested by the codes. As the recent destructive earthquakes in Turkey are examined, it can be concluded that TEC-1998 seems to underestimate the soil amplification for some parts of the spectrum. So, soil amplification values of TEC-1998 should be reevaluated in detail.
 - At the locations where non-representative soil layers are encountered through the profile, TEC-1998 may lead to local site classes which do not reflect the real site conditions. In such cases, the differences between the spectral ordinates reach unacceptable levels.
- (iv) An additional site class representing the site conditions like ground type “E” in EN-1998 may be included in TEC-1998.
- (v) In this study, investigation depth of seismic refraction surveys was insufficient to perform site classification procedures. Thus, shear wave velocity values had to be estimated from geotechnical parameters. This is a serious problem in terms of soil classification. There exists no restriction on investigation depth in TEC-1998. Considering the threshold values for thickness of the topmost soil layer presented in TEC-1998, a restriction should be included regarding geophysical and geotechnical investigation depth.

REFERENCES

- Ambraseys, N.N. and Finkel, C.F., 1991, "Long-term Seismicity of Istanbul and of the Marmara Region", *Terra Nova* 3, pp. 527-539.
- Ambraseys, N.N., Simpson, K.A. and Bommer, J.J., 1996, "Prediction of Horizontal Response Spectra in Europe", *Earthquake Engineering and Structural Dynamics* (25), pp. 371-400.
- Armijo, R., Meyer, B., Barka, A.A. and Hubert, A., 1999, "Propagation of the North Anatolian Fault into the Northern Aegean: timing and kinematics", *Geology* (27), pp.267-270.
- Aydan, Ö., Ulusay, R., Hasgür, Z. and Taşkın, B., 2000a, " A Site Investigation of Kocaeli Earthquake of August, 1999", *Turkish Earthquake Foundation-Earthquake Report* (No.TDV/DR 08-49), 180 pp.
- Aydan, Ö., Ulusay, R., Kumsar, H. and Tuncay, E., 2000b, "Site Investigation and Engineering Evaluation of the Düzce-Bolu Earthquake of November 12, 1999", *Turkish Earthquake Foundation-Earthquake Report* (No.TDV/DR 08-51), 300 pp.
- Bargu, S., Gözübol, A.M., Osmanşahin, İ., 2000, "Gemlik (Bursa) Alanın Jeolojik, Jeofizik ve Jeoteknik Etüd Raporu", İ.Ü. Araştırma ve Yardım Vakfı, Eğitim Faaliyetleri İşletmesi, İstanbul, 64pp.
- Barka, A.A., 1981, "Seismo-tectonic Aspects of the North Anatolian Fault Zone", Ph. D. Thesis, University of Bristol, Bristol.

- Barka, A.A., 1992, "The North Anatolian Fault Zone", *Annales Tecton.* (6), pp.164-195.
- Barka, A.A. and Hancock, P.L., 1984, "Neotectonic Deformation Patterns in the Convex-Northwards Arc of the North Anatolian Fault Zone, In: Dixon, J.E., Robertson, A.H.F. (Eds), *The geological evolution of the Eastern Mediterranean*, Geological Society Special Publication No.17, Geological Society London, pp. 763-774.
- Barka, A.A. and Kadinsky-Cade, K., 1988, "Strike-slip Fault Geometry in Turkey and Its Influence on Earthquake Activity", *Tectonics* (7), pp. 663-684.
- Barka, AA., and Gülen, L., 1989, "New Constraints on the Age and Total Offset of the North Anatolian Fault Zone: implications for tectonics of the Eastern Mediterranean Region", *METU J. Pure Appl. Sci.* (21), pp. 39-63.
- Barka, A.A., Akyüz, S.H., Cohen, H.A. and Watchorn, F., 2000, "Tectonic Evolution of the Niksar and Tasova-Erbaa Pull-apart Basins, North Anatolian Fault Zone: their significance for the motion of the Anatolian block", *Tectonophysics* (322), pp. 243-264.
- Bingöl, E., Akyürek, B. and Korkmazer, B., 1975, "Bİga Yarımadasının Jeolojisi ve Karakaya Formasyonunun Bazı Özellikleri", *Cumhuriyetin 50. Yılı Yerbilimleri Kongresi Tebliğleri*, Maden Tetkik ve Arama Enstitüsü (MTA) Publications, pp. 70-77.
- Boore, M.D., Joyner, W.B. and Fumal, T.E., 1997, "Equations for Estimating Horizontal Response Spectra and Peak Acceleration from Western North American Earthquakes: A Summary of Recent Works", *Seismological Research Letters* (68:1), pp. 128-153.

- Bozkurt, E., 2001, "Neotectonics of Turkey – a synthesis", *Geodinamica Acta* (14), pp. 3-30.
- Campbell, K.W., 1997, "Empirical Near-Source Attenuation Relationships for Horizontal and Vertical Components of Peak Ground Acceleration, Peak Ground Velocity and Pseudo-Absolute Acceleration Response Spectra", *Seismological Research Letters* (68:1), pp. 154-179.
- CEN (Comité Européen de Normalisation), 2004, "EN 1998-1 – Eurocode 8: Design of Structures for Earthquake Resistance. Part 1: General rules, seismic actions and rules for buildings", European Commission for Standardization, May 2004, Brussels.
- Coduto, D.P., 2001, "Foundation Design: Principles and Practices", Prentice Hall, Inc., New Jersey, 883 pp.
- Das, B.M., 1983, "Fundamentals of Soil Dynamics", Elsevier, New York, 399pp.
- Das, B.M., 2005, "Fundamentals of Geotechnical Engineering", Pacific Grove Brooks/Cole, Inc., California, 678 pp.
- Dirik, K., 1993, "Geological History of the Northward Arched Segment of the North Anatolian Transform Fault Zone", *Geol. J.* (28), pp. 251-266.
- Erdik, M., Şeşetyan, K., Demircioğlu, M.B. and Durukal, E., 2005, "Assessment of Earthquake Hazard for Bakirköy, Gemlik, Bandırma, Tekirdağ and Körfez", Republic of Turkey, Prime Ministry Project Implementation Unit, Marmara Earthquake Emergency Reconstruction (MEER) Project: A3 Component, Ankara, 61 pp.

- Erendil, M., Göncüoğlu, M.C., Tekeli, O., Aksay, A., Kuşçu, İ., Ürgün, B., Tunay, G. and Temren, A., 1991, "Armutlu Yarımadasının Jeolojisi", Maden Tetkik ve Arama Enstitüsü (MTA) Rap. (9165), 51 pp.
- Gautier, P., Brun, J.P., Moriceau, R., Sokoutis, D., Martinod, J. and Jolivet, L., 1999, "Timing, Kinematics and Cause of Aegean Extension: a scenario based on a comparison with simple analogue experiments", *Tectonophysics* (315), pp. 31-72.
- Genç, Ş.C., 1986, "Uludağ İznik Gölü Arasının Jeolojisi", Maden Tetkik ve Arama Enstitüsü (MTA) Rap. (7853), 136 pp.
- General Directorate of Disaster Affairs, 1997, "Seismic Zoning Map of Turkey".
- Göncüoğlu, M.C., Erendil, M., Tekeli, O., Aksay, A., Kuşçu, İ. and Ürgün, B., 1987. "Geology of the Armutlu Peninsula", IGCP Project 5, Guide Book Field Excursion along W-Anatolia, 12-18.
- Hardin, B.O. and Richart, F.E., 1963, "Elastic Wave Velocities in Granular Soils", *Journal of the Soil Mechanics and Foundations Division (ASCE 89)*, pp. 33-65.
- Hardin, B.O. and Black, W.L., 1968, "Vibration Modulus of Normally Consolidated Clay", *Journal of the Soil Mechanics and Foundations Division (ASCE 94)*, pp. 353-369.
- Hubert-Ferrari, A., Armijo, R., King, G., Meyer, B. and Barka, A.A., 2002, "Morphology, Displacement, and Slip-rates along North Anatolian Fault, Turkey", *Journal of Geophysical Research* (107).

- Humphries, W.K. and Wahls, H.E., 1968, "Stress History Effects on Dynamic Modulus of Clay", Journal of the Soil Mechanics and Foundations Division (ASCE 94), pp. 371-389.
- Jacky, J., 1944, "The Coefficient of Earth Pressure at Rest", J. Soc. Hungarian Arch. Eng., pp. 355-358.
- Kaya, O. and Kozur, H., 1987, "A New and Different Jurassic to Early Cretaceous Sedimentary Assemblage in Northwestern Turkey (Gemlik, Bursa): Implications for the pre-Jurassic to Early Cretaceous Tectonic Evolution", Hacettepe Univ. Yerbilimleri Dergisi (14), pp. 253-268.
- Koçyiğit, A., 1988, "Tectonic Setting of the Geyve Basin: age and total displacement of the Geyve Fault Zone", METU J. Pure Appl. Sci. (21), pp. 81-104.
- Koçyiğit, A., 1989, "Suşehri Basin: An Active Fault-Wedge Basin on the North Anatolian Fault Zone, Turkey", Tectonophysics (167), pp. 13-29.
- Koçyiğit, A., 2005, "Final Report on Active Fault Investigations in Pilot Municipalities and Their Neighbourhood: Eskişehir, Gemlik, Bandırma, Tekirdağ and Körfez", Republic of Turkey, Prime Ministry Project Implementation Unit, Marmara Earthquake Emergency Reconstruction (MEER) Project: A3 Component, Ankara, 81 pp.
- Kurtuluş, C., 1985, "Gemlik Körfezi Yüksek Ayrımlı Sığ Sismik Etüdü Raporu", Maden Tetkik ve Arama Enstitüsü (MTA) Rap. (8083), 32 pp.
- Lawrence, F.V., 1965, "Ultrasonic Shear Wave Velocities in Sand and Clay", Response of Soils to Dynamic Loading, Report No.23, MIT, Cambridge, Massachusetts.

MapInfo Corporation, 2004, "MapInfo Professional Version 7.8", GIS Software.

Massarsch, K.R., 1979, "Lateral Earth Pressure in Normally Consolidated Clays", Proceedings of the Seventh European Conference on Soil Mechanics and Foundation Engineering, Brighton, England, Vol 2, pp 245-249.

McKenzie, D.P., 1970, "Plate Tectonics of the Mediterranean Region", *Nature* (220), pp. 239-343.

Okay, A.İ. and Monie, P., 1997, "Early Mesozoic Subduction in the Eastern Mediterranean, Evidence from Triassic Eclogite in Northwest Turkey", *Geology* (25), pp. 595-598.

Okay, A.İ. and Göncüoğlu, M.C., 2004, "Karakaya Complex: a review of data and concepts", *Turkish Journal of Earth Sciences* (13), pp. 77-95.

Okay, A.İ. and Tüysüz, O., 1999, "Tethyan Sutures of Northern Turkey", In: Durand, B., Jolivet, L., Horvath, F. and Seranne, M. (eds) "The Mediterranean Basins: Tertiary Extension within the Alpine Orogen", Geological Society, London, Special Publications (156), pp. 475-515.

Okay, A.İ., Kaslılar-Özcan, A., İmren, C., Boztepe-Güney, A., Demirbağ, E. and Kuşçu, İ., 2000, "Active Faults and Evolving Strike-slip Basins in the Marmara Sea, Northwest Turkey: a multichannel seismic reflection study", *Tectonophysics* (321), pp.189-218.

Ricou, L.E., 1994, "Tethys Reconstructed: Plates, Continental Fragments and Their Boundaries since 260Myr from Central America to Southeastern Asia", *Geodinamica Acta* (7), pp. 169-218.

- Sadigh, K., Chang, C-Y., Egan, J.A., Maksidi, F. and Youngs, R.R., 1997, "Attenuation Relationships for Shallow Crustal Earthquakes Based on California Strong Motion Data", *Seismological Research Letters* (68:1), pp. 180-189.
- Seymen, İ., 1975, "Tectonic Characteristics of the North Anatolian Fault Zone in Kelkit Valley", Ph. D. Thesis, İstanbul Technical University, İstanbul.
- Stampfli, G.M., 1996, "The Intra-Alpine Terrain: A Paleotethyan Remnant in the Alpine Variscides", *Eclogae Geologicae Helvetiae* (89), pp. 13-42.
- Straub, C., Kahle, H.G., Schindler, C., 1997, "GPS and Geologic Estimates of the Tectonic Activity in the Marmara Sea Region, NW Anatolia", *J. Geophys. Res. Solid Earth* (B12), pp. 27587-27601.
- Şengör, A.M.C., 1979a, "The North Anatolian Transform Fault: its age, offset and tectonic significance", *Journal of Geological Society, London* (136), pp. 269-282.
- Şengör, A.M.C., 1979b, "Mid-Mesozoic Closure of Permo-Triassic Tethys and Its Implications", *Nature* (279), pp. 590-593.
- Şengör, A.M.C., 1987, "Tectonics of the Tethysides: Orogenic collage development in a collisional setting", *Annual Reviews of Earth and Planetary Science* (15), pp. 213-244.
- Şengör, A.M.C. and Yılmaz, Y., 1981, "Tethyan Evolution of Turkey: a Plate Tectonic Approach", *Tectonophysics* (75), pp. 181-241.
- Şengör, A.M.C., Yılmaz, Y. and Ketin, İ., 1980, "Remnants of a pre-Late Jurassic Ocean in Northern Turkey: Fragments of Permo-Triassic Paleotethys? ", *Geological Society of America Bulletin* (91), pp. 599-609.

- Taymaz, T., Jackson, J. and McKenzie, D.P., 1991, "Active Tectonics of the North and Central Aegean", *Geophy. J. Inter.* (106), pp. 433-490.
- Tekeli, O., 1981, "Subduction Complex of pre-Jurassic age, Northern Anatolia, Turkey", *Geology* (9), pp. 68-72.
- Terzaghi, K. and Peck, R.B., 1967, "Soil Mechanics in Engineering Practice", John Willey & Sons, Inc., New York, 729 pp.
- Turkish Earthquake Code (TEC), 1998, "Specification for Structures to be Built in Disaster Areas, Part-III: Earthquake Disaster Prevention", Government of Republic of Turkey, Ministry of Public Works and Settlement, Ankara, 84pp.
- Tüysüz, O., Barka, A.A. and Yiğitbaş, E., 1998, "Geology of the Saros Graben: its implications on the evolution of North Anatolian Fault in the Ganos-Saros Region, NW Turkey", *Tectonophysics* (293), pp. 105-126.
- Westaway, R., 1994, "Present-day Kinematics of the Middle East and Eastern Mediterranean", *Journal of Geophysical Research* (99), pp. 12071-12090.
- World Institute for Disaster Risk Management, 2004, "Microzonation for Municipalities: State of the Art Report", Republic of Turkey, Ministry of Public Works and Settlement, General Directorate of Disaster Affairs, Ankara, 127 pp.
- Yaltırak, C., 2000, "Kuzey Anadolu Fayı'nın Marmara Kolları ve Bölgenin Tektonik Yapısı", *Güney Marmara Depremleri ve Jeofizik Toplantısı*, Bursa, 22 Eylül, 2000, s.44-48.

- Yaltırak, C. and Alpar, B., 2002, "Evolution of the middle strand of North Anatolian Fault and shallow seismic investigation of the southeastern Marmara Sea (Gemlik Bay)", *Marine Geology* (190), pp. 307-327.
- Yaltırak, C., Alpar, B., Sakıncı, M. and Yüce, H., 2000, "Origin of the Strait of Çanakkale (Dardanelles): regional tectonics and the Mediterranean-Marmara incursion", *Marine Geology* (16), pp.139-156.
- Yılmaz, Y., 1981, "Sakarya Kıtası Güney Kenarının Tektonik Evrimi", *İÜ Yerbilimleri Dergisi* (11:1-2), pp. 33-52.
- Yılmaz, Y., Genç, Ş.C., Yiğitbaş, E., Bozcu, M. and Yılmaz, K., 1995, "Geological Evolution of the Late Mesozoic Continental Margin of Northwestern Anatolia", *Tectonophysics* (243), pp. 155-171.

APPENDIX A

7OKER SONDAJ ve İNŞAAT LTD.ŞTİ.		DRILLING and CONSTRUCTION Co.		Sondaj No / Boring No : S-4	
				Sayfa No / Sheet No : 1	
SONDAJ LOGU / BORING LOG					
PROJE ADI / PROJECT NAME : MEER - GEMLİK BELEDİYESİ		MÜHENDİS / ENGINEER : Mehmet GÖKÇEER			
KOORDİNATLAR / COORDINATES : X: 4477043.36 Y: 428721.15		YERALTI SUYU DURUMU / GROUND WATER DATA			
SONDAJ KOTU / ELEVATION (m) : 3.60		DERİNLİK / DEPTH (m)		TARİH / DATE	
SONDAJ DERİNLİĞİ / BORING DEPTH (m) : 30.10		3.40		04.06.2005	
SONDAJ MAKİNASI / DRILLING RIG : ACKER-2		0.60		21.06.2005	
SONDÖR / FOREMAN : Rasim ÇİÇEK					
BAŞLAMA TARİHİ / DATE STARTED : 04.06.2005					
BİTİŞ TARİHİ / DATE COMPLETED : 06.06.2005					
MUHAFAZA BORU / CASING		DİŞ ÇAP / O.D. (mm) = 114		İÇ ÇAP / I.D. (mm) : 101	
				UZUNLUĞU / LENGTH (m) : 15.00	
DERİNLİK / DEPTH (m)	KAROT ve % a CORE % RECOVERY	R.Q.D. %	NUMUNE NO / SAMPLE NO	NUMUNE DERİNLİĞİ / SAMPLE DEPTH from to	ZEMİN TANIMLAMASI / SOIL DESCRIPTION
1					Dolgu; beton kaplama, moloz, çakıl ve kilden oluşmuş.
2			SPT-1	1.50-1.95	1.70 KİL; grimsi kahverenkli ile gri, orta katı; az siltli, az ince çakıllı.
3			P-1	2.70	CLAY; grayish brown to gray colored, medium stiff, contains some silt, some fine gravels.
4			UD-1	3.00-3.35	3.20 KİL/SİLT; yeşilimsi gri, çok yumuşak; 4.00m-5.00m arası çakıl bantı.
5			SPT-2	3.35-3.80	CLAY/SİLT; greenish gray colored, very soft; contains gravel band in between 4.00m-5.00m.
6			P-2	5.70	6.00 KİL; gri, çok yumuşak ile yumuşak; az siltli, 9.20-9.50m. arası sarı ince kum bantı.
7			UD-2	6.00-6.40	
8			SPT-4	6.40-6.85	
9			SPT-5	7.50-7.95	9.70 CLAY; gray colored, very soft to soft; contains some silt, yellow colored fine grained sand band in between 9.20m-9.50m.
10			P-3	8.70	
11			UD-3	9.00-9.35	
12			SPT-6	9.35-9.80	ÇAKILLI KUM; sarımsı kahverenkli, ince orta, orta sıkı; killi; çakıllar ince ile iri.
13			SPT-7	10.50-10.95	GRAVELLY SAND; yellowish brown colored, fine to medium dense; contains clay; gravels are fine to coarse.
14			P-4	11.70	
15			UD-4	12.00-12.20	
			SPT-8	12.20-12.65	
			SPT-9	13.50-13.95	Tanım için sonraki sayfaya bakınız.
			P-5	11.70	See next page for description
KIVAM DURUMU / STIFFNESS		SİKLİK / DENSITY		ORANLAR / PROPORTIONS	
N = 0 - 2 Çok yumuşak V.soft		N = 0 - 4 Çok gevşek V.loose		0 - 10 % Pek az (Seyrek) Trace	
N = 3 - 4 Yumuşak Soft		N = 5 - 10 Gevşek Loose		10 - 20 % Az Little	
N = 5 - 8 Orta katı M.stiff		N = 11 - 30 Orta sıkı M.dense		20 - 35 % Sıfat Adjective (Or some)	
N = 9 - 15 Katı Stiff		N = 31 - 50 Sıkı Dense		35 - 50 % Ve And	
N = 16 - 30 Çok katı V.stiff		N > 50 Çok sıkı V.dense			
N > 30 Sert Hard					
DAYANIMLILIK / STRENGTH		AYRIŞMA / WEATHERING		KAYA KALİTESİ TANIMI / R.Q.D.	
I Çok dayanımlı Very strong		I Taze Fresh		0 - 25 % Çok zayıf Very poor	
II Dayanımlı Strong		II Az ayrılmış Slightly weathered		25 - 50 % Zayıf Poor	
III Orta Medium		III Orta ayrılmış Mod. weathered		50 - 75 % Orta Fair	
IV Zayıf Weak		IV Çok ayrılmış Highly weathered		75 - 90 % İyi Good	
V Çok zayıf Very weak		V Tamamen ayrılmış Comp. weathered		90 - 100 % Çok iyi Excellent	
				UD : Örselenmemiş Numune / Undisturbed Sample	
				D : Örselenmiş Numune / Disturbed Sample	
				SPT : Standart Pen Deneyi / Standard Pen. Test	
				VST : Vane Deneyi / Vane Shear Test	
				P : Pressiometre Deneyi / Pressuremeter Test	
				K : Karot Numunesi / Core Sample	

Figure A.1: Borehole log of S-4.

APPENDIX A

7OKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ
Sondaj No / Boring No : S-4
Sayfa No / Sheet No : 2

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.O.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRIRMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
												Darbe Sayısı No. of Blows				N ₃₀	GRAFIK / GRAPH																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
												0-15	15-30	30-45			10	20	30	40	50																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
16			UD-5 SPT-10	15.00-15.30 15.30-15.75	ÇAKILLI KİL; rezidüel; sarımsı kahverenkli, sert; az siltli, az kumlu, yer yer ince kum bantlı; çakıllar ince ile blok boyutlu, köşeli.							8	13	20	33																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							

Figure A.1: (cont.)

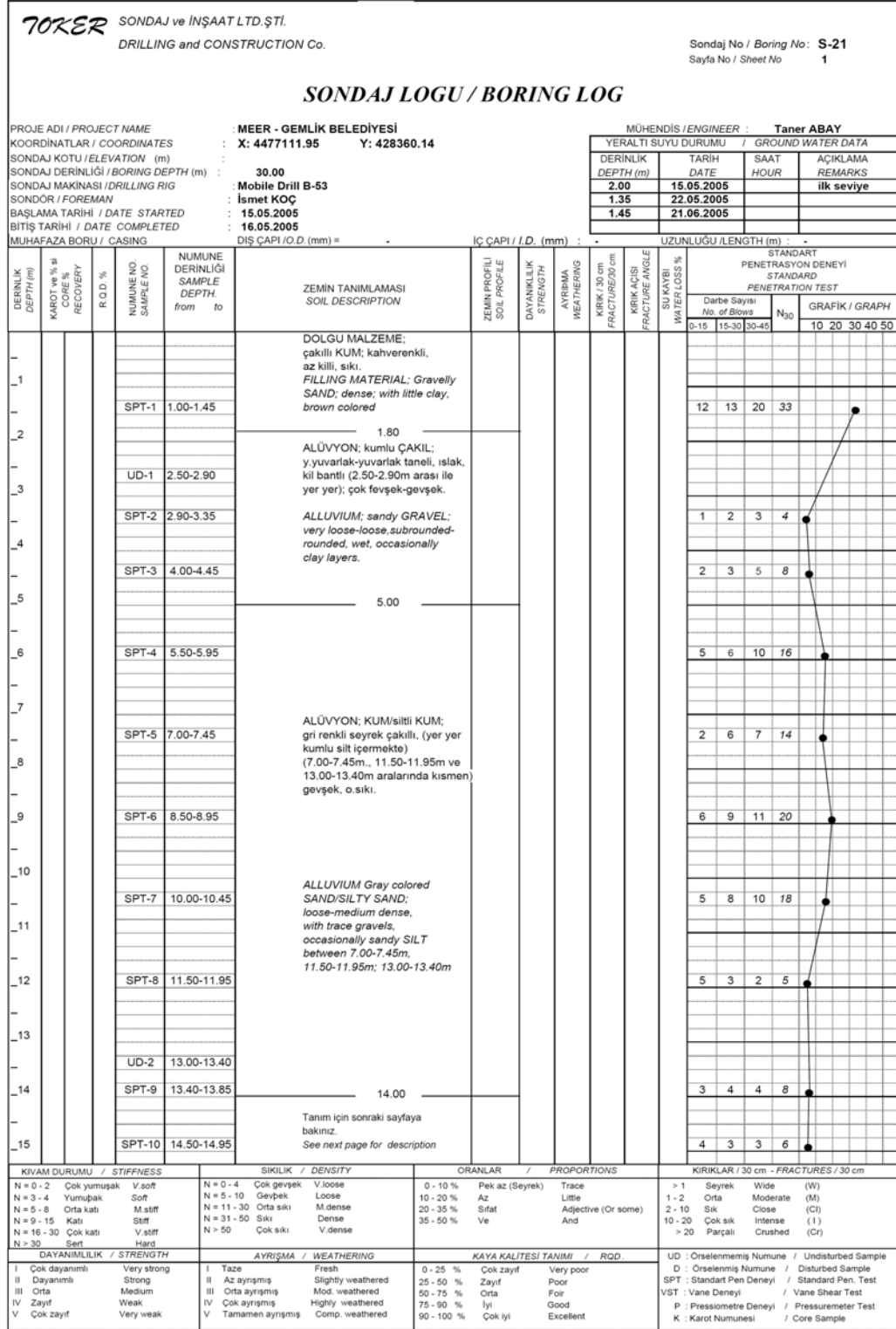


Figure A.2: Borehole log of S-21

[illegible]

Figure A.2: (cont.)

7OKER SONDAJ ve İNŞAAT LTD.ŞTİ.		DRILLING and CONSTRUCTION Co.		Sondaj No / Boring No : S-22	
				Sayfa No / Sheet No : 1	
SONDAJ LOGU / BORING LOG					
PROJE ADI / PROJECT NAME : MEER - GEMLİK BELEDİYESİ				MÜHENDİS / ENGINEER : Taner ABAY	
KOORDİNATLAR / COORDINATES : X: 4477280.96 Y: 428935.96				YERALTI SUYU DURUMU / GROUND WATER DATA	
SONDAJ KOTU / ELEVATION (m) : 2.30				DERİNLİK / DEPTH (m)	
SONDAJ DERİNLİĞİ / BORING DEPTH (m) : 30.00				TARİH / DATE	
SONDAJ MAKİNASI / DRILLING RIG : İsmet KOÇ				SAAT / HOUR	
SONDÖR / FOREMAN : İsmet KOÇ				AÇIKLAMA / REMARKS	
BAŞLAMA TARİHİ / DATE STARTED : 13.05.2005				ilk seviye	
BİTİŞ TARİHİ / DATE COMPLETED : 14.05.2005					
MUHAFAZA BORU / CASING : DIŞ ÇAP / O.D. (mm) =				UZUNLUĞU / LENGTH (m) :	
DERİNLİK / DEPTH (m)	KAROT ve % RECOVERY	NUMUNE NO. / SAMPLE NO.	NUMUNE DERİNLİĞİ / SAMPLE DEPTH. from to	ZEMİN TANIMLAMASI / SOIL DESCRIPTION	STANDART PENETRASYON DENEYİ / STANDARD PENETRATION TEST
					Darbe Sayısı / No. of Blows
					0-15 15-30 30-45
					N ₆₀ GRAFİK / GRAPH
					10 20 30 40 50
1				Dolgu Toprak / FILLING MATERIAL	
				0.30	
2		SPT-1	1.00-1.45	ALÜVYON: KİL: açık kahverenkli (gri alacalı) seyrek kumlu, organik (kavkı ve bitki kökleri içermekte), o.katı.	
				ALLUVIUM: light brown CLAY; medium stiff with trace sand, containing fossil shells and organic materials (ORGANIC CLAY)	
				2.00	
3		UD-1	2.50-3.00		
4		SPT-2	3.00-3.45		
				ALÜVYON:	
				Gri KUM: seyrek çakıllı ile çakıllı (yarı yuvarlak, yuvarlak), ıslak, kilikilli silt bandı içermekte (4.00-4.45m arası), gevşek, o.sıkı.	
5		SPT-3	4.00-4.45		
6		SPT-4	5.50-5.95		
7					
8		SPT-5	7.00-7.45		
				ALLUVIUM:	
				Gray SAND: loose-medium dense, damp containing gravels, occasionally clay/ clayey silt layers inbetween 4.00m-4.45m gravels are subrounded-rounded.	
9		SPT-6	8.50-8.95		
10					
11		SPT-7	10.00-10.45		
12		SPT-8	11.50-11.95		
13				12.50	
14		SPT-9	13.00-13.45		
				ALÜVYON: siltli KUM; gri renkli, ince-orta taneli, kil bantlı, gevşek, o.sıkı. (14.50-14.95m arası, kısmen çakıllı)	
15		SPT-10	14.50-14.95		
				ALLUVIUM: Gray silty SAND; loose-medium dense, fine-medium grained, with clay layers, occasionally gravels inbetween 14.50m and 14.95m.	
KIVAM DURUMU / STIFFNESS		SİKLİLİK / DENSITY		ORANLAR / PROPORTIONS	
N = 0 - 2 Çok yumuşak V.soft		N = 0 - 4 Çok gevşek V.loose		0 - 10 % Pek az (Seyrek) Trace	
N = 3 - 4 Yumuşak Soft		N = 5 - 10 Gevşek Loose		10 - 20 % Az Little	
N = 5 - 8 Orta katı M.stiff		N = 11 - 30 Orta sıkı M.dense		20 - 35 % Sifat Adjective (Or some)	
N = 9 - 15 Katı Stiff		N = 31 - 50 Sıkı Dense		35 - 50 % Ve And	
N = 16 - 30 Çok katı V.stiff		N > 50 Çok sıkı V.dense			
N > 30 Sert Hard					
DAYANIMLILIK / STRENGTH		AYRIŞMA / WEATHERING		KAYA KALİTESİ TANIMI / RQD	
I Çok dayanımlı Very strong		I Taze Fresh		0 - 25 % Çok zayıf Very poor	
II Dayanımlı Strong		II Az ayrılmış Slightly weathered		25 - 50 % Zayıf Poor	
III Orta Medium		III Orta ayrılmış Mod. weathered		50 - 75 % Orta For	
IV Zayıf Weak		IV Çok ayrılmış Highly weathered		75 - 90 % İyi Good	
V Çok zayıf Very weak		V Tamamen ayrılmış Comp. weathered		90 - 100 % Çok iyi Excellent	
				UD : Örselenmemiş Numune / Undisturbed Sample	
				D : Örselenmiş Numune / Disturbed Sample	
				SPT : Standart Pen Deneysel / Standard Pen. Test	
				VST : Vane Deneysel / Vane Shear Test	
				P : Pressiometre Deneysel / Pressuremeter Test	
				K : Karot Numunesi / Core Sample	

Figure A.3: Borehole log of S-22

APPENDIX A

7OKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ
Sondaj No / Boring No : S-22
Sayfa No / Sheet No : 2

DERİNLİK DEPTH (m)	KAROT ve % al CORE % RECOVERY	R.O.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRIRMA WEATHERING	KIRIK / 30 cm FRACTURE/90 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST									
												Darbe Sayısı No. of Blows			N ₃₀	GRAFIK / GRAPH					
												0-15	15-30	30-45		10	20	30	40	50	
16					ALÜVYON; siltli KUM; gri renkli, ince-orta taneli, kil bantlı, gevşek, o.sıkı. (14.50-14.95m arası, kısmen çakıllı)																
			SPT-11	16.00-16.45	ALLUVIUM; Gray silty SAND; loose-medium dense, fine-medium grained, with clay layers, occasionally gravels inbetween 14.50m and 14.95m.							14	9	6	15						
17																					
			SPT-12	17.50-17.95	17.70							3	2	3	5						
18																					
			SPT-13	19.00-19.45								2	3	3	6						
19					ALÜVYON; Gri KİL; seyrek kavkılı, plastik, doymun, o.katı, katı.																
			UD-2	20.50-20.90																	
20			SPT-14	20.70-21.35	ALLUVIUM; Gray CLAY; medium stiff-stiff, damp, plastic, with trace fossil shells.							2	2	4	6						
			SPT-15	22.00-22.45								3	4	5	9						
21																					
			UD-3	23.50-23.90																	
22			SPT-16	23.90-24.35								5	5	6	11						
			SPT-17	25.00-25.45								2	3	3	6						
23																					
			UD-4	26.50-26.90	29.90																
24			SPT-18	26.90-27.35	ORGANİK ZEMİN; yoğun kavkı, turba içermekte, kumlu, seyrek killi ile killi.							5	4	3	7						
			SPT-19	28.00-28.45	ORGANIC SOIL; composed of fossil shells, plant remains, sand, clay.							4	3	5	8						
25																					
			UD-5	29.50-29.90																	
26			SPT-20	29.90-30.35	30.35							4	9	10	19						
27					Kuyu Sonu End of Hole																
28																					
29																					
30																					
31																					
32																					
33																					
34																					
35																					

Figure A.3: (cont.)

7OKER SONDAJ ve İNŞAAT LTD.ŞTİ. DRILLING and CONSTRUCTION Co.		Sondaj No / Boring No : S-23 Sayfa No / Sheet No : 1																	
SONDAJ LOGU / BORING LOG																			
PROJE ADI / PROJECT NAME : MEER - GEMLİK BELEDİYESİ KOORDİNATLAR / COORDINATES : X: 4477104.44 Y: 429221.14 SONDAJ KOTU / ELEVATION (m) : 5.00 SONDAJ DERİNLİĞİ / BORING DEPTH (m) : 30.00 SONDAJ MAKİNASI / DRILLING RIG : Mobile Drill B-53 SONDÖR / FOREMAN : İsmet KOÇ BAŞLAMA TARİHİ / DATE STARTED : 16.05.2005 BİTİŞ TARİHİ / DATE COMPLETED : 17.05.2005 MUHAFAZA BORU / CASING : DIŞ ÇAP / O.D. (mm) = - İÇ ÇAP / I.D. (mm) = -		MÜHENDİS / ENGINEER : Taner ABAY YERALTI SUYU DURUMU / GROUND WATER DATA <table border="1"> <tr> <th>DERİNLİK / DEPTH (m)</th> <th>TARİH / DATE</th> <th>SAAT / HOUR</th> <th>AÇIKLAMA / REMARKS</th> </tr> <tr> <td>6.00</td> <td>16.05.2005</td> <td></td> <td>ilk seviye</td> </tr> <tr> <td>3.65</td> <td>22.05.2005</td> <td></td> <td></td> </tr> <tr> <td>3.60</td> <td>21.06.2005</td> <td></td> <td></td> </tr> </table>		DERİNLİK / DEPTH (m)	TARİH / DATE	SAAT / HOUR	AÇIKLAMA / REMARKS	6.00	16.05.2005		ilk seviye	3.65	22.05.2005			3.60	21.06.2005		
DERİNLİK / DEPTH (m)	TARİH / DATE	SAAT / HOUR	AÇIKLAMA / REMARKS																
6.00	16.05.2005		ilk seviye																
3.65	22.05.2005																		
3.60	21.06.2005																		
DERİNLİK / DEPTH (m)	KAROT ve % si / CORE % RECOVERY	R.Q.D. %	NUMUNE NO. / SAMPLE NO.	NUMUNE DERİNLİĞİ / SAMPLE DEPTH. from to	ZEMİN TANIMLAMASI / SOIL DESCRIPTION	ZEMİN PROFİLİ / SOIL PROFILE	DAYANIKLILIK / STRENGTH	AYRISMA / WEATHERING	KIRIK / 30 cm FRACTURE/cm	KIRIK AÇISI / FRACTURE ANGLE	SU KAYBI / WATER LOSS %	STANDART PENETRASYON DENEYİ / STANDARD PENETRATION TEST							
												Darbe Sayısı / No. of Blows 0-15 15-30 30-45 N ₆₀ GRAFİK / GRAPH 10 20 30 40 50							
1				SPT-1 1.00-1.45	Dolgu malzeme: çakıllı KUM; kahverenkli. FILLING MATERIAL: gravelly SAND; medium dense brown colored							9	13	6	19				
2					2.00														
3				UD-1 2.50-3.00	ALÜVYON: KİL; az siltli/siltli, boz kahverenkli (gri alacalı), seyrek ile az kumlu, seyrek kavkılı, o.katı-katı.							4	7	7	14				
4				SPT-2 3.00-3.45								4	3	3	6				
5				SPT-3 4.00-4.45	ALLUVIUM; brown gray matted CLAY; medium stiff-stiff, with trace-little sand, trace fossil shells.														
6				UD-2 5.50-6.00															
7				SPT-4 6.00-6.45	ALÜVYON: çakıllı KUM/ KÜMLÜ ÇAKIL; kahve, gri renkli; kpt. kumtaşı, silttaşı silttaşı kökenli, y.yuvarlak-yuvarlak, kil bantlı ile kısmen az killi ıslak. ALLUVIUM: Gravelly SAND/Sandy GRAVEL; medium dense, originated from limestone, sandstone, siltstone, subrounded-rounded, with clay layers and occasionally containing silt.							4	6	9	15				
8				SPT-5 7.00-7.45								9	9	10	19				
9				SPT-6 8.50-8.95	ALÜVYON: KUM/siltli KUM, kahve, gri renkli, ince-orta taneli, seyrek çakıllı (12.00m'ye kadar), "killi silt" mercaklı (16.00m'de) ile "kumlu ince çakıl" bantlı (13.00-13.45 m. arası), ıslak, gevşek, o.sıkı, (siltli KUM; 8.50-8.95m arasında ve kısmen 11.50-11.95m arasında yer almaktadır.							3	5	8	13				
10				SPT-7 10.00-10.45								2	3	5	8				
11				SPT-8 11.50-11.95	ALLUVIUM; brown-gray SAND/silty SAND; loose-medium dense, fine-medium grained. (Between 8.00m-12.00m trace garvels) (Clayey silt lenses at 16.00m) (Between 13.00-13.45 m. sandy fine garvels)							2	4	4	8				
12				SPT-9 13.00-13.45								2	3	3	6				
13				SPT-10 14.50-14.95								3	2	2	4				
14																			
15																			
KIVAM DURUMU / STIFFNESS		SİKLİLİK / DENSITY		ORANLAR / PROPORTIONS		KIRIKLAR / 30 cm - FRACTURES / 30 cm													
N = 0 - 2	Çok yumuşak	V.soft	N = 0 - 4	Çok gevşek	V.loose	0 - 10 %	Pek az (Seyrek)	Trace	> 1	Seyrek	Wide	(W)							
N = 3 - 4	Yumuşak	Soft	N = 5 - 10	Gevşek	Loose	10 - 20 %	Az	Little	1 - 2	Orta	Moderate	(M)							
N = 5 - 8	Orta katı	M.stiff	N = 11 - 30	Orta sıkı	M.dense	20 - 35 %	Sıfat	Adjective (Or some)	2 - 10	Sık	Close	(C)							
N = 9 - 15	Katı	Stiff	N = 31 - 50	Sıkı	Dense	35 - 50 %	Ve	And	10 - 20	Çok sık	Intense	(I)							
N = 16 - 30	Çok katı	V.stiff	N > 50	Çok sıkı	V.dense				> 20	Parçalı	Crushed	(Cr)							
N > 30	Sert	Hard																	
DAYANIMLILIK / STRENGTH		AYRISMA / WEATHERING		KAYA KALİTESİ TANIMI / RQD		UD : Örselememiş Numune / Undisturbed Sample D : Örselemiş Numune / Disturbed Sample SPT : Standart Pen Denevi / Standard Pen. Test VST : Vane Denevi / Vane Shear Test P : Pressiometre Denevi / Pressurometer Test K : Karot Numunesi / Core Sample													
I	Çok dayanımlı	Very strong	I	Taze	Fresh	0 - 25 %	Çok zayıf	Very poor											
II	Dayanımlı	Strong	II	Az ayrılmış	Slightly weathered	25 - 50 %	Zayıf	Poor											
III	Orta	Medium	III	Orta ayrılmış	Mod. weathered	50 - 75 %	Orta	Fair											
IV	Zayıf	Weak	IV	Çok ayrılmış	Highly weathered	75 - 90 %	İyi	Good											
V	Çok zayıf	Very weak	V	Tamamen ayrılmış	Comp. weathered	90 - 100 %	Çok iyi	Excellent											

Figure A.4: Borehole log of S-23

APPENDIX A

7OKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ
Sondaj No / Boring No : S-23
Sayfa No / Sheet No : 2

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.O.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRIRMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST									
												Darbe Sayısı No. of Blows			N ₃₀	GRAFIK / GRAPH					
												0-15	15-30	30-45		10	20	30	40	50	
16					Tanım için önceki sayfaya bakınız.																
			SPT-11	16.00-16.45	See previons page for description.							4	3	3	6						
17					17.00																
18			SPT-12	17.50-17.95	ALÜVYON; Gri KİL; doğun, silt/ince kum mercekli, 17.00-19.00m arası kıllı kum/kumlu kil bantları ile 23.90-24.35m arası "kavkılı kumlu silt" bandı içermekte, yumuşak o.katı.							2	2	3	5						
19																					
20			SPT-13	19.00-19.45								2	2	2	4						
21																					
22			SPT-14	20.50-20.95								3	3	4	7						
23					ALLUVIUM; gray CLAY; soft-medium stiff, with silt/fine sand lenses, between 17.00m-19.00m clayey sand/sandy clay layers; between 23.90-24.35m sandy silt rich in fossil shells.																
24			UD-3	23.50-23.90																	
25			SPT-16	23.90-24.35								8	11	8	19						
26					25.00																
27			SPT-17	25.00-25.45	Alüvyon / karasal KİL; az siltli; kahve, sarımsı kahverenkli; seyrek kumlu ile kumlu, seyrek ince çakıllı (yarı köşeli-yuvarlak, kıltaşı, kumtaşı kökenli), katı, çok katı.							5	7	8	15						
28			UD-4	26.50-26.90																	
29			SPT-18	26.90-27.35								7	12	14	26						
30					ALLUVIUM; brown yellowish brown CLAY; stiff-very stiff, with trace-little sand, trace fine subrounded- rounded gravels originated from claystone, sandstone.																
31			UD-5	28.00-28.30																	
32			SPT-19	28.50-28.95								9	13	15	28						
33																					
34			SPT-20	30.00-30.45	30.45							8	10	15	25						
35					Kuyu Sonu End of Hole																

Figure A.4: (cont.)

APPENDIX A

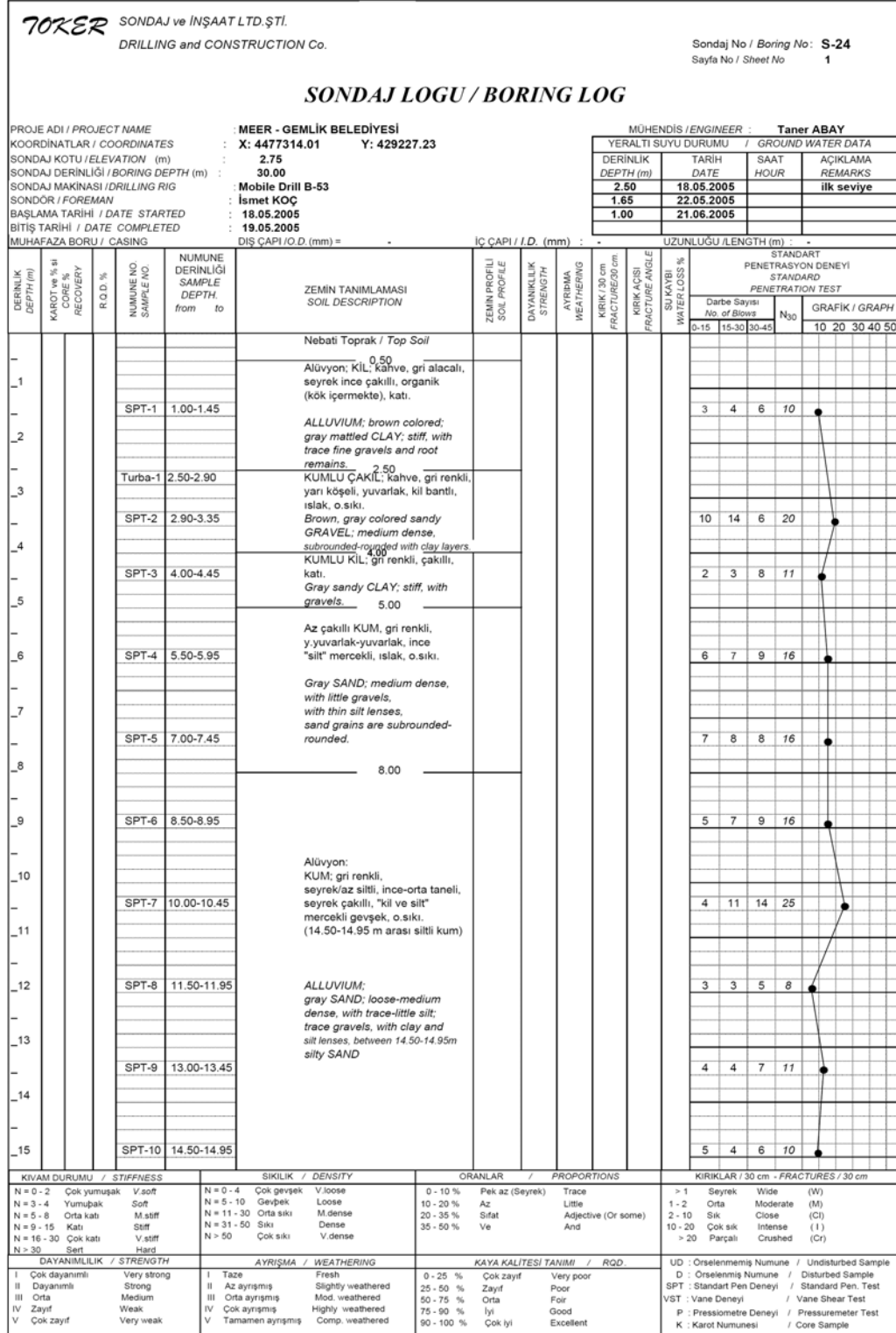


Figure A.5: Borehole log of S-24

70KER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING AND CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ
Sondaj No / Boring No : S-24
Sayfa No / Sheet No : 2

DERİNLİK DEPTH (m)	KAROT ve % su CORE % RECOVERY	R.O.D. %	NUMUNE NO SAMPLE NO.	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRIMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm.	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST									
												Darbe Sayısı No. of Blows				GRAFIK / GRAPH					
												0-15	15-30	30-45	N ₃₀	10	20	30	40	50	
16					Tanım için önceki sayfaya bakınız. See previons page for description.																
			SPT-11	16.00-16.45	17.00																
17																					
18			UD-1	17.50-18.00																	
			SPT-12	18.00-18.45																	
19																					
			SPT-13	19.00-19.45																	
20					ALÜVYON; Gri KİL; doygun, "silt" ve "ince kum" mercekli, o.katı, kavrıklı (27.00-28.00 m. arası)																
21			UD-2	20.50-21.00																	
			SPT-14	21.00-21.45																	
22					ALLUVIUM; gray CLAY; medium stiff, with silt and fine sand lenses. Between 27.00m-28.00m fossil shells.																
			SPT-15	22.00-22.45																	
23																					
			UD-3	23.50-24.00																	
24			SPT-16	24.00-24.45																	
25																					
			SPT-17	25.50-25.95																	
26																					
			UD-4	27.00-27.50																	
28			SPT-18	27.50-27.95	28.00 KUM; gri, yeşil renkli; az ince çakıllı, ıslak organik matzeme içermekte, o.sıkı. Gray to gray SAND; medium dense, with little fine gravels and containing organic materials.																
29			SPT-19	28.50-28.95	29.80 Kumlu ÇAKIL; killi, köşeli-yuvarlak kumtaşı, andezit kökenli, çok sıkı. Sansy GRAVEL; very dense, with clay, angular-rounded, originated from andesite.																
30			SPT-20 SPT-21	29.50-29.95 30.00-30.24	30.24																
31																					
32					Kuyu Sonu End of Hole																
33																					
34																					
35																					

Figure A.5: (cont.)

7OKER SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

Sondaj No / Boring No : **S-25**
Sayfa No / Sheet No : **1**

SONDAJ LOGU / BORING LOG

PROJE ADI / PROJECT NAME : **MEER - GEMLİK BELEDİYESİ**
KOORDİNATLAR / COORDINATES : **X: 4477480.78 Y: 429621.34**
SONDAJ KOTU / ELEVATION (m) : **2.75**
SONDAJ DERİNLİĞİ / BORING DEPTH (m) : **30.00**
SONDAJ MAKİNASI / DRILLING RIG : **ACKER-I**
SONDÖR / FOREMAN : **Rasim ÇİÇEK**
BAŞLAMA TARİHİ / DATE STARTED : **21.05.2005**
BİTİŞ TARİHİ / DATE COMPLETED : **22.05.2005**
MUHAFAZA BORU / CASING : **DIŞ ÇAP / O.D. (mm) = 114 İÇ ÇAP / I.D. (mm) : 101**

MÜHENDİS / ENGINEER : **Taner ABAY**

YERALTI SUYU DURUMU / GROUND WATER DATA		STANDART PENETRASYON DENEYİ / STANDARD PENETRATION TEST	
DERİNLİK / DEPTH (m)	TARİH / DATE	SAAT / HOUR	AÇIKLAMA / REMARKS
2.00	21.05.2005		ilk seviye
3.70	22.05.2005		
4.40	21.06.2005		

DERİNLİK / DEPTH (m)	KAROT ve % s / CORE % RECOVERY	R.O.D. %	NUMUNE NO / SAMPLE NO	NUMUNE DERİNLİĞİ / SAMPLE DEPTH from to	ZEMİN TANIMLAMASI / SOIL DESCRIPTION	ZEMİN PROFİLİ / SOIL PROFILE	DAYANIKLILIK / STRENGTH	AYRISMA / WEATHERING	KIRIK / 30 cm FRACTURE / 30 cm	KIRIK AÇISI / FRACTURE ANGLE	SU KAYBI / WATER LOSS %	STANDART PENETRASYON DENEYİ / STANDARD PENETRATION TEST								
												Darbe Sayısı / No. of Blows	N ₆₀	GRAFIK / GRAPH						
1					Dolgu Malzeme (kum ve çakıl) / FILLING MATERIAL (SAND and GRAVEL)							0-15	15-30	30-45	N ₆₀	10	20	30	40	50
2			SPT-1	1.50-1.95	1.20 SİLT/kumlu SİLT; kahverenkli (gri alacalı), kısmen kilili ve çakıllı (1.50-1.95m arası), kil ve "ince kum" bantları içermekte, yumuşak.							2	2	1	3					
3			UD-1	3.00-3.30	Brown, gray mottled SİLT/ sandy SİLT; soft, with trace clay and gravels between 1.50-1.95m; with clay and fine sand layers.							1	2	2	4					
4			SPT-2	3.30-3.75	4.00 Kumlu ÇAKIL; gri, bej renkli, y. köşeli-yuvarlak, katı, kumtaşı, kıltaşı kökenli, ıslak, gevşek, o.siki.							2	3	3	6					
5			SPT-3	4.50-4.95	Gray-beige sandy GRAVEL; loose-medium dense, subangular rounded, originated from limestone, sandstone, claystone.															
6			UD-2	6.00-6.40	6.20 Kumlu ÇAKIL; gri, bej renkli, y. köşeli-yuvarlak, kçt.kumtaşı, kıltaşı kökenli; ıslak, gevşek, o.siki.							3	4	6	10					
7			SPT-4	6.40-6.85	Gray-beige sandy GRAVEL; loose-medium dense, subangular-rounded, originated from limestone, sandstone, claystone.							8	8	9	17					
8			SPT-5	7.50-7.95	8.50 Siltli ÇAKIL; kısmen kumlu (10.50-10.95m. Arası), seyrek ile az kilili; y. köşeli-yuvarlak, o.siki.							3	4	8	12					
9			SPT-6	9.00-9.40	Silty GRAVEL; medium dense, with trace sand and clay subangular-rounded. (between 10.50-10.95)							5	9	14	23					
10			SPT-7	10.50-10.95	11.50 Çakıllı KUM; yeşilimsi gri, gri renkli, seyrek siltli, ince "silt" bantları içermekte, gevşek. Greenish gray-gray gravelly SAND; loose, with trace silt and thin silt layers.							7	4	6	10					
11			SPT-8	12.00-12.45	13.00 KİL; gri renkli, sıkça "silt" bantlı/ mercekli, yumuşak. O.katı. Gray CLAY; soft-medium stiff with silt layers/senses.							1	1	3	4					
12			SPT-9	13.50-13.95																
13			UD-3	15.00-15.40																

KIVAM DURUMU / STIFFNESS			SİKLİK / DENSITY			ORANLAR / PROPORTIONS			KIRIKLAR / 30 cm - FRACTURES / 30 cm		
N = 0 - 2	Çok yumuşak	V.soft	N = 0 - 4	Çok gevşek	V.loose	0 - 10 %	Pek az (Seyrek)	Trace	> 1	Seyrek	Wide (W)
N = 3 - 4	Yumuşak	Soft	N = 5 - 10	Gevşek	Loose	10 - 20 %	Az	Little	1 - 2	Orta	Moderate (M)
N = 5 - 8	Orta katı	M.stiff	N = 11 - 30	Orta sıkı	M.dense	20 - 35 %	Sıfat	Adjective (Or some)	2 - 10	Sık	Close (C)
N = 9 - 15	Katı	Stiff	N = 31 - 50	Sıkı	Dense	35 - 50 %	Ve	And	10 - 20	Çok sık	Intense (I)
N = 16 - 30	Çok katı	V.stiff	N > 50	Çok sıkı	V.dense				> 20	Parçalı	Crushed (Cr)
N > 30	Sert	Hard									

DAYANIMLILIK / STRENGTH		AYRISMA / WEATHERING		KAYA KALİTESİ TANIMI / RQD		UD : Örselememiş Numune / Undisturbed Sample		
I	Çok dayanımlı	Very strong	I	Taze	Fresh	0 - 25 %	Çok zayıf	Very poor
II	Dayanımlı	Strong	II	Az ayrılmış	Slightly weathered	25 - 50 %	Zayıf	Poor
III	Orta	Medium	III	Orta ayrılmış	Mod. weathered	50 - 75 %	Orta	Fair
IV	Zayıf	Weak	IV	Çok ayrılmış	Highly weathered	75 - 90 %	İyi	Good
V	Çok zayıf	Very weak	V	Tamamen ayrılmış	Comp. weathered	90 - 100 %	Çok iyi	Excellent

UD : Örselememiş Numune / Undisturbed Sample
D : Örselemiş Numune / Disturbed Sample
SPT : Standart Pen Deneyi / Standard Pen. Test
VST : Vane Deneyi / Vane Shear Test
P : Pressiometre Deneyi / Pressuremeter Test
K : Karot Numunesi / Core Sample

Figure A.6: Borehole log of S-25

APPENDIX A

7OKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ
Sondaj No / Boring No : S-25
Sayfa No / Sheet No : 2

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.O.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRIMA WEATHERING	KIRIK / 30 cm FRACTURE 30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST										
												Darbe Sayısı No. of Blows				N ₃₀	GRAFIK / GRAPH					
												0-15	15-30	30-45			10	20	30	40	50	
16			SPT-10	15.40-15.85	KİL; gri renkli, sıkça "silt" bantlı/ mercekli, yumuşak. O.katı. Gray CLAY; soft-medium stiff with silt layers/lenses,							2	2	2	4							
17			SPT-11	16.50-16.95								2	2	3	5							
18			UD-4	18.00-18.40	18.00																	
19			SPT-12	18.40-18.85	Killi SİLT; gri renkli; "kum" ile yer yer "kil" bantları içermekte, ıslak, yumuşak, o.katı, (kum; 18.40-18.85m arası ile kısmen 19.50-19.95m arasında gözlenmiştir.)							3	3	5	8							
20			SPT-13	19.50-19.95								5	5	3	8							
21			SPT-14	21.00-21.45	Gray clayey SİLT; soft-medium stiff, occasionally sand and clay layers. (Between 18.40-18.85m and 19.50-19.95m sand layers.)							2	3	3	6							
22			UD-5	22.50-22.80																		
23			SPT-15	22.30-23.25	23.50							2	1	2	3							
24			SPT-16	24.00-24.45	KİL; gri renkli, "killi silt" bantı ile ince "silt" mercekleri içermekte, seyrek kavkılı, o.katı, katı.							3	3	3	6							
25			UD-6	25.50-25.85																		
26			SPT-17	25.85-26.30								3	3	4	7							
27			SPT-18	27.00-27.45	Gray CLAY; with clayey silt, and thin silt lenses, with trace fossil shells. medium stiff-stiff							3	5	4	9							
28			UD-7	28.50-28.80																		
29			SPT-19	28.80-29.25	29.50 Killi kumlu ÇAKIL; gri, yeşil, bej renkli, yuvarlak,gevşek Gray, green,beige colored clayey sandy GRAVEL; loose,rounded.							4	6	6	12							
30			SPT-20	30.00-30.45	30.45							8	5	5	10							
31					Kuyu Sonu End of Hole																	
32																						
33																						
34																						
35																						

Figure A.6: (cont.)

7OKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

Sondaj No / Boring No : **S-26**
Sayfa No / Sheet No : **1**

SONDAJ LOGU / BORING LOG

PROJE ADI / PROJECT NAME : **MEER - GEMLİK BELEDİYESİ**
KOORDİNATLAR / COORDINATES : **X: 4477501.14 Y: 428350.82**
SONDAJ KOTU / ELEVATION (m) : **1.20**
SONDAJ DERİNLİĞİ / BORING DEPTH (m) : **30.85**
SONDAJ MAKİNASI / DRILLING RIG : **ACKER-2**
SONDÖR / FOREMAN : **Rasim ÇİÇEK**
BAŞLAMA TARİHİ / DATE STARTED : **17.06.2005**
BİTİŞ TARİHİ / DATE COMPLETED : **18.06.2005**
MUHAFAZA BORU / CASING : **DIŞ ÇAP / O.D. (mm) = 114**

MÜHENDİS / ENGINEER : **Taner ABAY**
YERALTI SUYU DURUMU / GROUND WATER DATA
DERİNLİK / DEPTH (m) : **0.80** TARİH / DATE : **17.06.2005** SAAT / HOUR : **ilk seviye**
3.70 : **22.05.2005**
4.40 : **21.06.2005**
UZUNLUĞU / LENGTH (m) : **24.00**

DERİNLİK / DEPTH (m)	KAROT ve % a / CORE % RECOVERY	R.O.D. %	NUMUNE NO / SAMPLE NO.	NUMUNE DERİNLİĞİ / SAMPLE DEPTH. from to	ZEMİN TANIMLAMASI / SOIL DESCRIPTION	ZEMİN PROFİLİ / SOIL PROFILE	DAYANIKLILIK / STRENGTH	AYIRISMA / WEATHERING	KIRIK / 30 cm / FRACTURE/30 cm	KIRIK AÇISI / FRACTURE ANGLE	SU KAYBI / WATER LOSS %	STANDART PENETRASYON DENEYİ / STANDARD PENETRATION TEST	GRAFİK / GRAPH										
												Darbe Sayısı / No. of Blows	N ₃₀	0-15	15-30	30-45	GRAFİK / GRAPH	10	20	30	40	50	
1					DOLGU; beton kaplama ve stabilize malzeme, <i>FILL; concrete pavement and graded material</i> , 1.00																		
2					DOLGU; kum ve çakıl; bloklu <i>FILL; sand and gravel, with blocks.</i> 2.30																		
3					ALÜVYON/ ÇAKIL; gri, az kumlu, ince ile kaba, yuvarlak, ıslak, o.siki. <i>ALLUVIUM/GRAVEL; gray, with little sand, fine to coarse, rounded, wet, m.dense.</i> 3.50																		
4				SPT-1	3.00-3.45									10	7	6	13						
5				SPT-2	4.50-4.95									5	6	8	14						
6						Çakıllı KUM; gri, az siltli ile siltli, yer yer çakıl ve kum bantları içermekte, (6.00-6.45m de ve 12.00-12.45m. arası gibi), nemli-ıslak, gevşek, o.siki.								3	4	6	10						
7																							
8				SPT-4	7.50-7.93									4	8	8	16						
9						Gravelly SAND; gray, with little to some silt; contains occasional gravel and sand bands (like at 6.00-6.45m and between 12.00-12.45m) moist-wet; loose to m.dense.								5	7	8	15						
10																							
11				SPT-6	10.50-10.95									4	9	8	17						
12																							
13				SPT-7	12.00-12.45									7	9	8	17						
14						13.00																	
15				SPT-8	13.50-13.95	Tanım için sonraki sayfaya bakınız. <i>See next page for description</i>								5	7	7	14						

KIVAM DURUMU / STIFFNESS	SIKLIK / DENSITY	ORANLAR / PROPORTIONS	KIRIKLAR / 30 cm - FRACTURES / 30 cm
N = 0 - 2 Çok yumuşak / V.soft N = 3 - 4 Yumuşak / Soft N = 5 - 8 Orta katı / M.stiff N = 9 - 15 Katı / Stiff N = 16 - 30 Çok katı / V.stiff N > 30 Sert / Hard	N = 0 - 4 Çok gevşek / V.loose N = 5 - 10 Gevşek / Loose N = 11 - 30 Orta sıkı / M.dense N = 31 - 50 Sıkı / Dense N > 50 Çok sıkı / V.dense	0 - 10 % Pek az (Seyrek) / Trace 10 - 20 % Az / Little 20 - 35 % Sıfat / Adjective (Or some) 35 - 50 % Ve / And	> 1 Seyrek / Wide (W) 1 - 2 Orta / Moderate (M) 2 - 10 Sık / Close (C) 10 - 20 Çok sık / Intense (I) > 20 Parçalı / Crushed (Cr)
DAYANIMLILIK / STRENGTH	AYIRISMA / WEATHERING	KAYA KALİTESİ TANIMI / RGD	UD : Örselememiş Numune / Undisturbed Sample D : Örselemiş Numune / Disturbed Sample SPT : Standard Pen Deneği / Standard Pen. Test VST : Vane Deneği / Vane Shear Test P : Pressiometre Deneği / Pressuremeter Test K : Karot Numunesi / Core Sample
I Çok dayanımlı / Very strong II Dayanımlı / Strong III Orta / Medium IV Zayıf / Weak V Çok zayıf / Very weak	I Taze / Fresh II Az ayrılmış / Slightly weathered III Orta ayrılmış / Mod. weathered IV Çok ayrılmış / Highly weathered V Tamamen ayrılmış / Comp. weathered	0 - 25 % Çok zayıf / Very poor 25 - 50 % Zayıf / Poor 50 - 75 % Orta / Fair 75 - 90 % İyi / Good 90 - 100 % Çok iyi / Excellent	

Figure A.7: Borehole log of S-26

APPENDIX A

7OKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ
Sondaj No / Boring No : S-26
Sayfa No / Sheet No : 2

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.Q.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRIRMA WEATHERING	KIRIK / 30 cm FRACTURE/90 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST										
												Darbe Sayısı No. of Blows				N ₃₀	GRAFIK / GRAPH					
												0-15	15-30	30-45			10	20	30	40	50	
16			SPT-9	15.00-15.45	İnce KUM; gri, silt ve kil bantları içermekte, seyrek turbalı; 15.00-15.45m.de çakıllı kum- orta; kahve gri renkli ve çakıl bantı içermekte nemli-ıslak; gevşek, o.siki.							7	2	6	8							
17			SPT-10	16.50-16.95	Fine SAND; gray, with silt and clay bands, trace turb. contains gravelly sand-medium; brown, gray and gravel bands at 15.00-15.45m, moist-wet; loose, m.dense.							3	4	7	11							
18			Torba-1	18.00-18.20																		
19			SPT-11	18.20-18.65								3	4	5	9							
20			SPT-12	19.50-19.95	19.00 SILT; gri, seyrek killi; o.katı. SILT; gray, trace clay, m.stiff.							3	3	4	7							
21			UD-1	21.00-21.40	20.50 KİL; gri, siyah, silt ve kil silt bantlı, seyrek ince kavkılı, o.katı.																	
22			SPT-13	21.40-21.83	CLAY; gray, black; with silt and clayey silt bands, trace fine shells, m.stiff.							3	4	3	7							
23			SPT-14	22.50-22.95	22.00							3	3	3	6							
24			UD-2	24.00-24.40	KİL; yeşilimsi gri, grimsi yeşil renkli, doygun, ince silt bantları içermekte, seyrek kavkılı, o.katı.																	
25			SPT-15	24.40-24.85								3	3	4	7							
26			SPT-16	25.50-25.95								3	3	3	6							
27			UD-3	27.00-27.35	CLAY; greenish gray, grayish green; saturatad, contains little amount of fine silt lenses, trace shell, m.dense.																	
28			SPT-17	27.35-27.80								4	4	4	8							
29			SPT-18	28.50-28.95								3	4	4	8							
30			UD-4	30.00-30.40																		
31			SPT-19	30.40-30.85	30.85 Kuyu Sonu End of Hole							3	3	3	6							
32																						
33																						
34																						
35																						

Figure A.7: (cont.)

7OKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

Sondaj No / Boring No : **S-27**
Sayfa No / Sheet No **1**

SONDAJ LOGU / BORING LOG

PROJE ADI / PROJECT NAME : **MEER - GEMLİK BELEDİYESİ**
KOORDİNATLAR / COORDINATES : **X: 4477809.68 Y: 428273.25**
SONDAJ KOTU / ELEVATION (m) : **1.10**
SONDAJ DERİNLİĞİ / BORING DEPTH (m) : **30.95**
SONDAJ MAKİNASI / DRILLING RIG : **Mobile Drill B-53**
SONDÖR / FOREMAN : **Erdoğan BİÇAKÇI**
BAŞLAMA TARİHİ / DATE STARTED : **18.06.2005**
BİTİŞ TARİHİ / DATE COMPLETED : **18.06.2005**
MUHAFAZA BORU / CASING : **DIŞ ÇAP / O.D. (mm) = 114**

MÜHENDİS / ENGINEER : **Taner ABAY**
YERALTI SUYU DURUMU / GROUND WATER DATA
DERİNLİK / DEPTH (m) : **0.75** TARİH / DATE : **18.06.2005** SAAT / HOUR : **18.06.2005** AÇIKLAMA / REMARKS : **ilk seviye**
DERİNLİK / DEPTH (m) : **1.10** TARİH / DATE : **20.06.2005** SAAT / HOUR : **20.06.2005** AÇIKLAMA / REMARKS :
DERİNLİK / DEPTH (m) : TARİH / DATE : SAAT / HOUR : AÇIKLAMA / REMARKS :
DERİNLİK / DEPTH (m) : TARİH / DATE : SAAT / HOUR : AÇIKLAMA / REMARKS :
UZUNLUĞU / LENGTH (m) : **30.00**

DERİNLİK / DEPTH (m)	KAROT ve % a CORE % RECOVERY	R.O.D. %	NUMUNE NO / SAMPLE NO	NUMUNE DERİNLİĞİ / SAMPLE DEPTH from to	ZEMİN TANIMLAMASI / SOIL DESCRIPTION	ZEMİN PROFİLİ / SOIL PROFILE	DAYANIKLILIK / STRENGTH	AYRISMA / WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI / FRACTURE ANGLE	SU KAYBI / WATER LOSS %	STANDART PENETRASYON DENEYİ / STANDARD PENETRATION TEST	GRAFİK / GRAPH		
												Darbe Sayısı / No. of Blows	N ₃₀		
												0-15	15-30	30-45	10 20 30 40 50
1					DOLGU; kil, kum ve çakıldan oluşmakta; tuğla parçaları içermekte. FILL; composed of clay, sand and gravel; contains brick pieces.										
2			SPT-1	1.50-1.95	DOLGU; çakıl ve kum, koyu gri, siyah, tuğla parçaları içermekte, gevşek. FILL; sand and gravel; dark gray, black; contains brick pieces; loose.							2	3	4	7
3			SPT-2	3.00-3.45								2	4	3	7
4					ALÜVYON; ince KUM/SİLT; koyu gri, gri; seyrek yuvarlak çakıllı, seyrek ince killi silt bantlı, ıslak; çok yumuşak/ çok gevşek. ALLUVIUM; fine SAND/SILT; dark gray, gray, trace rounded gravels, contains trace amount of thin bands of clayey silt, wet ; v.soft /v.loose.							5	1	1	2
5			SPT-3	4.50-4.95											
6			SPT-4	6.00-6.45								0	1	1	2
7															
8			SPT-5	7.50-7.95	KUM; koyu gri, seyrek siltli, seyrek yuvarlak çakıllı (ince), ıslak, çok gevşek, gevşek. SAND; dark gray; with trace silt, trace rounded fine gravels, wet; very loose, loose.							4	1	2	3
9															
10			SPT-6	9.00-9.45								2	2	3	5
11			SPT-7	10.50-10.95								0	1	1	2
12					SİLT; gri, siyah renkli, yer yer kum ve killi silt bantları içermekte, yer yer tırbalı, çok yumuşak, 0.katı. SILT; gray, black colored; occasionally contains sand and clayey silt bands and turb; very soft, m. stiff.							2	3	3	6
13			SPT-8	12.00-12.45											
14			SPT-9	13.50-13.95								3	3	3	6
15															

KIVAM DURUMU / STIFFNESS	SIKLIK / DENSITY	ORANLAR / PROPORTIONS	KIRIKLAR / 30 cm - FRACTURES / 30 cm
N = 0 - 2 Çok yumuşak V.soft N = 3 - 4 Yumuşak Soft N = 5 - 8 Orta katı M.stiff N = 9 - 15 Katı Stiff N = 16 - 30 Çok katı V.stiff N > 30 Sert Hard	N = 0 - 4 Çok gevşek V.loose N = 5 - 10 Gevşek Loose N = 11 - 30 Orta sıkı M.dense N = 31 - 50 Sıkı Dense N > 50 Çok sıkı V.dense	0 - 10 % Pek az (Seyrek) 10 - 20 % Az Little 20 - 35 % Sıfat Adjective (Cr some) 35 - 50 % Ve And	> 1 Seyrek Wide (W) 1 - 2 Orta Moderate (M) 2 - 10 Sık Close (Cl) 10 - 20 Çok sık Intense (I) > 20 Parçalı Crushed (Cr)
DAYANIMLILIK / STRENGTH	AYRISMA / WEATHERING	KAYA KALİTESİ TANIMI / RGD	UD : Örselenmemiş Numune / Undisturbed Sample D : Örselenmiş Numune / Disturbed Sample SPT : Standart Pen Deneysel / Standard Pen. Test VST : Vane Deneysel / Vane Shear Test P : Pressiometre Deneysel / Pressuremeter Test K : Karot Numunesi / Core Sample
I Çok dayanımlı Very strong II Dayanımlı Strong III Orta Medium IV Zayıf Weak V Çok zayıf Very weak	I Taze Fresh II Az ayrılmış Slightly weathered III Orta ayrılmış Mod. weathered IV Çok ayrılmış Highly weathered V Tamamen ayrılmış Comp. weathered	0 - 25 % Çok zayıf Very poor 25 - 50 % Zayıf Poor 50 - 75 % Orta Fair 75 - 90 % İyi Good 90 - 100 % Çok iyi Excellent	

Figure A.8: Borehole log of S-27

APPENDIX A

7OKER

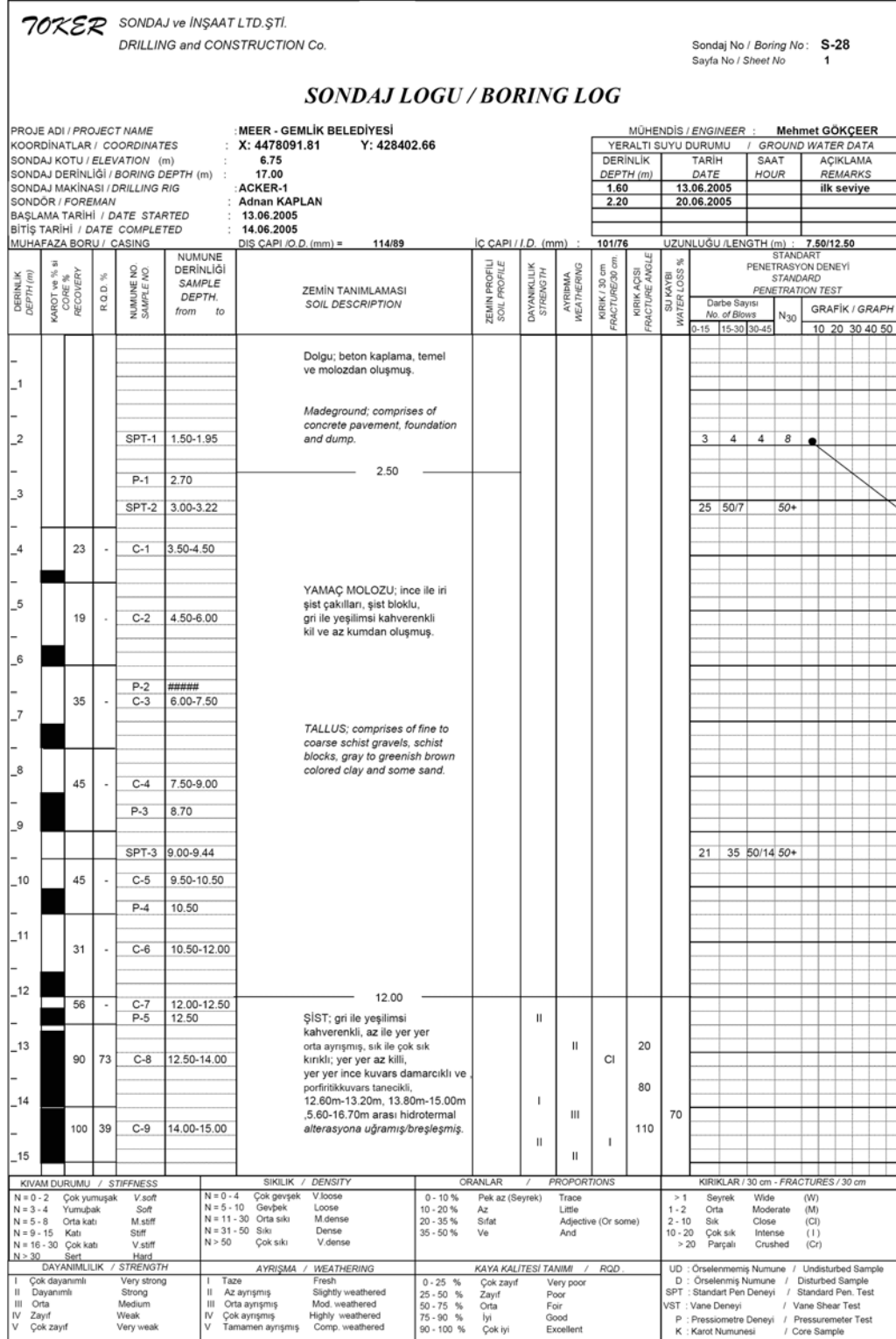
SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ
Sondaj No / Boring No : S-27
Sayfa No / Sheet No : 2

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.Q.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRIMA WEATHERING	KRİK / 30 cm FRACTURE/30 cm	KRİK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST										
												Darbe Sayısı No. of Blows				N ₃₀	GRAFIK / GRAPH					
												0-15	15-30	30-45			10	20	30	40	50	
16			SPT-10	15.00-15.45	Tanım için önceki sayfaya bakınız. See previous page for description. 16.00							1	1	1	2							
17			UD-1	16.50-16.90	Killi SİLT: gri renkli, kum bantlı, seyrek olarak kil bantları mevcut, seyrek turbalı, yumuşak.																	
18			SPT-11	16.90-17.35	CLAYEY SİLT: gray, with sand bands; contains also trace amount of clay bands, trace turb, soft.							2	1	2	3							
19			SPT-12	18.00-18.45								1	2	1	3							
20			SPT-13	19.50-19.95								2	2	3	5							
21			UD-2	21.00-21.50	KİL: koyu gri, siyah; ince silt bantları içermekte, yer yer kavkılı; 22.00'ye kadar yer yer kum ve killi silt bantlı; o.katı, katı.																	
22			SPT-14	21.50-21.95								4	4	5	9							
23			SPT-15	22.50-22.95								4	4	4	8							
24			UD-3	24.00-24.30	CLAY: dark gray, block; with thin silt bands, occasionally with fossil shells; contains sand and clayey silt bands down to 22.00 m. depth, m.stiff, stiff.																	
25			SPT-16	24.50-24.95								4	6	4	10							
26			SPT-17	25.50-25.95								5	5	5	10							
27			UD-4	27.00-27.50																		
28			SPT-18	27.50-27.95	KİL: gri, yeşilimsi gri, yer yer killi silt bantlı, yumuşak, o.katı.							4	5	6	11							
29			SPT-19	28.50-28.95	CLAY: gray, greenish gray, occasionally with clayey silt bands; soft, m.stiff.							3	4	6	10							
30			UD-5	30.00-30.50																		
31			SPT-20	30.50-30.95								3	2	2	4							
32					Kuyu Sonu End of Hole																	
33																						
34																						
35																						

Figure A.8: (cont.)

APPENDIX A



APPENDIX A

TOKER SONDAJ ve İNŞAAT LTD.ŞTİ. DRILLING and CONSTRUCTION Co.										PROJE / PROJECT : MEER - GEMLIK BELEDİYESİ Sondaj No / Boring No : S-28 Sayfa No / Sheet No : 2									
DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.Q.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRIRMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST							
												Darbe Sayısı No of Blows			N ₃₀	GRAFIK / GRAPH			
												0-15	15-30	30-45	10	20	30	40	50
16	100	70	C-10 P-6	15.00-16.00 15.50	SCHIST; gray to greenish brown colored, weakly to partly moderately altered, closely to intensely fractured; contains partly some clay, thin occasional quartz veinlets and porphyritic quartz grains, hydrothermally altered/brecciated in between 12.60m-13.20m, 13.80m-15.00m 15.60m-16.70m.														
17	85	-	C-11	16.00-17.00		17.00													
18					Kuyu Sonu End of Hole														
19																			
20																			
21																			
22																			
23																			
24																			
25																			
26																			
27																			
28																			
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31																			
32																			
33																			
34																			
35																			

Figure A.9: (cont.)

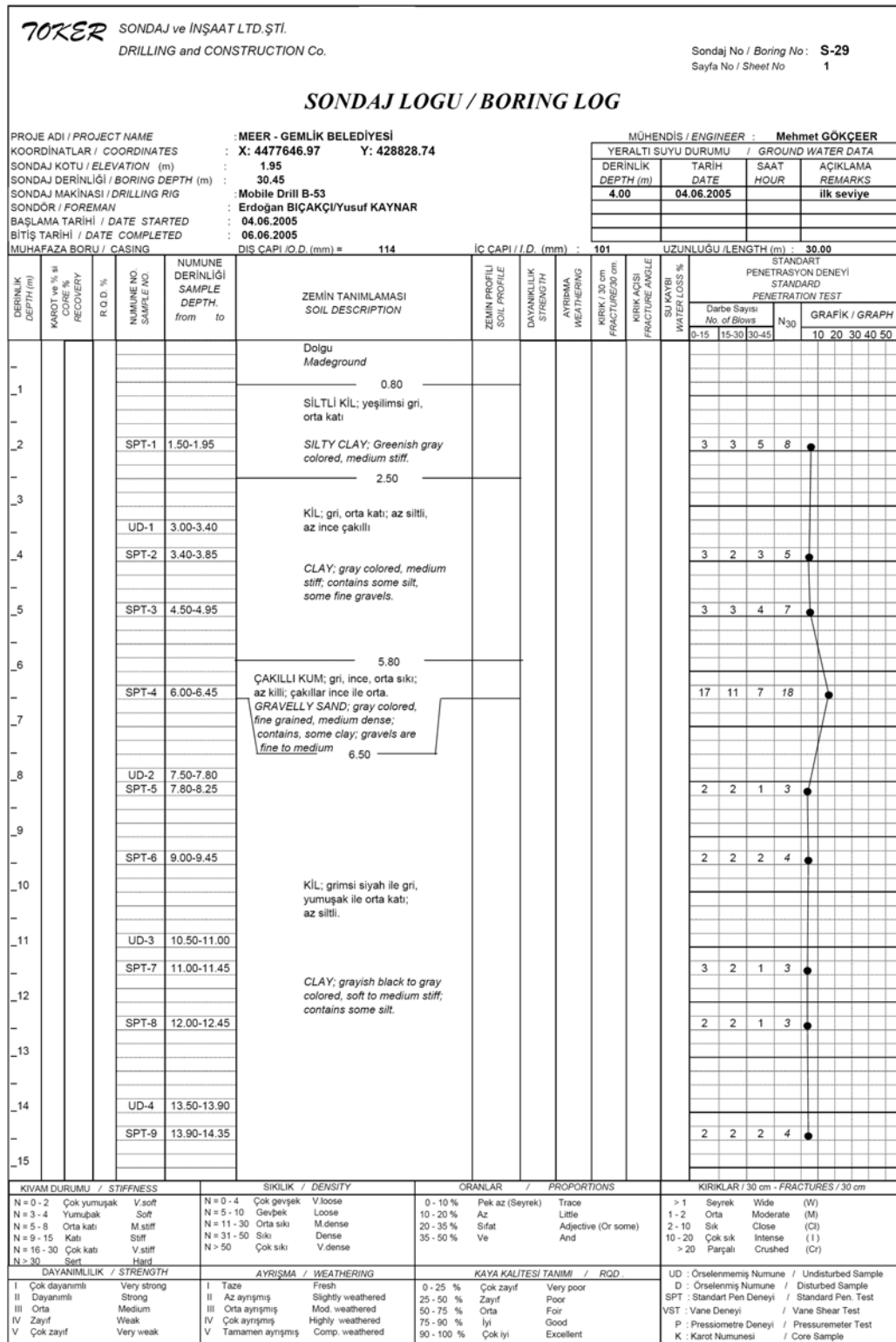


Figure A.10: Borehole log of S-29

APPENDIX A

7OKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ
Sondaj No / Boring No : S-29
Sayfa No / Sheet No : 2

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.O.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRIRMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST										
												Darbe Sayısı No. of Blows					N ₃₀	GRAFIK / GRAPH				
												0-15	15-30	30-45				10	20	30	40	50
16			SPT-10	15.00-15.45	KİL; grimsi siyah ile gri, yumuşak ile orta katı; az siltli. CLAY; grayish black to gray colored, soft to medium stiff; contains some silt.							2	2	3	5	•						
17			UD-5	16.50-16.85																		
18			SPT-11	16.85-17.30									2	2	3	5	•					
19			SPT-12	18.00-18.45									2	2	2	4	•					
20			UD-6 SPT-13	19.50-19.75 19.75-20.20									1	2	2	4	•					
21			SPT-14	21.00-21.45									2	2	3	5	•					
22																						
23			UD-7 SPT-15	22.50-22.80 22.80-23.25									3	2	3	5	•					
24			SPT-16	24.00-24.45									3	3	2	5	•					
25																						
26			UD-8 SPT-17	25.50-26.00 26.00-26.45								2	1	3	4	•						
27			SPT-18	27.00-27.45								3	2	1	3	•						
28			UD-5	28.50-29.00																		
29			SPT-19	29.00-29.45								3	3	3	6	•						
30			SPT-20	30.00-30.45	30.45							2	1	2	3	•						
31					Kuyu Sonu End of Hole																	
32																						
33																						
34																						
35																						

Figure A.10: (cont.)

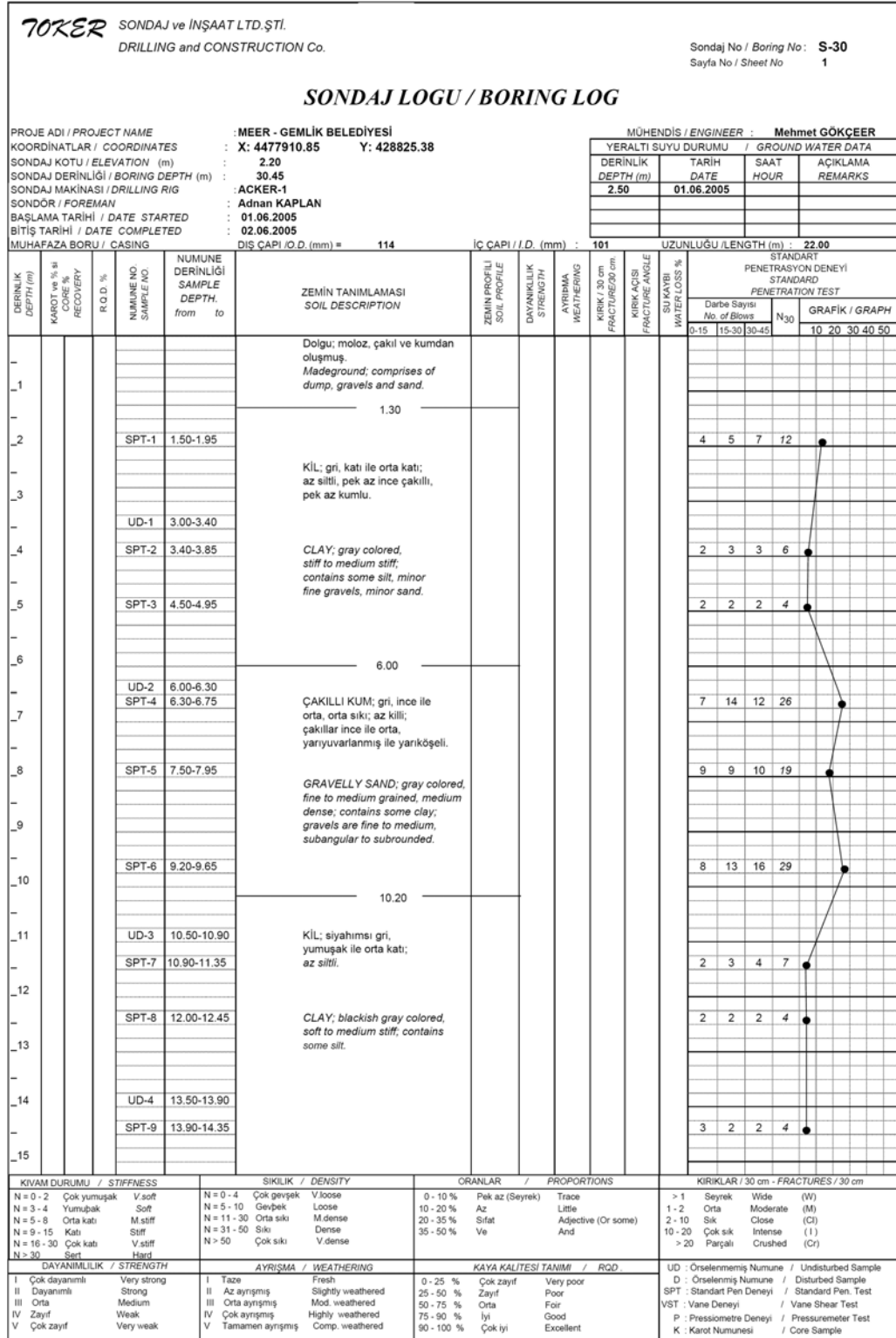


Figure A.11: Borehole log of S-30

APPENDIX A

7OKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ
Sondaj No / Boring No : S-30
Sayfa No / Sheet No : 2

DERİNLİK
DEPTH (m)

KAROT ve % si
CORE %
RECOVERY

R.Q.D. %

NUMUNE NO
SAMPLE NO

NUMUNE
DERİNLİĞİ
SAMPLE
DEPTH
from to

ZEMİN TANIMLAMASI
SOIL DESCRIPTION

ZEMİN PROFİLİ
SOIL PROFILE

DAYANIKLILIK
STRENGTH

AYRIRMA
WEATHERING

KIRIK / 30 cm
FRACTURE/30 cm

KIRIK AÇISI
FRACTURE ANGLE

SU KAYBI
WATER LOSS %

STANDART
PENETRASYON DENEYİ
STANDARD
PENETRATION TEST

Darbe Sayısı
No. of Blows

N₃₀

GRAFIK / GRAPH

16

SPT-10

15.00-15.45

KİL; siyahımsı gri,
yumuşak ile orta katı;
az siltli.

CLAY; blackish gray colored,
soft to medium stiff; contains
some silt.

<

Figure A.11: (cont.)

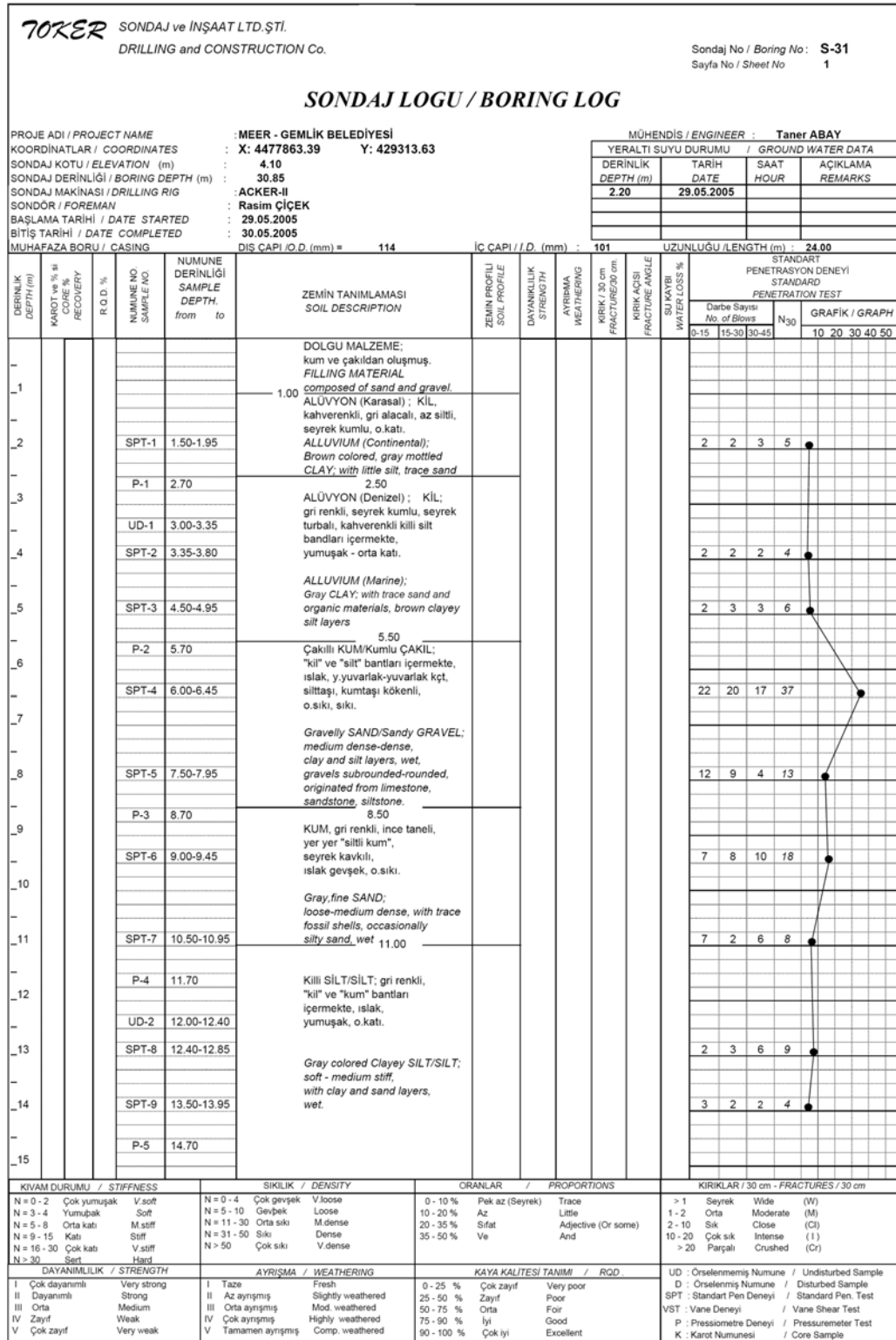


Figure A.12: Borehole log of S-31

APPENDIX A

TOKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT

Sondaj No / Boring No

Sayfa No / Sheet No

MEER - GEMLİK BELEDİYESİ

S-31

2

DERİNLİK

DEPTH (m)

KAROT ve % si

CORE %

RECOVERY

R.O.D. %

NUMUNE NO

SAMPLE NO

NUMUNE

DERİNLİĞİ

SAMPLE

DEPTH

from to

ZEMİN TANIMLAMASI

SOIL DESCRIPTION

ZEMİN PROFİLİ

SOIL PROFILE

DİNAMİK

STRENGTH

AYRIRMA

WEATHERING

KIRIK / 30 cm

FRACTURE/30 cm

KIRIK AÇISI

FRACTURE ANGLE

SU KAYBI

WATER LOSS %

STANDART

PENETRASYON DENEYİ

STANDARD

PENETRATION TEST

Darbe Sayısı

No. of Blows

0-15

15-30

30-45

N₆₀

GRAFIK / GRAPH

10 20 30 40 50

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

UD-3

15.00-15.43

SPT-10

15.45-15.90

SPT-11

16.50-16.75

SPT-12

18.40-18.85

P-6

19.20

SPT-13

19.50-19.95

P-7

21.00

UD-4

21.00-21.40

SPT-14

21.40-21.85

SPT-15

22.50-22.95

P-8

23.70

UD-5

24.00-24.40

SPT-16

24.40-24.85

SPT-17

25.50-25.95

P-9

26.70

UD-6

27.00-27.40

SPT-18

27.40-27.85

SPT-19

28.50-28.95

P-10

29.70

UD-7

30.00-30.40

SPT-20

30.40-30.85

Killi SİLT/SİLT; gri renkli,

"kil" ve "kum" bantları

içermekte, ıslak,

yumuşak, o.katı.

Gray colored Clayey SİLT/SİLT;

soft - medium stiff,

with clay and sand layers,

wet.

19.00

KİL; yeşilimsi gri, gri renkli,

doğgun, seyrek

kavkılı, kısmen "silt" bantları

içermekte (19.50m'de),

çok yumuşak-o.katı.

Greenish gray - gray CLAY;

very soft - medium stiff,

with trace fossil shells, and

occasionally silt layers around

19.50m, damp

30.85

Kuyu Sonu

End of Borehole

2

1

5

6

3

1

2

3

2

2

2

4

1

0

0

0

1

1

1

2

1

2

2

4

1

2

2

4

2

2

2

4

2

3

2

5

2

3

4

7

Figure A.12: (cont.)

7OKER SONDAJ ve İNŞAAT LTD.ŞTİ. DRILLING and CONSTRUCTION Co.		Sondaj No / Boring No : S-32 Sayfa No / Sheet No : 1													
SONDAJ LOGU / BORING LOG															
PROJE ADI / PROJECT NAME : MEER - GEMLIK BELEDİYESİ KOORDİNATLAR / COORDINATES : X: 4477925.34 Y: 429554.43 SONDAJ KOTU / ELEVATION (m) : 3.50 SONDAJ DERİNLİĞİ / BORING DEPTH (m) : 30.45 SONDAJ MAKİNASI / DRILLING RIG : Mobile Drili B-53 SONDÖR / FOREMAN : Erdogan BIÇAKÇI BAŞLAMA TARİHİ / DATE STARTED : 08.06.2005 BİTİŞ TARİHİ / DATE COMPLETED : 09.06.2005 MUHAFAZA BORU / CASING :		MÜHENDİS / ENGINEER : Mehmet GÖKÇEER YERALTI SUYU DURUMU / GROUND WATER DATA <table border="1"> <tr> <th>DERİNLİK / DEPTH (m)</th> <th>TARİH / DATE</th> <th>SAAT / HOUR</th> <th>AÇIKLAMA / REMARKS</th> </tr> <tr> <td>2.20</td> <td>08.06.2005</td> <td></td> <td>ilk seviye</td> </tr> <tr> <td>0.50</td> <td>21.06.2005</td> <td></td> <td></td> </tr> </table>		DERİNLİK / DEPTH (m)	TARİH / DATE	SAAT / HOUR	AÇIKLAMA / REMARKS	2.20	08.06.2005		ilk seviye	0.50	21.06.2005		
DERİNLİK / DEPTH (m)	TARİH / DATE	SAAT / HOUR	AÇIKLAMA / REMARKS												
2.20	08.06.2005		ilk seviye												
0.50	21.06.2005														
DISI ÇAPI / Ø D. (mm) : 114		İÇ ÇAPI / I.D. (mm) : 101													
UZUNLUĞU / LENGTH (m) : 30.00		STANDART PENETRASYON DENEYİ / STANDARD PENETRATION TEST <table border="1"> <tr> <th>Darbe Sayısı / No of Blows</th> <th>N₃₀</th> <th>GRAFIK / GRAPH</th> </tr> <tr> <td>0-15</td> <td>15-30</td> <td>30-45</td> </tr> </table>		Darbe Sayısı / No of Blows	N ₃₀	GRAFIK / GRAPH	0-15	15-30	30-45						
Darbe Sayısı / No of Blows	N ₃₀	GRAFIK / GRAPH													
0-15	15-30	30-45													
DERİNLİK / DEPTH (m)	KAROT ve % si / CORE % RECOVERY	R.Q.D. %	NUMUNE NO / SAMPLE NO												
NUMUNE DERİNLİĞİ / SAMPLE DEPTH. from to	ZEMİN TANIMLAMASI / SOIL DESCRIPTION														
1			Toprak / Top soil 0.30 SİLTİLİ KİL; yeşilimsi gri, orta katı. SILTY CLAY; greenish gray colored, medium stiff.												
2			SPT-1 1.50-1.95												
3			UD-1 3.00-3.50												
4			SPT-2 3.50-3.95												
5			SPT-3 4.50-4.95												
6			UD-2 6.00-6.50												
7			SPT-4 6.50-6.95												
8			SPT-5 7.50-7.95												
9			SPT-6 9.00-9.45												
10			SPT-7 10.50-10.95												
11			SPT-8 12.00-12.45												
12			UD-3 13.50-13.90												
13			SPT-9 13.90-14.35												
14			12.60 KİL; siyahımsı gri ile gri, orta katı ile yumuşak; az siltli, 26.00m-29.00m arası yaygın kavkılı. CLAY; blackish gray to gray colored, medium stiff to soft; contains some silt, extensive shell remains in between 26.00m-29.00m												
15															
KIVAM DURUMU / STIFFNESS		SİKLİLİK / DENSITY													
N = 0 - 2 Çok yumuşak V.soft N = 3 - 4 Yumuşak S.soft N = 5 - 8 Orta katı M.stiff N = 9 - 15 Katı Stiff N = 16 - 30 Çok katı V.stiff N > 30 Sert Hard		N = 0 - 4 Çok gevrek V.loose N = 5 - 10 Gevrek Loose N = 11 - 30 Orta sıkı M.dense N = 31 - 50 Sıkı Dense N > 50 Çok sıkı V.dense													
DAYANIMLILIK / STRENGTH		AYRIŞMA / WEATHERING													
I Çok dayanımlı Very strong II Dayanımlı Strong III Orta Medium IV Zayıf Weak V Çok zayıf Very weak		I Taze Fresh II Az ayrışmış Slightly weathered III Orta ayrışmış Mod. weathered IV Çok ayrışmış Highly weathered V Tamamen ayrışmış Comp. weathered													
KAYA KALİTESİ TANIMI / R.Q.D.		KIRIKLAR / 30 cm - FRACTURES / 30 cm													
0 - 10 % Çok zayıf Very poor 10 - 20 % Zayıf Poor 20 - 35 % Orta Fair 35 - 50 % İyi Good 50 - 75 % Çok iyi Excellent		> 1 Seyrek Wide (W) 1 - 2 Orta Moderate (M) 2 - 10 Sık Close (C) 10 - 20 Çok sık Intense (I) > 20 Parçalı Crushed (Cr)													
UD : Örselenmemiş Numune / Undisturbed Sample D : Örselenmiş Numune / Disturbed Sample SPT : Standart Pen Denevi / Standard Pen. Test VST : Vane Denevi / Vane Shear Test P : Pressiometre Denevi / Pressurometer Test K : Karot Numunesi / Core Sample															

Figure A.13: Borehole log of S-32

APPENDIX A

TOKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ

Sondaj No / Boring No : S-32

Sayfa No / Sheet No : 2

DERİNLİK Depth (m)	KAROT ve % si CORE % RECOVERY	R.O.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRILMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST										
												Darbe Sayısı No. of Blows				N ₃₀	GRAFIK / GRAPH					
												0-15	15-30	30-45			10	20	30	40	50	
16			SPT-10	15.00-15.45	KİL; siyahımsı gri ile gri, orta katı ile yumuşak; az siltli, 26.00m-29.00m arası yaygın kavkılı. CLAY; blackish gray to gray colored, medium stiff to soft; contains some silt, extensive shell remains in between 26.00m-29.00m							3	4	4	8							
17			UD-4	16.50-16.90																		
18			SPT-11	16.90-17.35									2	2	3	5						
19			SPT-12	18.00-18.45									2	3	3	6						
20			UD-5	19.50-20.00																		
21			SPT-13	20.00-20.45									2	2	2	4						
22			SPT-14	21.00-21.45									2	3	2	5						
23			UD-6	22.50-22.90																		
24			SPT-15	22.90-23.35									2	1	3	4						
25			SPT-16	24.00-24.45									2	2	3	5						
26			UD-7	25.50-25.80																		
27			SPT-17	25.80-26.25								2	2	2	4							
28			SPT-18	27.00-27.45								4	6	7	13							
29			UD-8	28.50-29.00																		
30			SPT-19	29.00-29.45	29.50 ÇAKILLI KUM; gri, ince, orta sıkı az kili; çakıllar ince ile orta, yuvarlanmış.							6	6	4	10							
31			SPT-20	30.00-30.45	GARAVELLY SAND; gray colored, fine grained, medium dense, contains some clay; gravels are fine to medium, rounded. 30.45							9	9	10	19							
32					Kuyu Sonu End of Hole																	
33					NOT: 28.50m'de metan gazı çıkışı gözlemlendi																	
34					NOTE: Methane gas exhousing at 28.50m.																	
35																						

Figure A.13: (cont.)

7OKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

Sondaj No / Boring No : **S-33**
Sayfa No / Sheet No **1**

SONDAJ LOGU / BORING LOG

PROJE ADI / PROJECT NAME : MEER - GEMLİK BELEDİYESİ
KOORDİNATLAR / COORDINATES : X: 4478207.28 Y: 429543.39
SONDAJ KOTU / ELEVATION (m) : 4.10
SONDAJ DERİNLİĞİ / BORING DEPTH (m) : 30.95
SONDAJ MAKİNASI / DRILLING RIG : Mobile Drill B-53
SONDÖR / FOREMAN : Erdoğan BİÇAKÇI
BAŞLAMA TARİHİ / DATE STARTED : 03.06.2005
BİTİŞ TARİHİ / DATE COMPLETED : 03.06.2005
MUHAFAZA BORU / CASING : DIŞ ÇAP / O.D (mm) = 114

MÜHENDİS / ENGINEER : Mehmet GÖKÇEER
YERALTI SUYU DURUMU / GROUND WATER DATA
DERİNLİK / DEPTH (m) : 2.00
TARİH / DATE : 03.06.2005
SAAT / HOUR : 21.06.2005
AÇIKLAMA / REMARKS : ilk seviye

DERİNLİK DEPTH (m)	KAROT ve %'si CORE % RECOVERY	R.O.D %	NUMUNE NO. SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRISMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST	GRAFİK / GRAPH			
												Darbe Sayısı No. of Blows	N ₃₀	10 20 30 40 50		
1					Dolgu / Modeground							2	1	3	4	●
2			SPT-1	1.50-1.95	0.50 KİLLİ KUM; kahverenkli, ince ile orta. CLAYEY SAND; brown colored, fine to medium grained.											
3					1.80 SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.							2	1	3	4	●
4			UD-1	3.00-3.40	SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
5			SPT-2	3.40-3.85	4.20 SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.							2	2	1	3	●
6					SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
7			UD-2	6.00-6.40	SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
8			SPT-4	6.40-6.85	SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.							2	3	2	5	●
9					SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
10			SPT-5	7.50-7.95	SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.							2	3	3	6	●
11					SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
12			UD-3	9.00-9.40	SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
13			SPT-6	9.40-9.85	SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.							2	3	5	8	●
14					SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
15			SPT-7	10.50-10.95	SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.							3	2	2	4	●
16					SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
17			UD-4	12.00-12.40	SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
18			SPT-8	12.40-12.85	SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.							2	3	2	5	●
19					SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
20			SPT-9	13.50-13.95	SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.							2	3	4	7	●
21					SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
22					SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
23					SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
24					SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
25					SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
26					SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
27					SİLTİLİ KİL: grimsi kahverenkli, yumuşak; pek az kumlu.											
28					SİLTİLİ KİL: grimsi kahverenkli,<											

Figure A.14: Borehole log of S-33

APPENDIX A

TOKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ
Sondaj No / Boring No : S-33
Sayfa No / Sheet No : 2

STANDART
PENETRASYON DENEYİ
STANDARD
PENETRATION TEST

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.O.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRILMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST									
												Darbe Sayısı No. of Blows			N ₃₀	GRAFIK / GRAPH					
												0-15	15-30	30-45			10	20	30	40	50
16			UD-5	15.00-15.50	KİL: gri ile siyahımsı gri, yumuşak ile orta katı; az siltli, yer yer pek az organik malzemeli, 9.90m-10.40m arası gri ince kum bantlı, 24.00m'den sonra yer yer kavkılı.																
			SPT-10	15.50-15.95									1	1	2	3					
17			SPT-11	16.50-16.95									1	2	1	3					
18			UD-6	18.00-18.50																	
19			SPT-12	18.50-18.95									1	0	1	1					
20			SPT-13	19.50-19.95									1	1	1	2					
21			UD-7	21.00-21.40		CLAY: gray to blackish gray colored, soft to medium stiff; contains some silt, partly minor organic materials, gray colored fine grained sand band in between 9.90m-10.40m, partly shell remains after 24.00m.															
22			SPT-14	21.40-21.85										1	1	1	2				
23			SPT-15	22.50-22.95										2	1	2	3				
24			UD-8	24.00-24.50																	
25			SPT-16	24.50-24.95									2	2	2	4					
26			SPT-17	25.50-25.95									2	1	3	4					
27			UD-9	27.00-27.50																	
28			SPT-18	27.50-27.95									3	3	3	6					
29			SPT-19	28.50-28.95									2	2	3	5					
30			UD-10	30.00-30.50																	
31			SPT-20	30.50-30.95	30.95							3	3	4	7						
32					Kuyu Sonu End of Hole																
33																					
34																					
35																					

Figure A.14: (cont.)

70KER

SONDAJ ve İNŞAAT LTD.ŞTİ.

DRILLING and CONSTRUCTION Co.

Sondaj No / Boring No : S-34

Sayfa No / Sheet No 1

SONDAJ LOGU / BORING LOG

PROJE ADI / PROJECT NAME : MEER - GEMLİK BELEDİYESİ

KOORDİNATLAR / COORDINATES : X: 4478389.69 Y: 429529.56

SONDAJ KOTU / ELEVATION (m) : 4.20

SONDAJ DERİNLİĞİ / BORING DEPTH (m) : 30.95

SONDAJ MAKİNASI / DRILLING RIG : Mobile Drill B-53

SONDÖR / FOREMAN : Erdoğan BİÇAKÇI/Yusuf KAYNAR

BAŞLAMA TARİHİ / DATE STARTED : 06.06.2005

BİTİŞ TARİHİ / DATE COMPLETED : 07.06.2005

MUHAFAZA BORU / CASING : DIŞ ÇAP/ O.D. (mm) = 114 İÇ ÇAP/ I.D. (mm) : 101 UZUNLUĞU / LENGTH (m) : 30.00

MÜHENDİS / ENGINEER : Mehmet GÖKÇEER

YERALTI SUYU DURUMU / GROUND WATER DATA	DERİNLİK / DEPTH (m)	TARİH / DATE	SAAT / HOUR	AÇIKLAMA / REMARKS
	4.00	06.06.2005		

DERİNLİK / DEPTH (m)	KAROT ve % Sİ / CORE % RECOVERY	R.O.D. %	NUMUNE NO. / SAMPLE NO.	NUMUNE DERİNLİĞİ / SAMPLE DEPTH. from to	ZEMİN TANIMLAMASI / SOIL DESCRIPTION	ZEMİN PROFİLİ / SOIL PROFILE	DAYANIKLILIK / STRENGTH	AYRISMA / WEATHERING	KIRIK / 30 cm FRACTURE/20 cm	KIRIK AÇISI / FRACTURE ANGLE	SU KAYBI / WATER LOSS %	STANDART PENETRASYON DENEYİ / STANDARD PENETRATION TEST		GRAFİK / GRAPH		
												Darbe Sayısı / No. of Blows	N ₃₀	10	20	30
1					Yüzey toprağı / Top soil 0.30											
2					SİLTİLİ KİL; gri, katı. / SILTY CLAY; gray colored. stiff.											
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																

KIVAM DURUMU / STIFFNESS

SİKİLİK / DENSITY

ORANLAR / PROPORTIONS

KIRIKLAR / 30 cm - FRACTURES / 30 cm

N = 0 - 2 Çok yumuşak / V.soft

N = 3 - 4 Yumuşak / Soft

N = 5 - 8 Orta katı / M.stiff

N = 9 - 15 Katı / Stiff

N = 16 - 30 Çok katı / V.stiff

N > 30 Sert / Hard

N = 0 - 4 Çok gevşek / V.loose

N = 5 - 10 Gevşek / Loose

N = 11 - 30 Orta sıkı / M.dense

N = 31 - 50 Sıkı / Dense

N > 50 Çok sıkı / V.dense

0 - 10 % Az (Seyrek) / Trace

10 - 20 % Az / Little

20 - 35 % Sıfat / Adjective (Or some)

35 - 50 % Ve / And

> 1 Seyrek / Wide (W)

1 - 2 Orta / Moderate (M)

2 - 10 Sık / Close (C)

10 - 20 Çok sık / Intense (I)

> 20 Parçali / Crushed (Cr)

DAYANIMLILIK / STRENGTH

AYRISMA / WEATHERING

KAYA KALİTESİ TANIMI / RQD

UD : Örselememiş Numune / Undisturbed Sample

D : Örselemiş Numune / Disturbed Sample

SPT : Standart Pen Deneysi / Standard Pen. Test

VST : Vane Deneysi / Vane Shear Test

P : Pressiometre Deneysi / Pressurometer Test

K : Karot Numunesi / Core Sample

I Çok dayanımlı / Very strong

II Dayanımlı / Strong

III Orta / Medium

IV Zayıf / Weak

V Çok zayıf / Very weak

I Taze / Fresh

II Az ayrılmış / Slightly weathered

III Orta ayrılmış / Mod. weathered

IV Çok ayrılmış / Highly weathered

V Tamamen ayrılmış / Comp. weathered

0 - 25 % Çok zayıf / Very poor

25 - 50 % Zayıf / Poor

50 - 75 % Orta / Fair

75 - 90 % İyi / Good

90 - 100 % Çok iyi / Excellent

Figure A.15: Borehole log of S-34

APPENDIX A

TOKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ

Sondaj No / Boring No : S-34

Sayfa No / Sheet No : 2

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.O.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRILMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST										
												Darbe Sayısı No. of Blows			N ₃₀	GRAFIK / GRAPH						
												0-15	15-30	30-45		10	20	30	40	50		
			UD-5	15.00-15.50																		
16			SPT-10	15.50-15.95	KİL; gri, yumuşak ile kati; az siltli, yer yer pek az turbalı ve kavkılı, 8.50m-9.10m arası kum bantlı.							1	0	1	1							
17			SPT-11	16.50-16.95								1	1	1	2							
18			UD-6	18.00-18.50	CLAY; gray colored, soft to stiff; contains some silt, partly minor organic materials and shell remains, sand band in between 8.50m-9.10m.																	
19			SPT-12	18.50-18.95								1	2	2	4							
20			SPT-13	19.50-19.95								1	0	1	1							
21			UD-7	21.00-21.50																		
22			SPT-14	21.50-21.95	21.60							3	4	4	8							
23			SPT-15	22.50-22.95								2	3	3	6							
24			UD-8	24.00-24.50	SİLTİLİ KİL; gri, orta kati; pek az kavkılı.																	
25			SPT-16	24.50-24.95	SILTY CLAY; gray colored, medium stiff; contains minor shell remains							2	2	3	5							
26			SPT-17	25.50-25.95								3	3	2	5							
27			UD-9	27.00-27.50																		
28			SPT-18	27.50-27.95								7	8	11	19							
29			SPT-19	28.50-28.95	28.50 KİL; gri, kati; az siltli. CLAY; gray colored, stiff; contains some silt.							6	6	6	12							
30			UD-10	30.00-30.50	30.50																	
31			SPT-20	30.50-30.95	ÇAKILLI KİL; kahverenkli, kati; az siltli; çakıllar ince ile iri. GRAVELLY CLAY; brown colored, stiff; contains some silt; gravels are fine to coarse. 30.95							6	7	7	14							
32					Kuyu Sonu End of Hole																	
33																						
34																						
35																						

Figure A.15: (cont.)

7OKER SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

Sondaj No / Boring No : **S-35**
Sayfa No / Sheet No : **1**

SONDAJ LOGU / BORING LOG

PROJE ADI / PROJECT NAME : **MEER - GEMLIK BELEDİYESİ**
KOORDİNATLAR / COORDINATES : **X: 4478471.17 Y: 430036.14**
SONDAJ KOTU / ELEVATION (m) : **15.60**
SONDAJ DERİNLİĞİ / BORING DEPTH (m) : **30.45**
SONDAJ MAKİNASI / DRILLING RIG : **ACKER-1**
SONDÖR / FOREMAN : **Adanan KAPLAN**
BAŞLAMA TARİHİ / DATE STARTED : **05.06.2005**
BİTİŞ TARİHİ / DATE COMPLETED : **06.06.2005**
MUHAFAZA BORU / CASING : **DIS ÇAPI / O.D. (mm) = 114/89 İÇ ÇAPI / I.D. (mm) : 101/76 UZUNLUĞU / LENGTH (m) : 12.00/29.00**

MÜHENDİS / ENGINEER : **Mehmet GÖKÇEER**

YERALTI SUYU DURUMU / GROUND WATER DATA		DERİNLİK / DEPTH (m)		TARİH / DATE	SAAT / HOUR	AÇIKLAMA / REMARKS
		18.00	05.06.2005			
		13.20	21.06.2005			

DERİNLİK / DEPTH (m)	KAROT ve % si / CORE % RECOVERY	R.Q.D. %	NUMUNE NO. / SAMPLE NO.	NUMUNE DERİNLİĞİ / SAMPLE DEPTH (from to)	ZEMİN TANIMLAMASI / SOIL DESCRIPTION	ZEMİN PROFİLİ / SOIL PROFILE	DAYANIKLILIK / STRENGTH	AYRISMA / WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI / FRACTURE ANGLE	SU KAYBI / WATER LOSS %	STANDART PENETRASYON DENEYİ / STANDARD PENETRATION TEST		GRAFİK / GRAPH	
												Darbe Sayısı / No. of Blows	N ₃₀		
					Yüzey toprağı / Top Soil										
0.30															
1															
2			SPT-1	1.50-1.95								11	6	9	15
3															
4			UD-1	3.00-3.40											
5			SPT-2	3.40-3.85								7	5	4	9
6															
7			SPT-3	4.50-4.95								7	5	9	14
8															
9			UD-2	6.00-6.40											
10			SPT-4	6.40-6.85								13	17	18	35
11															
12			SPT-5	7.50-7.95								16	15	20	35
13															
14			B-1	9.00-9.20											
15			SPT-6	9.20-9.60								19	23	50/10	50+
16															
17			SPT-7	10.50-10.95								17	20	36	56
18															
19			B-2	12.00-12.10											
20			SPT-8	12.10-12.55								17	19	34	53
21															
22			SPT-9	13.50-13.95								5	11	11	22
23															
24			B-3	15.00-15.30											

13.00

Tanım için sonraki sayfaya bakınız.
See next page for description

KIVAM DURUMU / STIFFNESS			SIKILIK / DENSITY			GRANLAR / PROPORTIONS			KIRIKLAR / 30 cm - FRACTURES / 30 cm		
N = 0 - 2	Çok yumuşak	V.soft	N = 0 - 4	Çok gevşek	V.loose	0 - 10 %	Pek az (Seyrek)	Trace	> 1	Seyrek	Wide (W)
N = 3 - 4	Yumukak	Soft	N = 5 - 10	Gevşek	Loose	10 - 20 %	Az	Little	1 - 2	Orta	Moderate (M)
N = 5 - 8	Orta katı	M.stiff	N = 11 - 30	Orta sıkı	M.dense	20 - 35 %	Sıfat	Adjective (Or some)	2 - 10	Sık	Close (C)
N = 9 - 15	Katı	Stiff	N = 31 - 50	Sıkı	Dense	35 - 50 %	Ve	And	10 - 20	Çok sık	Intense (I)
N = 16 - 30	Çok katı	V.stiff	N > 50	Çok sıkı	V.dense				> 20	Parçalı	Crushed (Cr)
N > 30	Sert	Hard									

DAYANIMLILIK / STRENGTH		AYRISMA / WEATHERING		KAYA KALİTESİ TANIMI / RQD		UD : Örselenmemiş Numune / Undisturbed Sample		
I	Çok dayanımlı	Very strong	I	Taze	Fresh	0 - 25 %	Çok zayıf	Very poor
II	Dayanımlı	Strong	II	Az ayrılmış	Slightly weathered	25 - 50 %	Zayıf	Poor
III	Orta	Medium	III	Orta ayrılmış	Mod. weathered	50 - 75 %	Orta	Fair
IV	Zayıf	Weak	IV	Çok ayrılmış	Highly weathered	75 - 90 %	İyi	Good
V	Çok zayıf	Very weak	V	Tamamen ayrılmış	Comp. weathered	90 - 100 %	Çok iyi	Excellent

UD : Örselenmemiş Numune / Undisturbed Sample
D : Örselenmiş Numune / Disturbed Sample
SPT : Standart Pen Deneysi / Standard Pen. Test
VST : Vane Deneysi / Vane Shear Test
P : Pressiometre Deneysi / Pressuremeter Test
K : Karot Numunesi / Core Sample

Figure A.16: Borehole log of S-35

APPENDIX A

TOKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ

Sondaj No / Boring No : S-35

Sayfa No / Sheet No : 2

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.O.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRILMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST										
												Darbe Sayısı No. of Blows				N ₃₀	GRAFIK / GRAPH					
												0-15	15-30	30-45			10	20	30	40	50	
16			SPT-10	15.30-15.75	ÇAKILLI KİL/KİLLİ ÇAKIL; rezidüel; sarımsı kahverenkli, çok katı ile sert/orta sıkı ile çok sıkı; kumlu ve yer yer ince kum bantlı; çakıllar ince ile blok boyutlu, köşeli, şist ve kuvarzit kökenli.							7	11	15	26							
17			SPT-11	16.50-16.95									9	10	16	26						
18			SPT-12	18.00-18.45		GRAVELLY CLAY/CLAYEY GRAVEL; residual; yellowish brown colored, very stiff to hard/medium dense to very dense; contains sand and thin occasional sand bands; gravels are fine to block sized, angular, schist and quartzite originated.							5	8	15	23						
19																						
20			B-4 SPT-13	19.50-19.70 19.70-19.90									17	50/5	50+							
21			SPT-14	21.00-21.05	21.00								50/5	50+								
22			B-5	22.00-22.50	MERMER; blok formunda; gri, az kili. <i>MARBLE;</i> in form of block; gray colored; contains some clay.																	
23						23.00																
24			SPT-15	24.00-24.26		ÇAKILLI KİL/KİLLİ ÇAKIL; rezidüel; sarımsı kahverenkli ile bejimsi kahverenkli, sert/ çok sıkı; kumlu; çakıllar ince ile blok boyutlu, köşeli, şist ve kuvarzit kökenli.							24	50/11	50+							
25			B-6	24.50-25.50																		
26			SPT-16	25.50-25.95	GRAVELLY CLAY/CLAYEY GRAVEL; residual; yellowish brown to beigeish brown colored, hard/very dense; contains sand; gravels are fine to block sized, angular, schist and quartzite originated.								48	27	14	41						
27			SPT-17	27.00-27.45										21	33	37	70					
28			SPT-18	28.50-28.57									50/7	50+								
29																						
30			SPT-19	30.00-30.45	30.45							17	24	37	61							
31					Kuyu Sonu End of Hole																	
32																						
33																						
34																						
35																						

Figure A.16: (cont.)

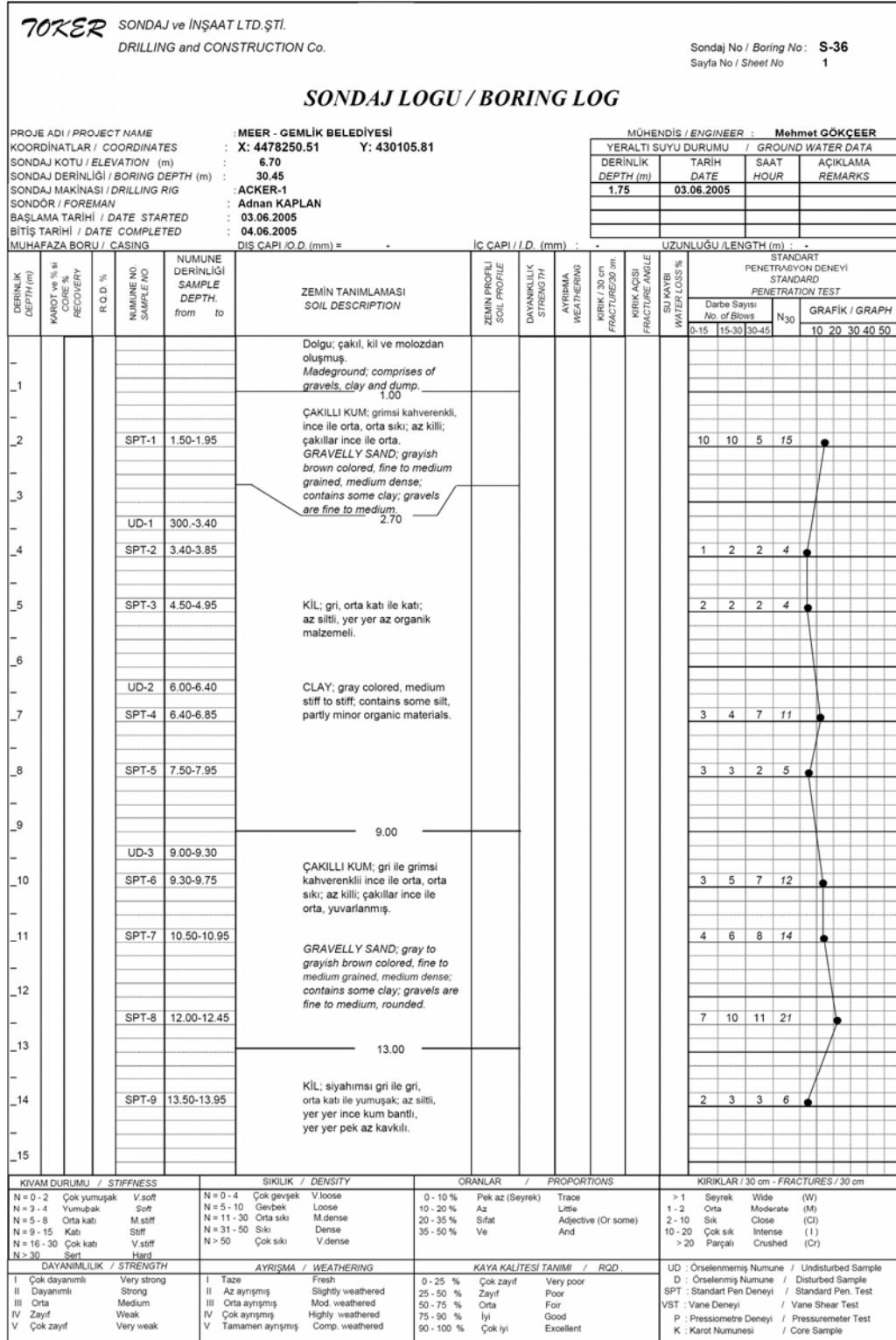


Figure A.17: Borehole log of S-36

APPENDIX A

TOKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ
Sondaj No / Boring No : S-36
Sayfa No / Sheet No : 2

STANDART
PENETRASYON DENEYİ
STANDARD
PENETRATION TEST

Darbe Sayısı
No. of Blows

N₃₀

GRAFIK / GRAPH

0-1515-3030-45

1020304050

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.O.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRILMA WEATHERING	KIRKIL / 30 cm FRACTURE/30 cm	KIRKIL AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %
16			UD-4	15.00-15.40	CLAY; blackish gray to gray colored, medium stiff to soft; contains some silt, partly thin sand bands, partly minor shell remains.						
			SPT-10	15.40-15.85							
17			SPT-11	16.50-16.95							
18					17.50						
			SPT-12	18.00-18.45	ÇAKILLI KİL; gri, katı; az siltli, yer yer ince kum bantlı; çakıllar ince ile iri.						
19					GRAVELLY CLAY; gray colored, stiff; contains some silt, partly thin sand bands, gravels are						
20			UD-5	19.50-19.70	19.90						
			SPT-13	19.70-20.15							
21											
			SPT-14	21.00-21.45							
22					ÇAKILLI KİL; rezidüel; kahverenkli, çok katı ile sert; az siltli, yer yer az kumlu, yer yer ince kum bantlı; çakıllar ince ile blok boyutlu, köşeli, şist kökenli.						
23			SPT-15	22.50-22.95							
24			B-1	24.00-24.20							
			SPT-16	24.20-24.65	GRAVELLY CLAY; residual; brown colored, very stiff to hard, contains some silt, partly some sand, thin occasional sand bands; gravels are fine to block sized, angular, schist originated.						
26			SPT-17	25.50-25.95							
27											
			B-1	27.00-27.30							
28			SPT-18	27.30-27.75							
29			SPT-19	28.50-28.95							
30											
			SPT-20	30.00-30.45	30.45						
31					Kuyu Sonu End of Hole						
32											
33											
34											
35											

Figure A.17: (cont.)

7OKER

SONDAJ ve İNŞAAT LTD.ŞTİ.

DRILLING and CONSTRUCTION Co.

Sondaj No / Boring No : S-37

Sayfa No / Sheet No 1

SONDAJ LOGU / BORING LOG

PROJE ADI / PROJECT NAME : MEER - GEMLİK BELEDİYESİ

KOORDİNATLAR / COORDINATES : X: 4478041.65 Y: 430409.68

SONDAJ KOTU / ELEVATION (m) : 7.50

SONDAJ DERİNLİĞİ / BORING DEPTH (m) : 30.00

SONDAJ MAKİNASI / DRILLING RIG : ACKER-II

SONDÖR / FOREMAN : Rasim ÇİÇEK

BAŞLAMA TARİHİ / DATE STARTED : 27.05.2005

BİTİŞ TARİHİ / DATE COMPLETED : 29.05.2005

MUHAFAZA BORU / CASING : DIŞ ÇAP / O.D (mm) = 114 İÇ ÇAP / I.D (mm) : 101

MÜHENDİS / ENGINEER : Taner ABAY

YERALTI SUYU DURUMU / GROUND WATER DATA

DERİNLİK / DEPTH (m)	TARİH / DATE	SAAT / HOUR	AÇIKLAMA / REMARKS
2.50	27.05.2005		ilk seviye
4.00	30.05.2005		
3.20	21.06.2005		

UZUNLUĞU / LENGTH (m) : 19.50

STANDAR PENETRASYON DENEYİ / STANDARD PENETRATION TEST

Darbe Sayısı / No. of Blows	N ₃₀	GRAFİK / GRAPH					
0-15	15-30	30-45	10	20	30	40	50

DERİNLİK / DEPTH (m)	KAROT ve % / CORE % / RECOVERY	R.O.D %	NUMUNE NO. / SAMPLE NO.	NUMUNE DERİNLİĞİ / SAMPLE DEPTH from to	ZEMİN TANIMLAMASI / SOIL DESCRIPTION	ZEMİN PROFİLİ / SOIL PROFILE	DAYANIKLILIK / STRENGTH	AYRIMA / WEATHERING	KIRIK / 30 cm / FRACTURE 20 cm	KIRIK AÇISI / FRACTURE ANGLE	SU KAYBI / WATER LOSS %	STANDAR PENETRASYON DENEYİ / STANDARD PENETRATION TEST
1					Dolgu Toprak / Filling Material 0.30							
2					Alüvyon (karasal) KİL; kahverenkli gri alıcalı, az siltli, yer yer kumlu, katı.							
3					CLAY; stiff, with little silt, occasionally sand, brown, gray matted.							
4					ALÜVYON (denizel) KUM; gri renkli; az siltli, seyrek çakılı (yuvarlak), gevşek							
5					ALLUVIUM; gray SAND; loose, with little silt, trace rounded gravels.							
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

KIVAM DURUMU / STIFFNESS	SIKILIK / DENSITY	GRANLAR / PROPORTIONS	KIRIKLAR / 30 cm - FRACTURES / 30 cm
N = 0 - 2 Çok yumuşak V.soft	N = 0 - 4 Çok gevşek V.loose	0 - 10 % Pek az (Seyrek) Trace	> 1 Seyrek Wide (W)
N = 3 - 4 Yumuşak Soft	N = 5 - 10 Gevşek Loose	10 - 20 % Az Little	1 - 2 Orta Moderate (M)
N = 5 - 8 Orta katı M.stiff	N = 11 - 30 Orta sıkı M.dense	20 - 35 % Sıfat Adjective (Or some)	2 - 10 Sık Close (C)
N = 9 - 15 Katı Stiff	N = 31 - 50 Sıkı Dense	35 - 50 % Ve And	10 - 20 Çok sık Intense (I)
N = 16 - 30 Çok katı V.stiff	N > 50 Çok sıkı V.dense		> 20 Parçalı Crushed (Cr)
N > 30 Sert Hard			

DAYANIMLILIK / STRENGTH	AYRISMA / WEATHERING	KAYA KALİTESİ TANIMI / RQD	UD - Örselememiş Numune / Undisturbed Sample
I Çok dayanımlı Very strong	I Taze Fresh	0 - 25 % Çok zayıf Very poor	D - Örselemiş Numune / Disturbed Sample
II Dayanımlı Strong	II Az ayrılmış Slightly weathered	25 - 50 % Zayıf Poor	SPT - Standart Pen Deneysi / Standard Pen. Test
III Orta Medium	III Orta ayrılmış Mod. weathered	50 - 75 % Orta Fair	VST - Vane Deneysi / Vane Shear Test
IV Zayıf Weakly	IV Çok ayrılmış Highly weathered	75 - 90 % İyi Good	P - Pressiometre Deneysi / Pressuremeter Test
V Çok zayıf Very weak	V Tamamen ayrılmış Comp. weathered	90 - 100 % Çok iyi Excellent	K - Karot Numunesi / Core Sample

Figure A.18: Borehole log of S-37

APPENDIX A

TOKER SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ
Sondaj No / Boring No : S-37
Sayfa No / Sheet No : 2

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.O.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRIBAMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST									
												Darbe Sayısı No. of Blows				N ₃₀	GRAFIK / GRAPH				
												0-15	15-30	30-45			10	20	30	40	50
16			UD-3	15.00-15.40	Tanım için önceki sayfaya bakınız. See previous page for description.																
			SPT-10	15.40-15.85	16.00 Siltli KUM; gri renkli, az çakıllı; kil (boz kahve) bantlı, o.sıklı.) Gray silty SAND; medium dense with little gravels, and clay layers.							6	10	10	20						
17			SPT-11	16.50-16.95	17.50							5	11	14	25						
18			P-6	17.70	SİLT; gri renkli; kısmen çakıllı (şist, silttaşı, kçt. Kökenli), yer yer killi, seyrek kavkılı, çok katı.																
19			UD-4	18.00-18.30	Gray SILT; very stiff, with trace fossil shells, occasionally gravels originated from siltstone, limestone, and occasionally clay.							8	10	13	23						
20			SPT-12	18.30-18.75	20.50							9	11	14	25						
21			P-7	20.70	KİL; boz kahve-gri renkli, seyrek kumlu, seyrek çakıllı; "killi silt" bandı içermekte, katı, çok katı.																
22			UD-5	21.00-21.35	Brown-gray CLAY; stiff-very stiff, with trace sand and gravels with clayey silt layers.							5	6	9	15						
23			SPT-14	21.35-21.80	23.75							5	7	10	17						
24			P-8	23.70	Alüvyon (Karasal); KİL; kırmızı renkli, katı.																
25			UD-6	24.00-24.25	ALLUVIUM; red colored CLAY; stiff.							7	7	8	15						
26			SPT-16	24.25-24.60	25.50																
27			SPT-17	25.50-25.95	Kolüvyon: Çakıllı KİL/killi ÇAKIL; kumlu; yeşil, kahve, kırmızı renkli, yer yer kireçli. (çakıllar; şist, kçt. kumtaşı kökenli, köşeli-yuvarlak)							7	9	14	23						
28			SPT-18	27.00-27.45	COLLUVIUM; green brown, red colored gravelly CLAY/clayey GRAVEL; hard-very dense, with sand and lime, gravels originated from limestone, sandstone, schist and angular-rounded.							23	27	41	68						
29			Torba-1	27.50-28.00	29.25																
30			P-9	28.00	AYRIŞMIŞ KAYA: ŞİST; kahverenkli, tamamen ayrıışmış. SCHIST; completely weathered, brown colored.																
31			SPT-19	28.00-28.95	30.10																
32			P-10	29.70	Kuyu Sonu End of Hole																
33			SPT-20	30.00-30.09								50/9				50+					
34																					
35																					

Figure A.18: (cont.)

7OKER SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

Sondaj No / Boring No : **S-38**
Sayfa No / Sheet No : **1**

SONDAJ LOGU / BORING LOG

PROJE ADI / PROJECT NAME : **MEER - GEMLİK BELEDİYESİ**
KOORDİNATLAR / COORDINATES : **X: 4477722.90 Y: 430314.59**
SONDAJ KOTU / ELEVATION (m) : **7.80**
SONDAJ DERİNLİĞİ / BORING DEPTH (m) : **30.45**
SONDAJ MAKİNASI / DRILLING RIG : **Mobile Drili B-53**
SONDÖR / FOREMAN : **Erdoğan BIÇAKÇI**
BAŞLAMA TARİHİ / DATE STARTED : **15.05.2005**
BİTİŞ TARİHİ / DATE COMPLETED : **16.05.2005**
MUHAFAZA BORU / CASING : **DIS CAPI / O.D. (mm) = 114 İÇ CAPI / I.D. (mm) : 101 UZUNLUĞU / LENGTH (m) : 30.00**

MÜHENDİS / ENGINEER : **Taner ABAY**

YERALTI SUYU DURUMU / GROUND WATER DATA		STANDART PENETRASYON DENEYİ / STANDARD PENETRATION TEST	
DERİNLİK / DEPTH (m)	TARİH / DATE	SAAT / HOUR	AÇIKLAMA / REMARKS
2.50	30.05.2005		ilk seviye
4.50	01.06.2005		
5.40	21.06.2005		

DERİNLİK / DEPTH (m)	KAROT ve % si / CORE % RECOVERY	R.O.D. %	NUMUNE NO. / SAMPLE NO.	NUMUNE DERİNLİĞİ / SAMPLE DEPTH from to	ZEMİN TANIMLAMASI / SOIL DESCRIPTION	ZEMİN PROFİLİ / SOIL PROFILE	DAYANIKLILIK / STRENGTH	AYRISMA / WEATHERING	KIRIK / 30 cm FRACTURE	KIRIK AÇISI / FRACTURE ANGLE	SU KAYBI / WATER LOSS %	Darbe Sayısı / No of Blows					N ₃₀	GRAFİK / GRAPH				
												0-15	15-30	30-45	10	20		30	40	50		
0.50					Bitkisel Toprak / Top Soil																	
1.20					ALÜVYON; siltli KUM; kahverenkli, çakıllı / ALLUVIUM; brown silty SAND with gravels.																	
1.50-1.95	SPT-1				Siltli KİL; kahverenkli (gri alacalı) / seyrek kumlu, organik, katı. / Brown-gray mottled Silty CLAY; stiff, with trace sand and organic materials.								4	6	6	12						
2.50					Çakıllı SİLTİLİ KİL / Kili, SİLTİLİ ÇAKIL; kumlu, seyrek kili, ıslak, katı/o.sıkı, (silt-gri renkli; çakıllar-y.yuvarlak, yuvarlak) / Gravely SILTY CLAY / Clayey, silty GRAVEL; stiff / medium dense, with sand, with trace clay, silt is gray colored, gravels are subrounded - rounded.								3	5	4	9						
3.00-3.45	SPT-2																					
4.50-4.95	SPT-3																					
5.50					Kumlu ÇAKIL; kili (kahverenkli), az siltli, kahve-gri renkli, y.yuvarlak, yuvarlak, gevşek. / Brown-gray Sandy GRAVEL; loose, with brown clay, with little silt, gravels subrounded-rounded.																	
6.00-6.45	SPT-4																					
7.50-8.00	UD-1				KİL; yeşilimsi gri, gri renkli, doymuş, yer yer turlalı, kısmen "kili silt" ve kum bandı içermekte (12.00m.lerde)																	
8.00-8.45	SPT-5																					
9.00-9.45	SPT-6				Greenish gray - gray colored CLAY; occasionally organic materials and clayey silt - sand layers around 12.00m.																	
10.50-10.90	UD-2																					
10.90-11.35	SPT-7																					
12.00-12.45	SPT-8																					
13.20					Kumlu ÇAKIL/Çakıllı KUM; gri renkli, seyrek ile az siltli, "kili silt" ve "silt" bantları içermekte, ıslak, o.sıkı, sıkı. / Gray sandy GRAVEL/Gravelly SAND; medium dense-dense with trace-little silt with clayey silt and silt layers, wet.																	
13.50-13.75	Torba-1																					
13.75-14.20	SPT-9																					
15.00-15.20	Torba-2																					

KIVAM DURUMU / STIFFNESS			SİKLİK / DENSITY			ORANLAR / PROPORTIONS			KIRIKLAR / 30 cm - FRACTURES / 30 cm		
N = 0 - 2	Çok yumuşak	V.soft	N = 0 - 4	Çok gevşek	V.loose	0 - 10 %	Pek az (Seyrek)	Trace	> 1	Seyrek	Wide (W)
N = 3 - 4	Yumukak	Soft	N = 5 - 10	Gevşek	Loose	10 - 20 %	Az	Little	1 - 2	Orta	Moderate (M)
N = 5 - 8	Orta katı	M.stiff	N = 11 - 30	Orta sıkı	M.dense	20 - 35 %	Sıfat	Adjective (Or some)	2 - 10	Sık	Close (C)
N = 9 - 15	Katı	Stiff	N = 31 - 50	Sıkı	Dense	35 - 50 %	Ve	And	10 - 20	Çok sık	Intense (I)
N = 16 - 30	Çok katı	V.stiff	N > 50	Çok sıkı	V.dense				> 20	Parçalı	Crushed (Cr)
N > 30	Sert	Hard									

DAYANIMLILIK / STRENGTH			AYRISMA / WEATHERING			KAYA KALİTESİ TANIMI / RQD		
I	Çok dayanımlı	Very strong	I	Taze	Fresh	0 - 25 %	Çok zayıf	Very poor
II	Dayanımlı	Strong	II	Az ayrılmış	Slightly weathered	25 - 50 %	Zayıf	Poor
III	Orta	Medium	III	Orta ayrılmış	Mod. weathered	50 - 75 %	Orta	Fair
IV	Zayıf	Weak	IV	Çok ayrılmış	Highly weathered	75 - 90 %	İyi	Good
V	Çok zayıf	Very weak	V	Tamamen ayrılmış	Comp. weathered	90 - 100 %	Çok iyi	Excellent

UD : Örselenmemiş Numune / Undisturbed Sample
D : Örselenmiş Numune / Disturbed Sample
SPT : Standart Pen Deneysi / Standard Pen. Test
VST : Vane Deneysi / Vane Shear Test
P : Presiometre Deneysi / Presuremeter Test
K : Karot Numunesi / Core Sample

Figure A.19: Borehole log of S-38

APPENDIX A

[illegible]

Figure A.19: (cont.)

APPENDIX A

7OKER SONDAJ ve İNŞAAT LTD.ŞTİ. DRILLING and CONSTRUCTION Co.		Sondaj No / Boring No : S-39 Sayfa No / Sheet No : 1																																																										
SONDAJ LOGU / BORING LOG																																																												
PROJE ADI / PROJECT NAME : MEER - GEMLIK BELEDİYESİ KOORDİNATLAR / COORDINATES : X: 4477608.65 Y: 429947.82 SONDAJ KOTU / ELEVATION (m) : 5.95 SONDAJ DERİNLİĞİ / BORING DEPTH (m) : 30.00 SONDAJ MAKİNASI / DRILLING RIG : Mobile Drill B-53 SONDÖR / FOREMAN : İsmet KOÇ BAŞLAMA TARİHİ / DATE STARTED : 20.05.2005 BİTİŞ TARİHİ / DATE COMPLETED : 21.05.2005 MUHAFAZA BORU / CASING : DIS CAPI / O.D. (mm) = - İÇ CAPI / I.D. (mm) = -		MÜHENDİS / ENGINEER : Taner ABAY YERALTI SUYU DURUMU / GROUND WATER DATA <table border="1"> <tr> <th>DERİNLİK / DEPTH (m)</th> <th>TARİH / DATE</th> <th>SAAT / HOUR</th> <th>AÇIKLAMA / REMARKS</th> </tr> <tr> <td>1.50</td> <td>20.05.2005</td> <td></td> <td>ilk seviye</td> </tr> <tr> <td>2.00</td> <td>22.05.2005</td> <td></td> <td></td> </tr> <tr> <td>1.30</td> <td>21.06.2005</td> <td></td> <td></td> </tr> </table>		DERİNLİK / DEPTH (m)	TARİH / DATE	SAAT / HOUR	AÇIKLAMA / REMARKS	1.50	20.05.2005		ilk seviye	2.00	22.05.2005			1.30	21.06.2005																																											
DERİNLİK / DEPTH (m)	TARİH / DATE	SAAT / HOUR	AÇIKLAMA / REMARKS																																																									
1.50	20.05.2005		ilk seviye																																																									
2.00	22.05.2005																																																											
1.30	21.06.2005																																																											
ZEMİN TANIMLAMASI / SOIL DESCRIPTION NEBATI TOPRAK (TOP SOIL) 0.50 Kumlu SİLT; killi, çakilli, kahverenkli, çok katı.(allüvyon) <i>Brown sandy SILT; very stiff, with clay and gravel (ALLUVIUM).</i> 2.00 Kumlu ÇAKIL; orta sıkı, kil bantlı, çakıllar yarı köşeli-yuvarlak, kumtaşı, kıltaşı, kireçtaşı kökenli. <i>Sandy GRAVEL, medium dense, with clay layers, gravels subrounded-rounded, originated from claystone, sandstone, limestone.</i> 3.30 Gri - yeşilimsi gri renkli KİL; çok yumuşak - katı, organik, kumlu / killi silt, kum, silt bantları içermekte (ALÜVYON) <i>Gray - greenish gray CLAY; very soft - stiff, with sand and clayey silt, with sand and silt layers (ALLUVIUM)</i> 9.50 Kahve - gri renkli Siltli KUM / KUM; orta sıkı, seyrek çakilli, 14.50 - 14.95m arası; 19.00 - 19.20m arası kumlu / killi silt bantlı ve yer yer kil, silt bantlı. <i>Brown - gray silty SAND / SAND; medium dense, with trace gravels, with sandy - clayey silt layers between 14.50m and 14.95m; 19.00m and 19.20m and with clay / silt layers.</i>		STANDART PENETRASYON DENEYİ / STANDARD PENETRATION TEST <table border="1"> <tr> <th>DERİNLİK / DEPTH (m)</th> <th>0-15</th> <th>15-30</th> <th>30-45</th> <th>N₃₀</th> <th>GRAFİK / GRAPH</th> </tr> <tr> <td>1.00 - 1.45</td> <td>5</td> <td>7</td> <td>11</td> <td>18</td> <td rowspan="10"> </td> </tr> <tr> <td>2.00 - 2.45</td> <td>11</td> <td>10</td> <td>4</td> <td>14</td> </tr> <tr> <td>4.00 - 4.50</td> <td>4</td> <td>6</td> <td>9</td> <td>15</td> </tr> <tr> <td>4.50 - 4.95</td> <td>1</td> <td>1</td> <td>1</td> <td>2</td> </tr> <tr> <td>5.50 - 5.95</td> <td>2</td> <td>4</td> <td>7</td> <td>11</td> </tr> <tr> <td>7.50 - 7.95</td> <td>3</td> <td>4</td> <td>6</td> <td>10</td> </tr> <tr> <td>8.50 - 8.95</td> <td>7</td> <td>10</td> <td>12</td> <td>22</td> </tr> <tr> <td>10.00 - 10.45</td> <td>4</td> <td>9</td> <td>11</td> <td>20</td> </tr> <tr> <td>11.50 - 11.95</td> <td>4</td> <td>7</td> <td>9</td> <td>16</td> </tr> <tr> <td>13.00 - 13.45</td> <td>2</td> <td>3</td> <td>5</td> <td>8</td> </tr> </table>		DERİNLİK / DEPTH (m)	0-15	15-30	30-45	N ₃₀	GRAFİK / GRAPH	1.00 - 1.45	5	7	11	18		2.00 - 2.45	11	10	4	14	4.00 - 4.50	4	6	9	15	4.50 - 4.95	1	1	1	2	5.50 - 5.95	2	4	7	11	7.50 - 7.95	3	4	6	10	8.50 - 8.95	7	10	12	22	10.00 - 10.45	4	9	11	20	11.50 - 11.95	4	7	9	16	13.00 - 13.45	2	3	5	8
DERİNLİK / DEPTH (m)	0-15	15-30	30-45	N ₃₀	GRAFİK / GRAPH																																																							
1.00 - 1.45	5	7	11	18																																																								
2.00 - 2.45	11	10	4	14																																																								
4.00 - 4.50	4	6	9	15																																																								
4.50 - 4.95	1	1	1	2																																																								
5.50 - 5.95	2	4	7	11																																																								
7.50 - 7.95	3	4	6	10																																																								
8.50 - 8.95	7	10	12	22																																																								
10.00 - 10.45	4	9	11	20																																																								
11.50 - 11.95	4	7	9	16																																																								
13.00 - 13.45	2	3	5	8																																																								
KIVAM DURUMU / STIFFNESS N = 0 - 2 Çok yumuşak V.soft N = 3 - 4 Yumuşak Soft N = 5 - 8 Orta katı M.stiff N = 9 - 15 Katı Stiff N = 16 - 30 Çok katı V.stiff N > 30 Sert Hard		SIKILIK / DENSITY N = 0 - 4 Çok gevşek V.loose N = 5 - 10 Gevşek Loose N = 11 - 30 Orta sıkı M.dense N = 31 - 50 Sıkı Dense N > 50 Çok sıkı V.dense																																																										
DAYANIMLILIK / STRENGTH I Çok dayanımlı Very strong II Dayanımlı Strong III Orta Medium IV Zayıf Weak V Çok zayıf Very weak		AYRIŞMA / WEATHERING I Taze Fresh II Az ayrılmış Slightly weathered III Orta ayrılmış Mod. weathered IV Çok ayrılmış Highly weathered V Tamamen ayrılmış Comp. weathered																																																										
ORANLAR / PROPORTIONS 0 - 10 % Pek az (Seyrek) Trace 10 - 20 % Az Little 20 - 35 % Sifat Adjective (Or some) 35 - 50 % Ve And		KIRIKLAR / 30 cm - FRACTURES / 30 cm > 1 Seyrek Wide (W) 1 - 2 Orta Moderate (M) 2 - 10 Sık Close (Cl) 10 - 20 Çok sık Intense (I) > 20 Parçalı Crushed (Cr)																																																										
KAYA KALİTESİ TANIMI / RQD 0 - 25 % Çok zayıf Very poor 25 - 50 % Zayıf Poor 50 - 75 % Orta Fair 75 - 90 % İyi Good 90 - 100 % Çok iyi Excellent		UD : Örselenmemiş Numune / Undisturbed Sample D : Örselenmiş Numune / Disturbed Sample SPT : Standart Pen Deneysi / Standard Pen. Test VST : Vane Deneysi / Vane Shear Test P : Pressiometre Deneysi / Pressurometer Test K : Karot Numunesi / Core Sample																																																										

Figure A.20: Borehole log of S-39

APPENDIX A

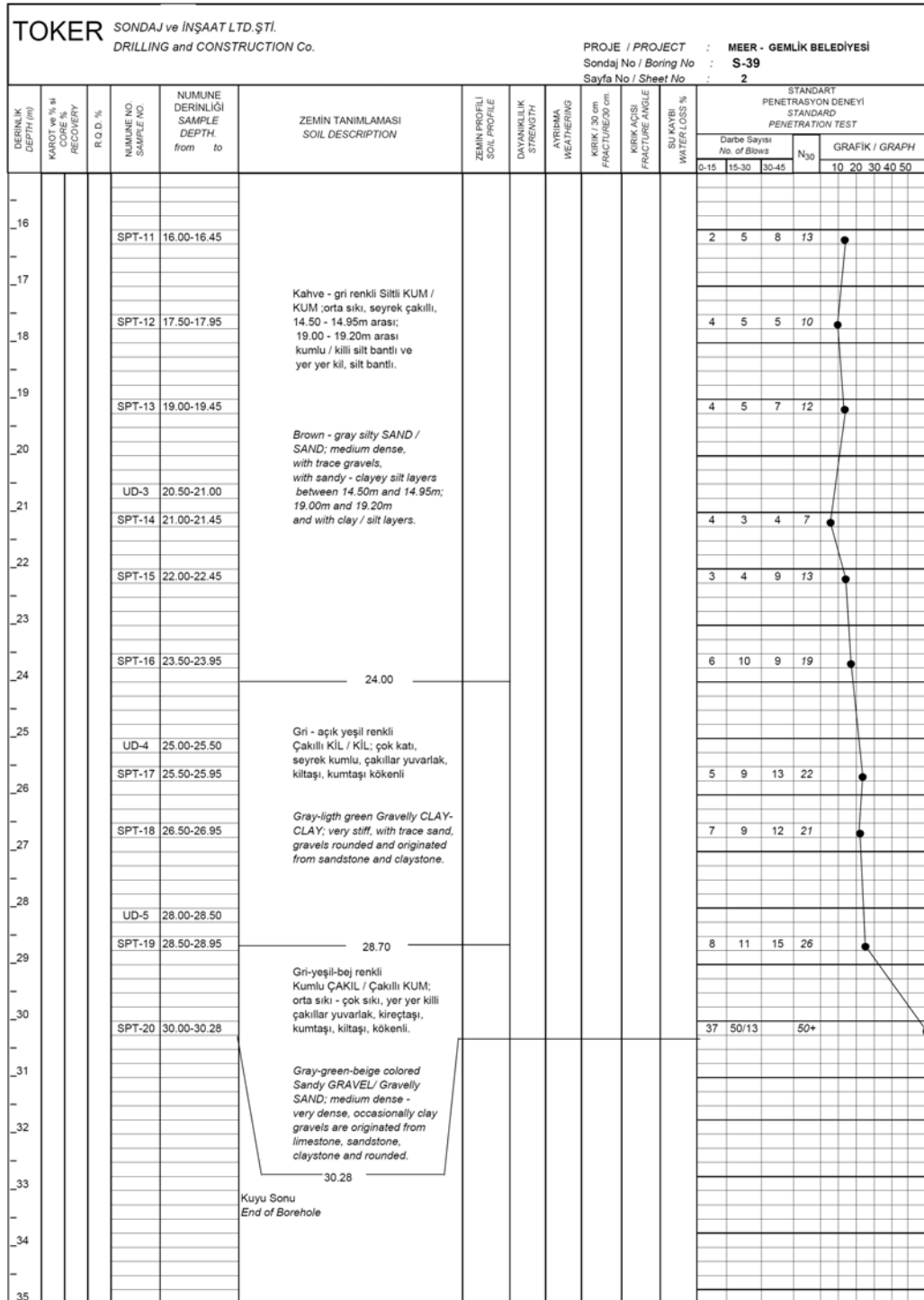


Figure A.20: (cont.)

7OKER SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

Sondaj No / Boring No : **S-40**
Sayfa No / Sheet No : **1**

SONDAJ LOGU / BORING LOG

PROJE ADI / PROJECT NAME : **MEER - GEMLIK BELEDİYESİ**
KOORDİNATLAR / COORDINATES : **X: 4477324.80 Y: 429970.20**
SONDAJ KOTU / ELEVATION (m) : **6.95**
SONDAJ DERİNLİĞİ / BORING DEPTH (m) : **30.45**
SONDAJ MAKİNASI / DRILLING RIG : **ACKER-2**
SONDÖR / FOREMAN : **Rasim ÇİÇEK**
BAŞLAMA TARİHİ / DATE STARTED : **06.06.2005**
BİTİŞ TARİHİ / DATE COMPLETED : **08.06.2005**

MÜHENDİS / ENGINEER : **Mehmet GÖKÇEER**

YERALTI SUYU DURUMU / GROUND WATER DATA

DERİNLİK DEPTH (m)	TARİH DATE	SAAT HOUR	AÇIKLAMA REMARKS
1.90	06.06.2005		

MUHAFAZA BORU / CASING : **DIS ÇAPİ / O.D. (mm) = 114 İÇ ÇAPİ / I.D. (mm) : 101** UZUNLUĞU / LENGTH (m) : **30.50**

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.O.D. %	NUMUNE NO. SAMPLE NO.	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRISMA WEATHERING	KIRILMA FRACTURE	KIRIK 130 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST							
													Darbe Sayısı No. of Blows	N ₃₀	GRAFIK / GRAPH					
					Yüzey toprağı / Top Soil								0-15	15-30	30-45	10	20	30	40	50
1					0.30 SİLTİLİ KİL; kahverenkli, yumuşak. SILTY CLAY; brown colored, soft															
2			SPT-1	1.50-1.95	1.90								2	2	2	4				
3					KİL; gri, yumuşak ile orta katı; az siltli.															
4			UD-1	3.00-3.40																
5			SPT-2	3.40-3.85									3	2	2	4				
6					CLAY; gray colored, soft to medium stiff; contains some silt.															
7			SPT-3	4.50-4.95									2	3	2	5				
8																				
9			SPT-4	6.00-6.45									10	12	7	19				
10																				
11			SPT-5	7.50-7.95									7	12	14	26				
12					ÇAKILLI KUM; gri ile grimsi kahverenkli, ince ile orta, orta sıkı; kili ve yer yer ince kil bantlı; çakıllar ince ile orta, yuvarlanmış.															
13			SPT-6	9.00-9.45									13	9	8	17				
14																				
15			SPT-7	10.50-10.95									15	10	8	18				
16					GRAVELLY SAND; gray to grayish brown colored, fine to medium grained, medium dense; contains clay, partly thin clay bands; gravels are fine to medium, rounded.															
17			SPT-8	12.00-12.45									3	5	7	12				
18																				
19			SPT-9	13.50-13.95									7	6	4	10				
20																				
21			UD-2	15.00-15.30																

KIVAM DURUMU / STIFFNESS			SIKILIK / DENSITY			GRANLAR / PROPORTIONS			KIRIKLAR / 30 cm - FRACTURES / 30 cm		
N = 0 - 2	Çok yumuşak	V.soft	N = 0 - 4	Çok gevrek	V.loose	0 - 10 %	Pek az (Seyrek)	Trace	> 1	Seyrek	Wide (W)
N = 3 - 4	Yumuşak	Soft	N = 5 - 10	Gevrek	Loose	10 - 20 %	Az	Little	1 - 2	Orta	Moderate (M)
N = 5 - 8	Orta katı	M.stiff	N = 11 - 30	Orta sıkı	M.dense	20 - 35 %	Sıfat	Adjective (Or some)	2 - 10	Sık	Close (C)
N = 9 - 15	Katı	Stiff	N = 31 - 50	Sıkı	Dense	35 - 50 %	Ve	And	10 - 20	Çok sık	Intense (I)
N = 16 - 30	Çok katı	V.stiff	N > 50	Çok sıkı	V.dense				> 20	Parçalı	Crushed (Cr)
N > 30	Sert	Hard									

DAYANIMLILIK / STRENGTH			AYRISMA / WEATHERING			KAYA KALİTESİ TANIMI / RQD		
I	Çok dayanımlı	Very strong	I	Taze	Fresh	0 - 25 %	Çok zayıf	Very poor
II	Dayanımlı	Strong	II	Az ayrılmış	Slightly weathered	25 - 50 %	Zayıf	Poor
III	Orta	Medium	III	Orta ayrılmış	Mod. weathered	50 - 75 %	Orta	Fair
IV	Zayıf	Weak	IV	Çok ayrılmış	Highly weathered	75 - 90 %	İyi	Good
V	Çok zayıf	Very weak	V	Tamamen ayrılmış	Comp. weathered	90 - 100 %	Çok iyi	Excellent

UD : Örselememiş Numune / Undisturbed Sample
D : Örselemiş Numune / Disturbed Sample
SPT : Standart Pen Deneği / Standard Pen. Test
VST : Vane Deneği / Vane Shear Test
P : Pressiometre Deneği / Pressurometer Test
K : Karot Numunesi / Core Sample

Figure A.21: Borehole log of S-40

APPENDIX A

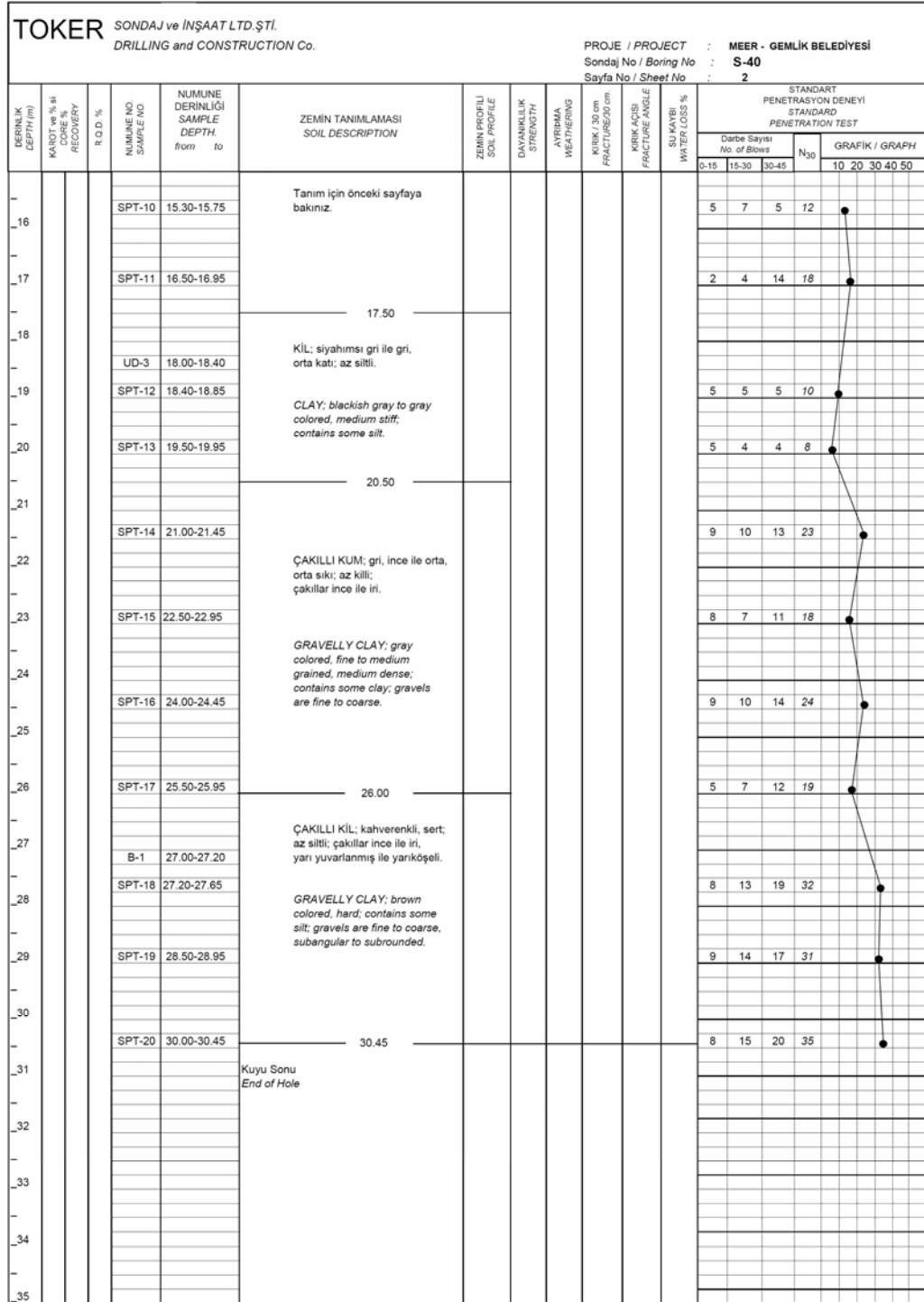


Figure A.21: (cont.)

7OKER SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

Sondaj No / Boring No : **S-41**
Sayfa No / Sheet No : **1**

SONDAJ LOGU / BORING LOG

PROJE ADI / PROJECT NAME : MEER - GEMLİK BELEDİYESİ
KOORDİNATLAR / COORDINATES : X: 4477377.98 Y: 430407.38
SONDAJ KOTU / ELEVATION (m) : 10.50
SONDAJ DERİNLİĞİ / BORING DEPTH (m) : 24.90
SONDAJ MAKİNASI / DRILLING RIG : ACKER-2
SONDÖR / FOREMAN : Rasim ÇİÇEK
BAŞLAMA TARİHİ / DATE STARTED : 02.06.2005
BİTİŞ TARİHİ / DATE COMPLETED : 03.06.2005
MUHAFAZA BORU / CASING : DIŞ ÇAP / O.D. (mm) = İÇ ÇAP / I.D. (mm) =

MÜHENDİS / ENGINEER : Mehmet GÖKÇEER

YERALTI SUYU DURUMU / GROUND WATER DATA			
DERİNLİK / DEPTH (m)	TARİH / DATE	SAAT / HOUR	AÇIKLAMA / REMARKS
3.00	02.06.2005		İlk seviye
4.40	21.06.2005		

DERİNLİK / DEPTH (m)	KAROT ve %'si / CORE % RECOVERY	R.Q.D. %	NUMUNE NO. / SAMPLE NO.	NUMUNE DERİNLİĞİ / SAMPLE DEPTH from to	ZEMİN TANIMLAMASI / SOIL DESCRIPTION	ZEMİN PROFİLİ / SOIL PROFILE	DAYANIKLILIK / STRENGTH	AYRISMA / WEATHERING	KIRIK / 30 cm FRACTURES	KIRIK KÜBÜ / FRACTURE VOLUME	SU KAYBI / WATER LOSS %	STANDART PENETRASYON DENEYİ / STANDARD PENETRATION TEST						
												Darbe Sayısı / No. of Blows	N ₆₀	GRAFIK / GRAPH				
0-15	15-30	30-45					10	20	30	40	50							
1					Yüzey toprağı / Top soil 0.30													
2			SPT-1	1.50-1.95	ÇAKILLI KİL; yeşilimsi kahverenkli ile gri, katı; az siltli, az kumlu; çakıllar ince ile orta, şist kökenli.								3	5	6	11		
3			P-1	2.70	GRAVELLY CLAY; greenish brown to gray colored, stiff; contains some silt, some sand; gravels are fine to medium, schist originated.													
4			UD-1	3.00-3.35														
5			SPT-2	3.35-3.80									2	3	7	10		
6					4.15	SİLTİLİ KİL; sarımsı kahverenkli, yumuşak; az kumlu.							3	2	2	4		
7			SPT-3	4.50-4.95	SILTY CLAY; yellowish brown colored, soft; contains some sand.													
8			P-2	5.70														
9					5.75	KUMLU KİL; sarımsı kahverenkli, orta katı; az siltli, pek az ince çakıllı, yer yer ince kum bantlı.							3	3	4	7		
10			UD-2	6.00-6.30														
11			SPT-4	6.30-6.75	SANDY CLAY; yellowish brown colored, medium stiff; contains some silt, some fine gravels, partly thin sand bands.								4	5	7	12		
12					7.70													
13			SPT-5	7.50-7.95									3	3	4	7		
14			P-3	8.70														
15																		
16			UD-3	9.00-9.30														
17			SPT-6	9.30-9.75									2	2	3	5		
18																		
19			SPT-7	10.50-10.95	KİL; siyahımsı gri ile gri, orta katı; az siltli.													
20			P-4	11.70														
21																		
22			UD-4	12.00-12.40	CLAY; blackish gray to gray colored, medium stiff; contains some silt.								4	5	5	10		
23																		
24			SPT-8	12.40-12.85									3	5	6	11		
25																		
26			SPT-9	13.50-13.95														
27			P-5	14.70														

KIVAM DURUMU / STIFFNESS		SİKLİLİK / DENSITY		ORANLAR / PROPORTIONS		KIRIKLAR / 30 cm - FRACTURES / 30 cm	
N = 0 - 2	Çok yumuşak	N = 0 - 4	Çok gevşek	0 - 10 %	Pek az (Seyrek)	> 1	Seyrek
N = 3 - 4	Yumuşak	N = 5 - 10	Gevşek	10 - 20 %	Az	1 - 2	Orta
N = 5 - 8	Orta katı	N = 11 - 30	Orta sıkı	20 - 35 %	Sıfat	2 - 10	Sık
N = 9 - 15	Katı	N = 31 - 50	Sıkı	35 - 50 %	Ve	10 - 20	Çok sık
N = 16 - 30	Çok katı	N > 50	Çok sıkı			> 20	Parçali
N > 30	Sert						Crushed

DAYANIMLILIK / STRENGTH		AYRISMA / WEATHERING		KAYA KALİTESİ TANIMI / RQD		UD : Örseilenmemiş Numune / Undisturbed Sample	
I	Çok dayanımlı	I	Taze	0 - 25 %	Çok zayıf	D	Örseilenmiş Numune / Disturbed Sample
II	Dayanımlı	II	Az ayrışmış	25 - 50 %	Zayıf	SPT	Standart Pen Deneyi / Standard Pen. Test
III	Orta	III	Orta ayrışmış	50 - 75 %	Orta	VST	Vane Deneyi / Vane Shear Test
IV	Zayıf	IV	Çok ayrışmış	75 - 90 %	İyi	P	Pressiometre Deneyi / Pressurometer Test
V	Çok zayıf	V	Tamamen ayrışmış	90 - 100 %	Çok iyi	K	Karot Numunesi / Core Sample

Figure A.22: Borehole log of S-41

APPENDIX A

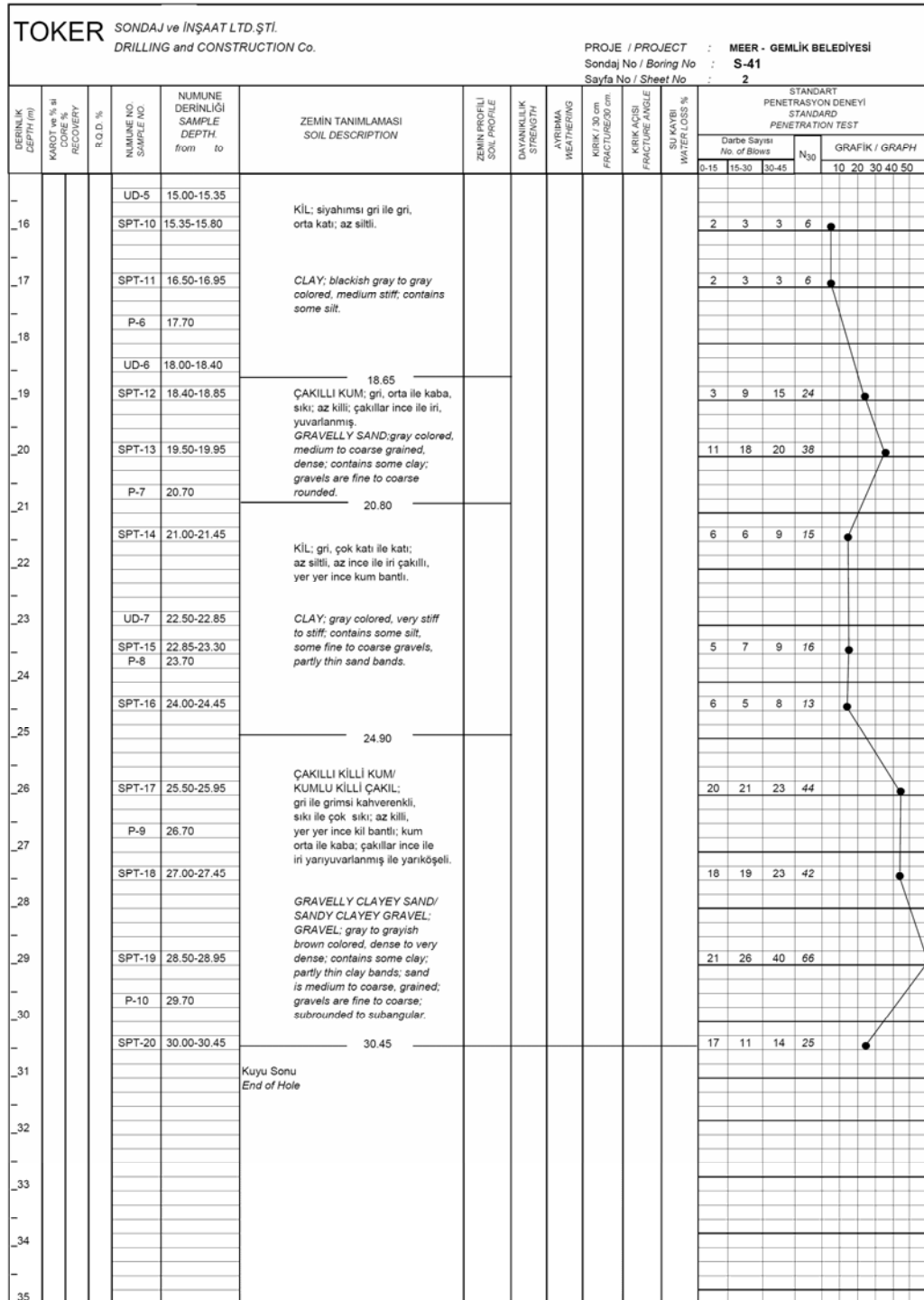


Figure A.22: (cont.)

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SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

Sondaj No / Boring No : S-42
Sayfa No / Sheet No 1

SONDAJ LOGU / BORING LOG

PROJE ADI / PROJECT NAME : MEER - GEMLİK BELEDİYESİ
 KOORDİNATLAR / COORDINATES : X: 4477070.31 Y: 430225.40
 SONDAJ KOTU / ELEVATION (m) : 11.20
 SONDAJ DERİNLİĞİ / BORING DEPTH (m) : 30.00
 SONDAJ MAKİNASI / DRILLING RIG : ACKER-II
 SONDÖR / FOREMAN : Rasim ÇİÇEK
 BAŞLAMA TARİHİ / DATE STARTED : 25.05.2005
 BİTİŞ TARİHİ / DATE COMPLETED : 27.05.2005
 MUHAFAZA BORU / CASING : DIŞ ÇAP / O.D. (mm) = 114

MÜHENDİS / ENGINEER : Taner ABAY

YERALTI SUYU DURUMU / GROUND WATER DATA	TARİH / DATE	SAAT / HOUR	AÇIKLAMA / REMARKS
DERİNLİK / DEPTH (m)	4.50	25.05.2005	ilk seviye
4.80	21.06.2005		

DERİNLİK / DEPTH (m)	KAROT ve % CORE % RECOVERY	R.Q.D. %	NUMUNE NO / SAMPLE NO	NUMUNE DERİNLİĞİ / SAMPLE DEPTH from to	ZEMİN TANIMLAMASI / SOIL DESCRIPTION	ZEMİN PROFİLİ / SOIL PROFILE	DAYANIKLILIK / STRENGTH	AYRISMA / WEATHERING	YERK. / 30 cm FRACTURE	KIRIK ALISI / FRACTURE FILL	SU KAYBI / WATER LOSS %	UZUNLUĞU / LENGTH (m)	STANDART PENETRASYON DENEYİ / STANDARD PENETRATION TEST	
													Darbe Sayısı / No. of Blows	GRAFIK / GRAPH
													15-30	10 20 30 40 50
1						DOLGU MALZEME; silt, kum ve çakıl boyutunda mermer parçaları.								
2			SPT-1	1.50-1.95									4	1 7 8
3			P-1	2.70		ALÜVYON (Karasa) kılı (kahve) KUM; çakilli, ıslak, gevşek (çakıllar; y.köşeli-yuvartak)								
4			UD-1	3.00-3.30		ALLUVIUM; brown clayey SAND with subangular-rounded gravels.							9	6 3 9
5			SPT-2	3.30-3.75										
6														
7			SPT-3	4.50-4.95		Kumlu ÇAKIL; seyrek siltli "kili silt" bandı ile ince "silt bantları içermekte, y.köşeli yuvartak, ıslak, o.sıkı.							15	12 7 19
8			P-2	5.70		Sandy GRAVELS; medium dense, with trace silt, and containing clayey silt, silt layers, gravels subangular- rounded								
9			SPT-4	6.00-6.45									19	17 12 29
10														
11			SPT-5	7.50-7.95		KİL; kahverenkli, ince "kumlu çakıl" bandı içermekte, o.katı. Brown CLAY; medium stiff with thin sandy gravel layers							7	3 4 7
12			P-3	8.70										
13			SPT-6	9.00-9.45		KİL; gri, boz kahverenkli, seyrek/az kumlu, seyrek çakilli, "kili kum" bandı içermekte (9.00-9.45m arasında) organik malzeme içermekte, o.katı-katı.							3	3 4 7
14														
15			UD-2	10.50-10.90		Brown-gray CLAY; medium stiff-stiff, with trace- little sand, trace gravels, clayey sand layers between 9.00-9.45 m. containing organic materials.							3	2 4 6
16			SPT-7	10.90-11.35										
17			P-4	11.70									4	5 6 11
18			SPT-8	12.00-12.45										
19														
20			SPT-9	13.50-13.95									5	7 8 15
21			P-5	14.70		Tanım için sonraki sayfaya bakınız. See next page for description								
22			UD-3	15.00-15.30										

KIVAM DURUMU / STIFFNESS	SIKILIK / DENSITY	ORANLAR / PROPORTIONS	KIRIKLAR / 30 cm - FRACTURES / 30 cm
N = 0 - 2 Çok yumuşak N = 3 - 4 Yumuşak N = 5 - 8 Orta katı N = 9 - 15 Katı N = 16 - 30 Çok katı N > 30 Sert	N = 0 - 4 Çok gevşek N = 5 - 10 Gevşek N = 11 - 30 Orta sıkı N = 31 - 50 Sıkı N > 50 Çok sıkı	0 - 10 % Pek az (Seyrek) 10 - 20 % Az 20 - 35 % Sıfat 35 - 50 % Ve	Trace Little Adjective (Or some) And
DAYANIMLILIK / STRENGTH	AYRISMA / WEATHERING	KAYA KALİTESİ TANIMI / R.Q.D.	UD - Örselenmemiş Numune / Undisturbed Sample D - Örsellenmiş Numune / Disturbed Sample SPT - Standart Pen Deneyi / Standard Pen. Test VST - Vane Deneyi / Vane Shear Test P - Presiometre Deneyi / Pressuremeter Test K - Karot Numunesi / Core Sample
I Çok dayanımlı II Dayanımlı III Orta IV Zayıf V Çok zayıf	I Taze II Az ayrışmış III Orta ayrışmış IV Çok ayrışmış V Tamamen ayrışmış	0 - 25 % Çok zayıf 25 - 50 % Zayıf 50 - 75 % Orta 75 - 90 % İyi 90 - 100 % Çok iyi	Very strong Strong Medium Weak Very weak

Figure A.23: Borehole log of S-42

APPENDIX A

[illegible]

Figure A.23: (cont.)

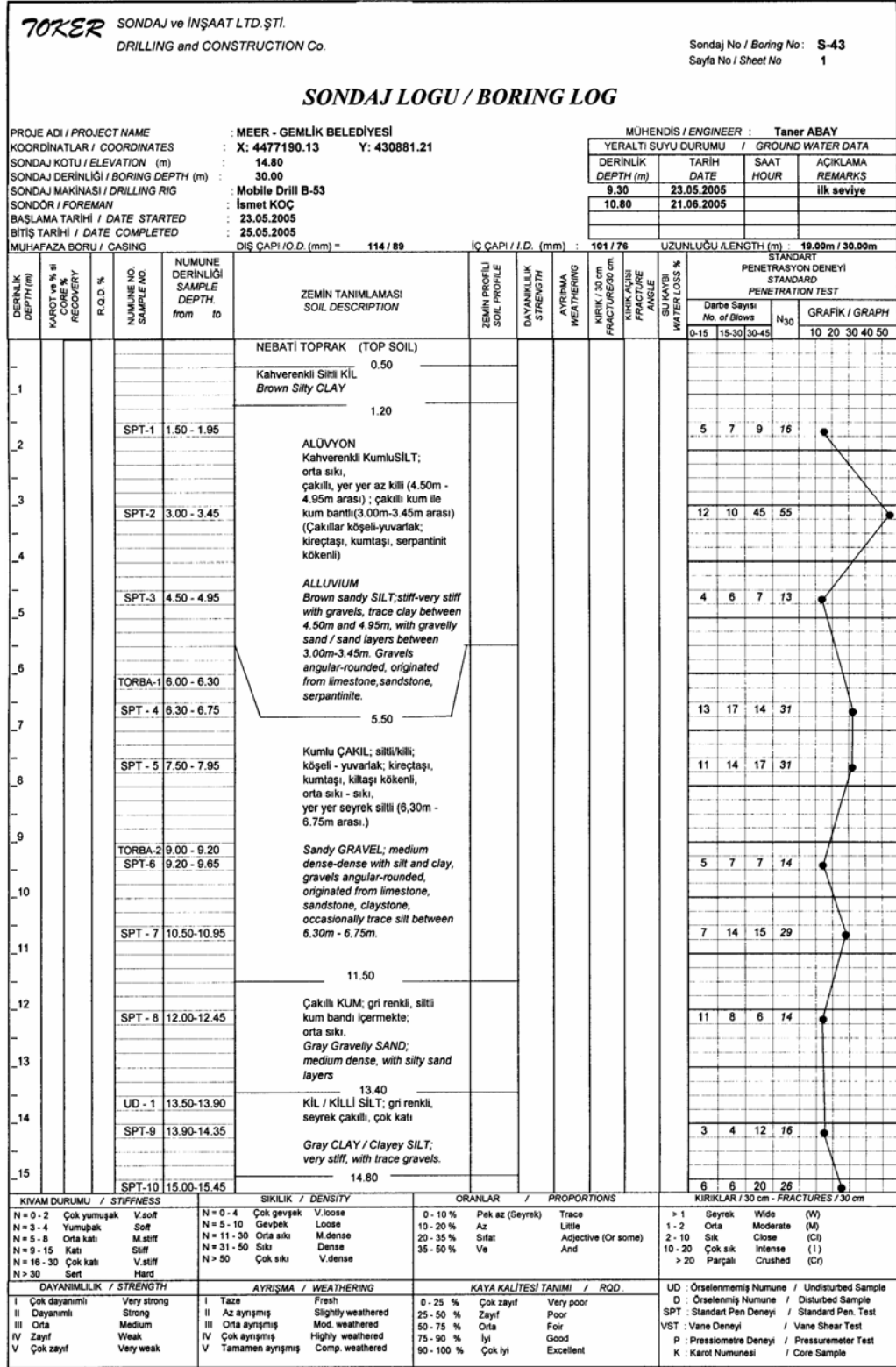


Figure A.24: Borehole log of S-43

APPENDIX A

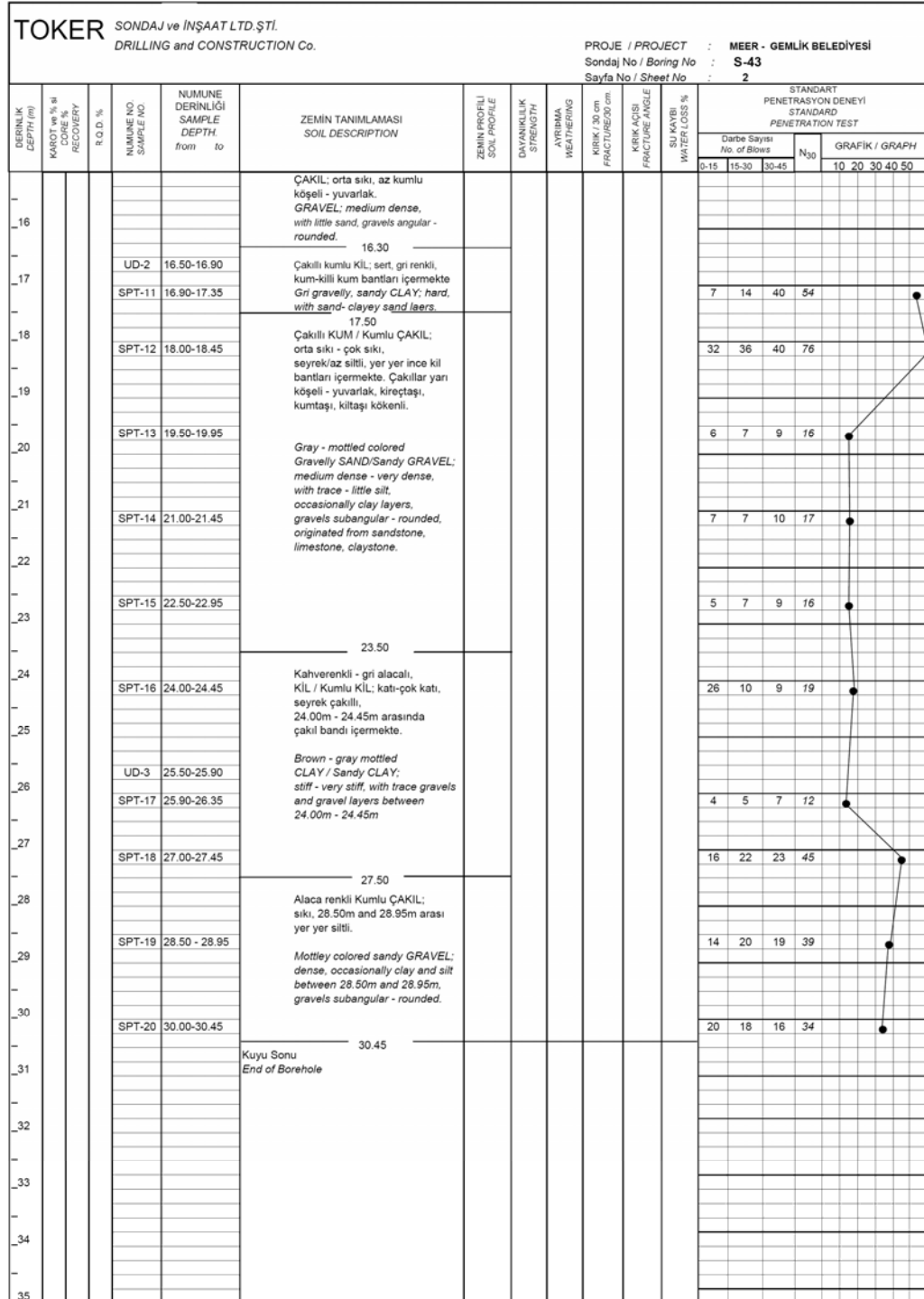


Figure A.24: (cont.)

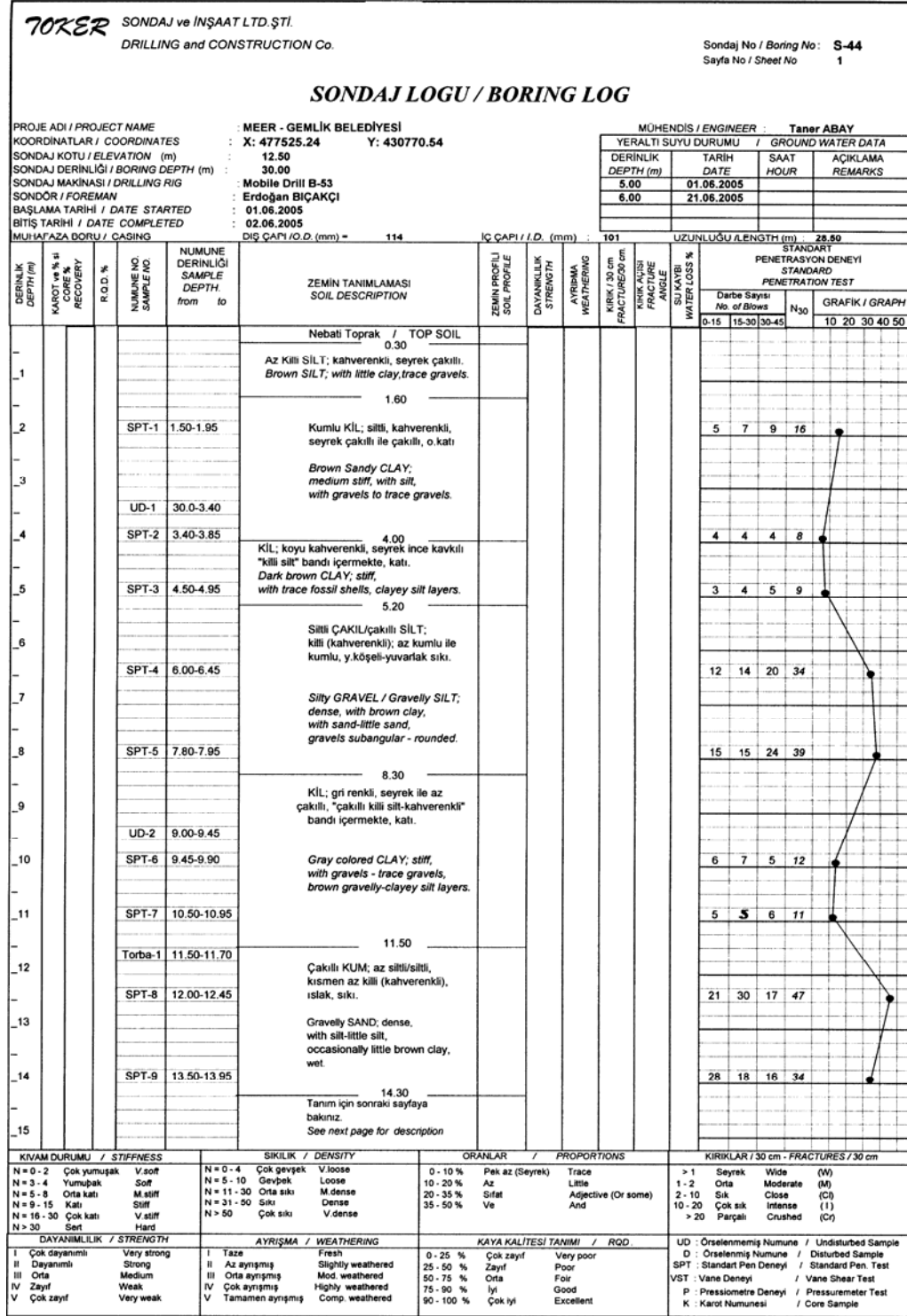


Figure A.25: Borehole log of S-44

APPENDIX A

TOKER SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ
Sondaj No / Boring No : S-44
Sayfa No / Sheet No : 2

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.Q.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRILMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST									
												Darbe Sayısı No. of Blows				N ₃₀	GRAFIK / GRAPH				
												0-15	15-30	30-45			10	20	30	40	50
16			UD-3	15.00-15.50	KİL; gri renkli, ince kum "arabantlı".																
			SPT-10	15.50-15.95	Gray colored CLAY; with sand interlayers.							7	9	11	20						
17			SPT-11	16.50-16.95								9	9	13	22						
18					17.50																
19			UD-4	18.00-18.35	KİL; gri-kahverenkli, seyrek kumlu, "ince çakıllı kum" bandı içermekte (18.35m'de) katı, çok katı.							3	4	8	12						
20			SPT-12	18.35-18.60	Gray-brown colored CLAY; stiff - very stiff, with trace sand, around 18.35m fine gravelly sand layers.							9	11	12	23						
21					20.20																
22			UD-5	21.00-21.40	Çakıllı KİL; kırmızı renkli (yer yer yeşil alacalı), az kumlu, sert (çakıllar; kuvars, şist, silttaşı, kökenli, yuvarlak)							23	38	50/14	50+						
23			SPT-14	21.40-21.84																	
24			SPT-15	22.50-22.90								16	25	50/10	50+						
25			Torba-2	23.00-23.25	Red colored, occasionally green mottled, Gravelly CLAY; hard, with little sand, gravels rounded and originated from quartz, schist, siltstone.							18	28	41	69						
26			SPT-16	24.00-24.45																	
27					25.00																
28			SPT-17	25.50-25.64	ŞİST; çok-tamamen ayrılmış; kuvars yeşil, mermer bloğu (gri, dayanımlı) içermekte.							50/14			50+						
29			SPT-18	27.00-27.10	SCHİST; highly - completely weathered, with green quartz and gray, strong marble blocks.							50/10			50+						
30	25	-	C-1	27.10-28.50																	
31			SPT-19	28.50-28.58	28.50							50/8			50+						
32	32	-	C-2	28.60-30.00	ŞİST; çok-tamamen ayrılmış; kahverimsi yeşil, mermer bloğu (gri, dayanımlı) içermekte SCHİST; highly - completely weathered, brownish green colored, with gray, strong marble blocks.																
33					30.00																
34					Kuyu Sonu End of Borehole																
35																					

Figure A.25: (cont.)

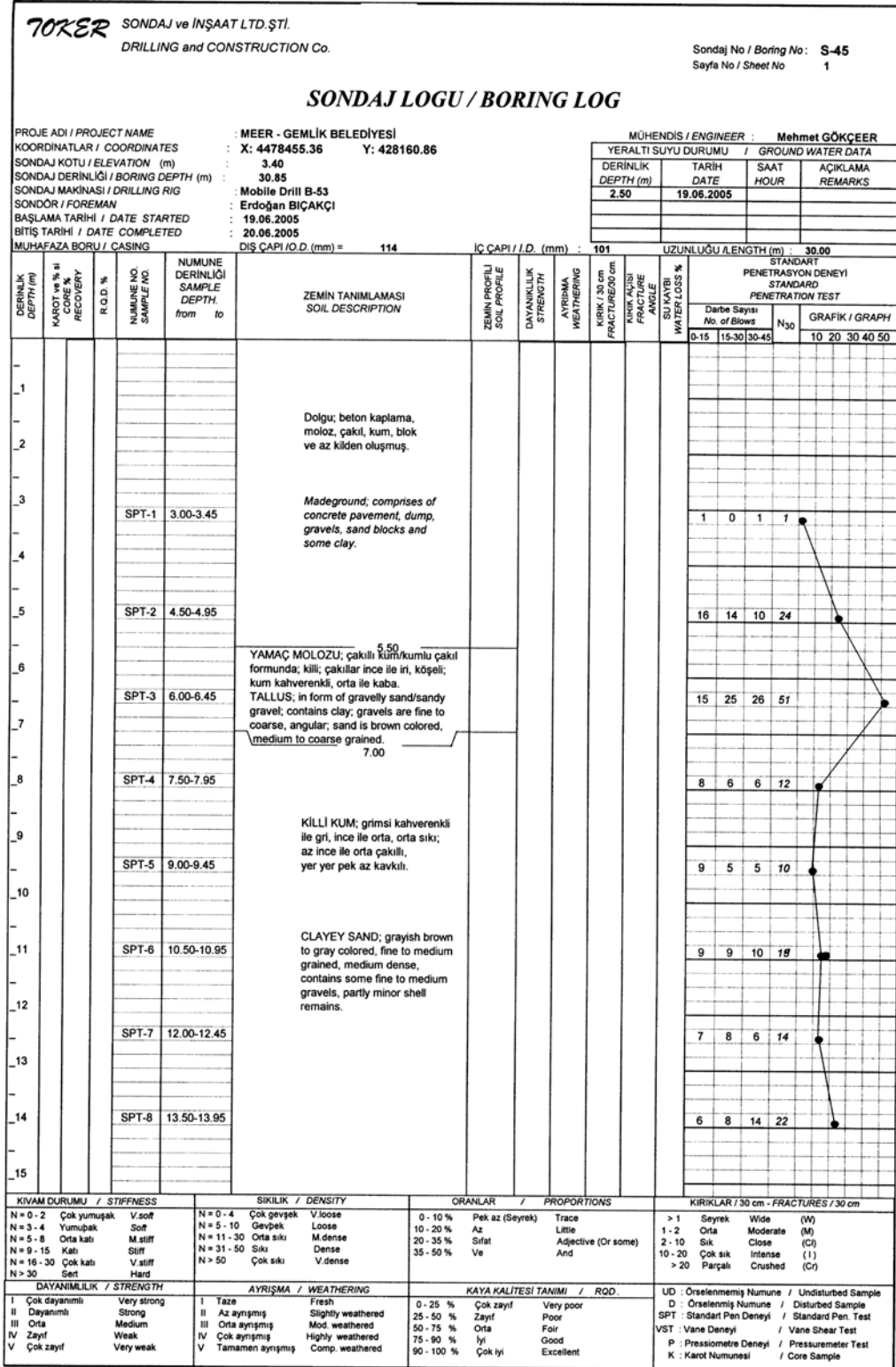


Figure A.26: Borehole log of S-45

APPENDIX A

TOKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ

Sondaj No / Boring No : S-45

Sayfa No / Sheet No : 2

STANDART
PENETRASYON DENEYİ
STANDARD
PENETRATION TEST

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.Q.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAVANIKLILIK STRENGTH	AYRIRMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST										
												Darbe Sayısı No. of Blows				N ₆₀	GRAFIK / GRAPH					
												0-15	15-30	30-45			10	20	30	40	50	
16			SPT-9	15.00-15.45	KİLLİ KUM; grimsi kahverenkli ile gri, ince ile orta, orta siki; az ince ile orta çakıllı, yer yer pek az kavkılı.							6	10	10	20							
17			SPT-10	16.50-16.95									8	8	9	17						
18			SPT-11	18.00-18.45									6	6	8	14						
19						CLAYEY SAND; grayish brown to gray colored, fine to medium grained, medium dense, contains some fine to medium gravels, partly minor shell remains.							6	7	7	14						
20			SPT-12	19.50-19.95																		
21			SPT-13	21.00-21.45									9	11	14	25						
22																						
23			SPT-14	22.50-22.95								8	7	8	15							
24					23.80 SİLTİLİ KİL; gri, çok katı, SILTY CLAY; gray colored, very stiff.																	
25			UD-1	24.00-24.40																		
26			SPT-15	24.40-24.85	25.00 ÇAKILLI KUM; gri, ince ile orta, orta siki; az kili, 26.90m-27.60m arası siltli kil bantlı; çakıllar ince ile orta yuvarlanmış.							8	8	13	21							
27			SPT-16	25.50-25.95								7	8	15	23							
28					GRAVELLY SAND; gray colored fine to medium grained, medium dense, contains some clay, silty clay band in between 26.90m-27.60m. Gravels are fine to medium, rounded.																	
29			UD-2	27.00-27.40																		
30			SPT-17	27.40-27.85									8	13	14	27						
31			SPT-19	28.50-28.95								10	11	13	24							
32					29.50 KİL; gri, çok katı; az siltli.																	
33			UD-3	30.00-30.40	CLAY; gray colored, very stiff; contains some silt.																	
34			SPT-19	30.40-30.85	30.85							9	12	13	25							
35					Kuyu Sonu End of Hole																	

Figure A.26: (cont.)

7OKER

SONDAJ ve İNŞAAT LTD. ŞTİ.

DRILLING and CONSTRUCTION Co.

Sondaj No / Boring No : S-46

Sayfa No / Sheet No 1

SONDAJ LOGU / BORING LOG

PROJE ADI / PROJECT NAME : MEER - GEMLİK BELEDİYESİ
 KOORDİNATLAR / COORDINATES : X: 4478571.37 Y: 428365.88
 SONDAJ KOTU / ELEVATION (m) : 13.20
 SONDAJ DERİNLİĞİ / BORING DEPTH (m) : 30.45
 SONDAJ MAKİNASI / DRILLING RIG : ACKER-I
 SONDÖR / FOREMAN : Adnan KAPLAN
 BAŞLAMA TARİHİ / DATE STARTED : 21.06.2005
 BİTİŞ TARİHİ / DATE COMPLETED : 22.06.2005
 MUHAFAZA BORU / CASING : DIŞ ÇAP / O.D. (mm) = 114/89

MÜHENDİS / ENGINEER : Mehmet GÖKÇEER

YERALTI SUYU DURUMU / GROUND WATER DATA			
DERİNLİK / DEPTH (m)	TARİH / DATE	SAAT / HOUR	AÇIKLAMA / REMARKS

UZUNLUĞU / LENGTH (m) : 15.00/25.00

DERİNLİK / DEPTH (m)	KAROT ve % / CORE % RECOVERY	R.Q.D. %	NUMUNE NO / SAMPLE NO	NUMUNE DERİNLİĞİ / SAMPLE DEPTH from to	ZEMİN TANIMLAMASI / SOIL DESCRIPTION	ZEMİN PROFİLİ / SOIL PROFILE	DAYANIKLILIK / STRENGTH	AYRISMA / WEATHERING	KIRIK / 30 cm FRACTURE	KIRILMA / 30 cm FRACTURE	SU KAYBI / WATER LOSS %	STANDART PENETRASYON DENEYİ / STANDARD PENETRATION TEST	GRAFİK / GRAPH							
												Darbe Sayısı / No of Blows								
												0-15	15-30	30-45	N ₃₀	10	20	30	40	50
1																				
2					SPT-1	1.50-1.95							3	4	5	9				
3																				
4					UD-1	3.00-3.30							15	11	5	16				
5					SPT-2	3.30-3.75														
6													5	3	5	8				
7					SPT-3	4.50-4.95														
8													3	4	14	18				
9					UD-2	6.00-6.30														
10					SPT-4	6.30-6.75	6.60													
11													14	17	19	36				
12					SPT-5	7.50-7.95														
13					B-1	8.00-9.00							19	23	25	48				
14																				
15					SPT-6	9.00-9.45														
16													16	22	31	53				
17					SPT-7	10.50-10.95														
18					B-2	11.00-12.00							18	24	34	58				
19																				
20					SPT-8	12.00-12.45														
21													20	24	30	54				
22					SPT-9	13.50-13.95														
23					B-3	14.00-15.00														
24																				
25																				

KIVAM DURUMU / STIFFNESS	SIKILIK / DENSITY	ORANLAR / PROPORTIONS	KIRILIR / 30 cm - FRACTURES / 30 cm
N = 0 - 2 Çok yumuşak N = 3 - 4 Yumuşak N = 5 - 8 Orta katı N = 9 - 15 Katı N = 16 - 30 Çok katı N > 30 Sert	N = 0 - 4 Çok gevşek N = 5 - 10 Gevşek N = 11 - 30 Orta sıkı N = 31 - 50 Sıkı N &		

Figure A.27: Borehole log of S-46

APPENDIX A

TOKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ

Sondaj No / Boring No : S-46

Sayfa No / Sheet No : 2

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.O.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRILMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST										
												Darbe Sayısı No. of Blows				N ₃₀	GRAFIK / GRAPH					
												0-15	15-30	30-45			10	20	30	40	50	
16			SPT-10	15.00-15.45	YAMAÇ MOLOZU/KOLUVYUM; değişken boyut ve kökenli (epiklastik kumtaşı, şist, mermer, kuvarzit) blok ve çakıllar, yeşilimsi kahverenkli kil ve ince ile kaba kumdan oluşmuş.							16	20	28	48							
17			SPT-11	16.50-16.95									20	23	31	54						
18						TALLUS/COLLUVIUM; comprises of variably sized and originated (epiclastic sandstone, schist, marble, quartzite) blocks and gravels, greenish brown colored clay and fine to coarse grained sand.							20	27	33	60						
19			SPT-12 B-4	18.00-18.45 18.50-19.50																		
20			SPT-13	19.50-19.95								23	25	35	60							
21					20.50																	
22			SPT-14	21.00-21.45	ALTERE ŞİST; çakıllı kil/ killi çakıl formunda; kil yeşilimsi kahverenkli; çakıllar ince ile iri, köşeli.							21	25	41	66							
23			SPT-15	22.50-22.95	ALTERED SCHIST; in form of gravelly clay/Clayey gravel; clay is greenish brown colored; gravels are fine to coarse, angular.							25	27	43	70							
24			SPT-16	24.00-24.45								25	28	39	67							
25					25.00																	
26			SPT-17	25.50-25.55	ÇAKILLI KİL; grimsi kahverenkli ile yeşilimsi gri, çok katı ile sert; az siltli, pek az kumlu, 29.00m'den sonra kumlu; çakıllar ince ile orta.							50/5			50+							
27			B-5	26.50-27.00																		
28			SPT-18	27.00-27.45									7	11	14	25						
29			SPT-19	28.50-28.95	GRAVELLY CLAY; grayish brown to greenish gray, very stiff to hard; contains some silt, minor sand, sandy after 29.00m; gravels are fine to medium.							8	13	16	29							
30																						
31			SPT-20	30.00-30.45								12	18	18	36							
32					Kuyu Sonu End of Hole																	
33																						
34																						
35																						

Figure A.27: (cont.)

7OKER SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

Sondaj No / Boring No : **S-50**
Sayfa No / Sheet No : **1**

SONDAJ LOGU / BORING LOG

PROJE ADI / PROJECT NAME : **MEER - GEMLİK BELEDİYESİ**
KOORDİNATLAR / COORDINATES : **X: 4478340.51 Y: 429031.56**
SONDAJ KOTU / ELEVATION (m) : **11.70**
SONDAJ DERİNLİĞİ / BORING DEPTH (m) : **20.00**
SONDAJ MAKİNASI / DRILLING RIG : **ACKER-2**
SONDÖR / FOREMAN : **Rasim ÇİÇEK**
BAŞLAMA TARİHİ / DATE STARTED : **31.05.2005**
BİTİŞ TARİHİ / DATE COMPLETED : **01.06.2005**
MÜHÜR / CASING : **DIŞ ÇAP / O.D. (mm) = 114/89 İÇ ÇAP / I.D. (mm) : 101/76 UZUNLUĞU / LENGTH (m) : 10.50/16.50**

MÜHENDİS / ENGINEER : **Mehmet GÖKÇEER**

DERİNLİK DEPTH (m)	KAROT ve % a CORE % RECOVERY	R.Q.D. %	NUMUNE NO SAMPLE NO.	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRISMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST	GRAFİK / GRAPH							
												Darbe Sayısı No. of Blows								
												0-15	15-30	30-45	N ₃₀	10	20	30	40	50
1					Yüzey toprağı / Top Soil 0.30 Yamaç molozu; kahverenkli kil değişken boyutlu çakıl ve az kumdan oluşmuş.															
2				SPT-1 1.50-1.57	Tallus; mades up of brown colored clay; variably sized gravels and some sand.							50/7	50+							
3				P-1 2.70																
4				SPT-2 3.00-3.09								50/9	50+							
5	43			C-1 3.10-4.50	ŞİST; yeşilimsi gri ile yeşilimsi kahverenkli, çok ile yer yer orta ayrılmış, parçalı; killi.			IV				50/8	50+							
6				SPT-3 4.50-4.58																
7	30			C-2 4.60-6.00	SCHİST; greenish gray to greenish brown colored, intensely to partly moderately altered, crushed; contains clay.		III	III	Cr	?	75									
8				P-2 5.70																
9				C-3 6.00-7.50				IV												
10																				
11				P-3 9.20	ŞİST; faylanmış/kırkık; yeşilimsi kahverenkli, yaygın killi ve milonitli			IV	V	?	?	90								
12	73			C-5 9.00-10.00	SCHİST; faulted/fractured; greenish brown colored; contains extensive clay and mylonite															
13				SPT-4 10.50-10.52				IV	V	?		90	50/2							
14				C-7 10.55-11.00																
15				P-4 11.00-12.00	ŞİST; yeşilimsi gri, orta ile yer yer çok ayrılmış, parçalı ile çok sık kırkık; 10.30m-11.00m arası faylanmış/kırkık; killi.		III	III	Cr		45° 20° 80°									
16				C-8 11.70																
17				P-5 12.00-13.50	SCHİST; greenish gray colored, moderately to partly intensely altered; faulted/fractured in between 10.30m-11.00m; contains clay.			IV	I											
18				C-9 12.00-13.50																
19				P-6 13.50-15.00				II	III											
20				C-10 13.50-15.00																
21				P-7 14.70																
22																				
23																				
24																				
25																				
26																				
27																				
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45																				
46																				
47																				
48																				
49																				
50																				

KIVAM DURUMU / STIFFNESS			SİKLİLİK / DENSITY			ORANLAR / PROPORTIONS			KIRIKLAR / 30 cm - FRACTURES / 30 cm		
N = 0 - 2	Çok yumuşak	V.soft	N = 0 - 4	Çok gevrek	V.loose	0 - 10 %	Pek az (Seyrek)	Trace	> 1	Seyrek	Wide (W)
N = 3 - 4	Yumuşak	Soft	N = 5 - 10	Gevrek	Loose	10 - 20 %	Az	Little	1 - 2	Orta	Moderate (M)
N = 5 - 8	Orta katı	M.stiff	N = 11 - 30	Orta sıkı	M.dense	20 - 35 %	Sıfat	Adjective (Or some)	2 - 10	Sık	Close (C)
N = 9 - 15	Katı	Stiff	N = 31 - 50	Sıkı	Dense	35 - 50 %	Ve	And	10 - 20	Çok sık	Intense (I)
N = 16 - 30	Çok katı	V.stiff	N > 50	Çok sıkı	V.dense				> 20	Parçalı	Crushed (Cr)
N > 30	Sert	Hard									

DAYANIMLILIK / STRENGTH		AYRISMA / WEATHERING		KAYA KALİTESİ TANIMI / RQD		UD : Örselememiş Numune / Undisturbed Sample	
I	Çok dayanımlı	I	Taze	0 - 25 %	Çok zayıf	Very poor	D : Örselemiş Numune / Disturbed Sample
II	Dayanımlı	II	Az ayrılmış	25 - 50 %	Zayıf	Poor	SPT : Standart Pen Deneği / Standard Pen. Test
III	Orta	III	Orta ayrılmış	50 - 75 %	Foş	Fair	VST : Vane Deneği / Vane Shear Test
IV	Zayıf	IV	Çok ayrılmış	75 - 90 %	İyi	Good	P : Pressiometre Deneği / Pressurometer Test
V	Çok zayıf	V	Tamamen ayrılmış	90 - 100 %	Çok iyi	Excellent	K : Karot Numunesi / Core Sample

Figure A.28: Borehole log of S-50

APPENDIX A

TOKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ
Sondaj No / Boring No : S-50
Sayfa No / Sheet No : 2

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.Q.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRIMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST									
												Darbe Sayısı No. of Blows			N ₃₀	GRAFIK / GRAPH					
												0-15	15-30	30-45		10	20	30	40	50	
16	39	17	C-11	15.00-16.50	ŞİST; yeşilimsi gri, orta ile yer yer çok ayrışmış,parçalı ile çok sık kırıklı; 10.30m-11.00m arası faylanmış/kırıklı; killi. SCHIST; greenish gray colored, moderately to partly intensely altered; faulted/fractured in between 10.30m-11.00m; contains clay.			III		45°											
17	19	9	C-12	16.50-18.00		II	I	20°	70												
18			P-6	17.70		II		80°													
19	21	-	C-13	18.00-20.00																	
20					20.00																
21					Kuyu Sonu End of Hole																
22																					
23																					
24																					
25																					
26																					
27																					
28																					
29																					
30																					
31																					
32																					
33																					
34																					
35																					

Figure A.28: (cont.)

TOKER SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

Sondaj No / Boring No: **S-51**
Sayfa No / Sheet No: **1**

SONDAJ LOGU / BORING LOG

PROJE ADI / PROJECT NAME : **MEER - GEMLİK BELEDİYESİ**
KOORDİNATLAR / COORDINATES : **X: 4478125.00 Y: 429286.45**
SONDAJ KOTU / ELEVATION (m) : **2.37**
SONDAJ DERİNLİĞİ / BORING DEPTH (m) : **55.00**
SONDAJ MAKİNASI / DRILLING RIG : **ACKER-2**
SONDÖR / FOREMAN : **Rasim ÇİÇEK**
BAŞLAMA TARİHİ / DATE STARTED : **25.06.2005**
BİTİŞ TARİHİ / DATE COMPLETED : **28.06.2005**
MUHAFAZA BORU / CASING : **DIŞ ÇAP / I.O.D. (mm) = 114/89**
İÇ ÇAP / I.D. (mm) : **101/76**
UZUNLUĞU / LENGTH (m) : **21.00/43.00**

MÜHENDİS / ENGINEER : **Taner ABAY**

DERİNLİK DEPTH (m)	TARİH DATE	SAAT HOUR	AÇIKLAMA REMARKS
0.60	25.06.2005		

DERİNLİK DEPTH (m)	NUMUNE NO SAMPLE NO.	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRISMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST	GRAFİK / GRAPH
										Derbe Sayısı No. of Blows	N ₃₀
										0-15	15-30
1			Bitkisel Toprak / Top Soil 0.40 Silty KİL; siltli kahve. Silty CLAY; milk brown 1.00								
2	SPT-1	1.50-1.95	Eski DOLGU; az siltli KİL; gri, az köşeli ile yuvarlak çakılı, yer yer kumlu; tuğla parçaları içermekte.							3	3
3											
4	UD-1	3.00-3.40	Ancient FILL MATERIAL; CLAY; gray, with little silt and rounded to angular gravels, partly with some sand, contains brick pieces.							1	1
5	SPT-2	3.40-3.85								2	2
6											
7	SPT-3	4.50-4.95	5.00 ALÜVYON; kumlu(gri) ÇAKIL; ince ile iri, yuvarlak ile yarı köşeli, ıslak, o.sıkı.							2	2
8											
9	Torba-1	6.00-6.30	ALLUVIUM; sandy (gri) GRAVEL; fine to coarse, rounded to subangular, wet, m. dense.							5	11
10	SPT-4	6.30-6.75								11	22
11											
12	SPT-5	7.50-7.95	7.00 SILT; gri, yer yer ince kumlu, kavkılı, çok yumuşak-katı.							5	5
13											
14	Torba-2	9.00-9.20								6	11
15	SPT-6	9.20-9.65	SILT; gray, partly with fine sand, contains fossil shells, v. soft to stiff.							1	0
16											
17	SPT-7	10.50-10.95								3	4
18											
19	UD-2	12.00-12.30	11.50 SİLTİLİ KİL; gri, yer yer kil bantları içermekte, çok yumuşak-yumuşak.							4	4
20	SPT-8	12.30-12.75								8	
21											
22	SPT-9	13.50-13.95	Silty CLAY; gray; occasionally contains clay bands, very soft, soft.							1	1
23											
24											
25											

KIVAM DURUMU / STIFFNESS	SİKLİLİK / DENSITY	ORANLAR / PROPORTIONS	KIRIKLAR / 30 cm - FRACTURES / 30 cm
N = 0 - 2 Çok yumuşak V. soft	N = 0 - 4 Çok gevşek V. loose	0 - 10 % Pek az (Seyrek) Trace	> 1 Seyrek Wide (W)
N = 3 - 4 Yumuşak Soft	N = 5 - 10 Gevşek Loose	10 - 20 % Az Little	1 - 2 Orta Moderate (M)
N = 5 - 8 Orta katı M. stiff	N = 11 - 30 Orta sıkı M. dense	20 - 35 % Sıfat Adjective (Or some)	2 - 10 Sık Close (C)
N = 9 - 15 Katı Stiff	N = 31 - 50 Sıkı Dense	35 - 50 % Ve And	10 - 20 Çok sık Intense (I)
N = 16 - 30 Çok katı V. stiff	N > 50 Çok sıkı V. dense		> 20 Parçalı Crushed (Cr)
N > 30 Sert Hard			

DAYANIMLILIK / STRENGTH	AYRISMA / WEATHERING	KAYA KALİTESİ TANIMI / RQD	UD : Örselenmemiş Numune / Undisturbed Sample
I Çok dayanımlı Very strong	I Taze Fresh	0 - 25 % Çok zayıf Very poor	D : Örselenmiş Numune / Disturbed Sample
II Dayanımlı Strong	II Az ayrılmış Slightly weathered	25 - 50 % Zayıf Poor	SPT : Standart Pen Deneyi / Standard Pen. Test
III Orta Medium	III Orta ayrılmış Mod. weathered	50 - 75 % Orta Fair	VST : Vane Deneyi / Vane Shear Test
IV Zayıf Weak	IV Çok ayrılmış Highly weathered	75 - 90 % İyi Good	P : Pressiometre Deneyi / Pressuremeter Test
V Çok zayıf Very weak	V Tamamen ayrılmış Comp. weathered	90 - 100 % Çok iyi Excellent	K : Karot Numunesi / Core Sample

Figure A.29: Borehole log of S-51

APPENDIX A

TOKER

SONDAJ ve İNŞAAT LTD.ŞTİ.
DRILLING and CONSTRUCTION Co.

PROJE / PROJECT : MEER - GEMLİK BELEDİYESİ

Sondaj No / Boring No : S-51

Sayfa No / Sheet No : 2

STANDART
PENETRASYON DENEYİ
STANDARD
PENETRATION TEST

DERİNLİK DEPTH (m)	KAROT ve % si CORE % RECOVERY	R.Q.D. %	NUMUNE NO SAMPLE NO	NUMUNE DERİNLİĞİ SAMPLE DEPTH from to	ZEMİN TANIMLAMASI SOIL DESCRIPTION	ZEMİN PROFİLİ SOIL PROFILE	DAYANIKLILIK STRENGTH	AYRIMA WEATHERING	KIRIK / 30 cm FRACTURE/30 cm	KIRIK AÇISI FRACTURE ANGLE	SU KAYBI WATER LOSS %	STANDART PENETRASYON DENEYİ STANDARD PENETRATION TEST					
												Darbe Sayısı No. of Blows			N ₃₀	GRAFİK / GRAPH	
												0-15	15-30	30-45			
16			UD-3	15.00-15.40	SİLTLİ KİL; gri, yer yer kil bantları içermekte, çok yumuşak-yumuşak.												
			SPT-10	15.40-15.85								1	0	1	1		
17			SPT-11	16.50-16.95	Silty CLAY; gray; occasionally contains clay bands, very soft, soft.												
												1	1	1	2		
18					18.00												
			UD-4	18.00-18.40													
			SPT-12	18.40-18.85								1	0	1	1		
20			SPT-13	19.50-19.95													
												1	1	1	2		
22			UD-5	21.00-21.40													
			SPT-14	21.40-21.85									1	2	1	3	
23			SPT-15	22.50-22.95	KİL; gri, yeşilimsi gri renkli, doğgun, yer yer ince silt mercekleri içermekte, çok yumuşak-o.katı.												
												2	2	2	4		
24					CLAY; gray, greenish gray, saturated, occasionally contains thin silt lenses, v.soft-m.stiff.												
			UD-6	24.00-24.40													
			SPT-16	24.40-24.85								1	0	1	1		
26			SPT-17	25.50-25.95													
												1	2	2	4		
28			UD-7	27.00-27.40													
			SPT-18	27.40-27.85									2	2	3	5	
29			SPT-19	28.50-28.95													
												1	2	3	5		
31			UD-8	30.00-30.50	30.50												
			SPT-20	30.50-30.95									8	10	12	22	
32			SPT-21	31.50-31.95	Siltli KİL; yeşil, yer yer çakıllı ile 3300-3345m arasında az kumlu çakıl bandı içermekte; katı, çok katı.												
												8	8	6	14		
33					Silty CLAY; green, occasionally with some gravel, contains sandy gravel band between 3300-3345m, stiff, v.stiff.												
			SPT-22	33.00-33.45									14	15	8	23	
35			SPT-23	34.50-34.95													
												9	11	13	24		

Figure A.29: (cont.)

EMRE SONDAJ					SONDAJ LOGU		SONDAJ METODU		SONDAJ NO : S 4			
PROJE ADI GEMLİK BELEDİYESİ SONDAJ YERİ 11 EYLÜL İ.Ö.O. Y.A.S. SEVİYESİ 1,01 m BAŞLAMA TARİHİ 31.07.2000 BİTİŞ TARİHİ 02.08.2000							ROTARY		SAYFA NO : 1			
							MUHAFAZA BORUSU (15)		METREDİR			
							SONDAJ MAKİNASI		LONG YEAR			
							SONDÖRÜN ADI SOYADI		Yılmaz GEREK			
							LOGU HAZIRLAYAN		Jeo.Müh. Edip ADANALI			
							SONDAJ MÜHENDİSİ		Jeo.Müh. Serdar ÖZKAŞ			
KUYU ÇAPI (mm)	KUYU İÇİ DENEYİ	TCR % ROD %	NUMUNE	DERİNLİK m.	FORMASYON ÖZELLİKLERİ (Tanım, renk, kıvam, sıklık, nemlilik, yeraltı suyu durumu)	ZEMİN PROFİLİ	SPT DENEYİ			STANDART PENETRASYON GRAFİĞİ		
							DARBE SAYISI			N Son 30 cm darbe sayısı		
					</							

Figure A.30: Borehole log of SE-4

EMRE SONDAJ					SONDAJ LOGU	SONDAJ METODU		SONDAJ NO : S 5						
PROJE ADI GEMLİK BELEDİYESİ SONDAJ YERİ ŞEREFİYE SOKAK (CAMI) Y.A.S. SEVİYESİ 1,20 m BAŞLAMA TARİHİ 03.07.2000 BİTİŞ TARİHİ 04.07.200						ROTARY		SAYFA NO : 1						
						MUHAFAZA BORUSU (10,50) METREDİR		HEPSİ (1) SAYFA						
								SONDAJ MAKİNASI LONG YEAR						
								SONDÖRÜN ADI SOYADI Yılmaz GEREK						
								LOGU HAZIRLAYAN Jeo.Müh. Edip ADANALI						
SONDAJ MÜHENDİSİ Jeo.Müh. Serdar ÖZKAŞ														
KUYU ÇAPİ (mm)	KUYU İÇİ DENEYİ	TCR % RQD %	NUMUNE	DERİNLİK m.	FORMASYON ÖZELLİKLERİ (Tanım, renk, kıvam, sıklık, nemlilik, yeraltı suyu durumu)	ZEMİN PROFİLİ	SPT DENEYİ			STANDART PENETRASYON GRAFİĞİ				
							DARBE SAYISI			N Son 30 cm darbe sayısı				
							0-15cm	15-30cm	30-45cm	10 20 30 40 50				
				1.00	Dolgu zemin									
				2.00										
	SPT		D1	3.00	Blok-çakıllı, kırmızı, beyaz, koyu gri, siyah renkli tutturulmamış çakıl			9	8	9				
				4.00										
	SPT		D2	5.00	Kırmızı, beyaz, koyu gri, siyah renkli, kumlu blok-çakıl			3	3	2				
				6.00										
	SPT		D3	7.00	Koyu gri renkli, kaba kumlu, yer yer beyaz (kuvars) içerikli			11	7	7				
				8.00										
				9.00	Blok - çakıl									
				10.00										
	SPT		D4	11.00	Koyu renkli yarı yuvarlak - köşeli ve beyaz renkli kuvars blok - çakıllı, kumlu, koyu gri renkli tutturulmamış silt			3	5	6				
				12.00										
	SPT		D5	13.00	Koyu renkli yarı yuvarlak köşeli, beyaz renkli kuvars blok - çakıllı siltli			6	5	5				
				14.00										
				15.00	Koyu gri renkli ince kum bloklu									
				16.00										
				17.00	Koyu gri - gri renkli bloklu-çakıllı killi silt									
				18.00	Bloklu-çakıllı killi silt									
				19.00	Kıyıcı somu									
KISALTMALAR TANIMI					SPT İNCE DANELİ ZEMİN TANIMI	SPT İRİ DANELİ ZEMİN TANIMI	(R Q D) KAYA KALİTESİ TANIMI							
SPT STANDART PENETRASYON DENEYİ					N: 0-5 ÇOK YUMUŞAK	N: 0-4 ÇOK GEYER	% 0-25 ÇOK ZAYIF							
P PRESİOMETRE DENEYİ					N: 5-9 YUMUŞAK	N: 5-10 GEYER	% 25-30 ZAYIF							
UD ÖRSELENMEMİŞ ZEMİN ÖRNEĞİ					N: 10-14 ORTA KATI	N: 11-20 ORTA BİĞİ	% 30-75 ORTA							
D ÖRSELENMİŞ ZEMİN ÖRNEĞİ					N: 15-18 KATI	N: 21-30 BİĞİ	% 75-90 İYİ							
K KAROT KAYA ÖRNEĞİ					N: 18-30 ÇOK KATI	N: >30 ÇOK BİĞİ	% 90-100 ÇOK İYİ							

Figure A.31: Borehole log of SE-5

EMRE SONDAJ					SONDAJ LOGU		SONDAJ METODU		SONDAJ NO : S 11	
PROJE ADI GEMLİK BELEDİYESİ SONDAJ YERİ MERKEZ POLİS KARAKOLU Y.A.S. SEVİYESİ 0,30 m BAŞLAMA TARİHİ 21.08.2000 BİTİŞ TARİHİ 23.08.2000							ROTARY		SAYFA NO : 1	
							MUHAFAZA BORUSU (18) METREDİR		HEPSİ (1) SAYFA	
							SONDAJ MAKİNASI		LONG YEAR	
							SONDÖRÜN ADI SOYADI		Yılmaz GEREK	
							LOGU HAZIRLAYAN		Jeo.Müh. Edip ADANALI	
					SONDAJ MÜHENDİSİ		Jeo.Müh. Serdar ÖZKAŞ			
KUYU ÇAPİ (mm)	KUYU İÇİ DENEYİ	TCR ROD %	NUMUNE	DERİNLİK m.	FORMASYON ÖZELLİKLERİ (Tanım, renk, kıvam, sıklık, nemlilik, yeraltı suyu durumu)	ZEMİN PROFİLİ	SPT DENEYİ		STANDART PENETRASYON GRAFİĞİ	
							DARBE SAYISI		N Son 30 cm darbe sayısı	
								0-15	15-30	30-45
								10	20	30
								40	50	
				1.00	Blok Zemin					
				2.00						
	SPT		D1	3.00	Koyu gri renkli az çakıllı ince kumlu silt		3	1	2	
				4.00						
	SPT		D2	5.00	Koyu gri renkli az çakıllı killi silt		1	1	4	
				6.00						
	SPT		D3	7.00			11	7	8	
				8.00						
				9.00						
				10.00						
				11.00						
	SPT		D4	12.00			5	7	10	
				13.00						
	SPT		D5	14.00			5	6	10	
				15.00						
	SPT		D6	16.00			5	6	8	
				17.00						
				18.00						
				19.00						
					Kuyu sonu					
KISALTMALAR TANIMI					SPT İNCE DANELİ ZEMİN TANIMI	SPT İRİ DANELİ ZEMİN TANIMI	(R Q D) KAYA KALİTESİ TANIMI			
SPT STANDART PENETRASYON DENEYİ					N : 0-3 ÇOK YUMUŞAK	N : 0-4 ÇOK GEVŞEK	% 0-25 ÇOK ZAYIF			
F PRESİOMETRE DENEYİ					N : 3-4 YUMUŞAK	N : 5-10 GEVŞEK	% 25-30 ZAYIF			
UD ÖRSELENMEMİŞ ZEMİN ÖRNEĞİ					N : 5-8 ORTA KATI	N : 11-30 ORTA BİKİ	% 30-75 ORTA			
D ÖRSELENMİŞ ZEMİN ÖRNEĞİ					N : 9-15 KATI	N : 31-50 BİKİ	% 75-90 İYİ			
K KAROT KAYA ÖRNEĞİ					N : 16-30 ÇOK KATI	N : >30 ÇOK BİKİ	% 90-100 ÇOK İYİ			
					N : >30 BERT					

Figure A.32: Borehole log of SE-11

EMRE SONDAJ						SONDAJ METODU		SONDAJ NO : E 12										
SONDAJ LOGU						ROTARY		SAYFA NO : 1										
						MUHAFAZA BORUSU (18) METREDİR		HEPSİ (1) SAYFA										
						SONDAJ MAKİNASI		LONG YEAR										
						SONDÖRÜN ADI SOYADI		Yılmaz GEREK										
PROJE ADI GEMLİK BELEDİYESİ						LOGU HAZIRLAYAN		Jeo.Müh. Edip ADANALI										
SONDAJ YERİ ESKİ ZEYTİN HALI						SONDAJ MÜHENDİSİ		Jeo.Müh. Serdar ÖZKAŞ										
Y.A.S. SEVİYESİ 1,05 m																		
BAŞLAMA TARİHİ 23.08.2000																		
BİTİŞ TARİHİ 24.08.2000																		
KUYU ÇAP (mm)	KUYU İÇİ DENEYİ	TCR %	RQD %	NUMUNE	DERİNLİK m.	FORMASYON ÖZELLİKLERİ (Tanım, renk, kıvam, sıklık, nemlilik, yeraltı suyu durumu)	ZEMİN PROFİLİ	SPT DENEYİ			STANDART PENETRASYON GRAFİĞİ							
								DARBE SAYISI			N Son 30 cm darbe sayısı							
								4-6 cm	6-10 cm	10-15 cm	10	20	30	40	50			
					1.00	Dolgu Zemin												
					2.00													
	SPT			D1	3.00			4	3	5								
	Shelby			U1		Yeşil renkli kil												
					4.00	Grimsi yeşil siltli kil												
	SPT			D2	5.00	Grimsi yeşil renkli kum		6	6	6								
					6.00													
	SPT			D3	7.00			4	3	3								
					8.00													
	SPT			D4	9.00			3	4	5								
					10.00	Koyu gri renkli organik kil (Bataklık kili)												
	SPT			D5	11.00			3	2	4								
					12.00													
	Shelby			U2	13.00													
					14.00													
					15.00	Kıyru sonu												
	Shelby			U3	16.00													
	Shelby			U4	17.00													
					18.00													
	SPT			D6	19.00			8	8	10								
KIRALTMALAR TANIMI						SPT İNCE DANELİ ZEMİN TANIMI		SPT İRİ DANELİ ZEMİN TANIMI		(R Q D) KAYA KALİTESİ TANIMI								
SPT STANDART PENETRASYON DEĞERİ						N: 0-5 ÇOK YUMUŞAK		N: 5-10 ÇOK GÜÇLÜ		N: 0-25 ÇOK ZAYIF								
P PRESİOMETRE DEĞERİ						N: 5-10 YUMUŞAK		N: 10-20 ORTA KATI		N: 25-50 ZAYIF								
UD ÖRSELENMİŞ ZEMİN ÖRNEĞİ						N: 10-20 ORTA KATI		N: 20-30 GÜÇLÜ		N: 50-75 ORTA								
D ÖRSELENMİŞ ZEMİN ÖRNEĞİ						N: 30-40 ÇOK KATI		N: 40-50 ÇOK GÜÇLÜ		N: 75-90 İYİ								
K KANOT KAYA ÖRNEĞİ						N: 50-60 ÇOK KATI		N: 60-70 ÇOK GÜÇLÜ		N: 90-100 ÇOK İYİ								

Figure A.33: Borehole log of SE-12

EMRE SONDAJ

EMRE SONDAJ

SONDAJ

LOGU

SONDAJ METODU

ROTARY

MUHAFAZA BORUSU (15) METREDİR

SONDAJ MAKİNASI LONG YEAR

SONDÖRÜN ADI SOYADI Yılmaz GEREK

LOGU HAZIRLAYAN Geo.Müh. Edip ADANALI

SONDAJ MÜHENDİSİ Geo.Müh. Serdar ÖZKAŞ

SONDAJ NO : S 14

SAYFA NO : 1

HEPSİ (1) SAYFA

PROJE ADI GEMLİK BELEDİYESİ

SONDAJ YERİ KUMLA YOLU ÜZERİ

Y.A.S. SEVİYESİ 0,51 m

BAŞLAMA TARİHİ 26.08.2000

BİTİŞ TARİHİ 28.09.2000

KUYU ÇAPİ (mm)	KUYU İÇİ DENEYİ	TCR	RQD %	NUMUNE	DERİNLİK m.	FORMASYON ÖZELLİKLERİ (Tanım, renk, kıvrım, sıklık, nemlilik, yeraltı suyu durumu)	ZEMİN PROFİLİ	SPT DENEYİ			STANDART PENETRASYON GRAFİĞİ									
								DARBE SAYISI												
								N=10cm	10-30cm	30-100cm	N	5	10	15	20	30	40	50		
						Nebati Toprak														
					1.00	Kahve renkli az çakıllı kumlu kil														
				2.00																
	Shelby			U1	3.00	Koyu gri mavi renkli yüksek plastisiteli kil														
					4.00															
	SPT			D1	5.00															
					6.00															
	Shelby			U2	7.00															
					8.00															
					9.00															
	SPT			D2	10.00															
					11.00															
	SPT			D3	12.00															
					13.00															
	SPT			D4	14.00															
					15.00															
	Shelby			U3	16.00															
					17.00															
	Shelby			U4	18.00															
					19.00															
						Kuyu Sonu														

KİSİLTİMLER TANIMI SPT STANDART PENETRASYON DENEYİ P PRESİOMETRE DENEYİ UD ÖRNEKLENMEZLİK ZEMİN ÖRNEĞİ D ÖRNEKLENMEZLİK ZEMİN ÖRNEĞİ K KAROT KAYA ÖRNEĞİ	SPT İNCE DANELİ ZEMİN TANIMI N : 0-3 ÇOK YUMUŞAK N : 3-4 YUMUŞAK N : 4-8 ORTA KATTI N : 8-15 KATTI N : 15-30 ÇOK KATTI N : >30 SERT	SPT İRİ DANELİ ZEMİN TANIMI N : 0-4 ÇOK YUMUŞAK N : 4-10 YUMUŞAK N : 10-30 ORTA SIKI N : 30-50 SIKI N : >50 ÇOK SIKI	(R Q D) KAYA KALİTESİ TANIMI % 0-25 ÇOK ZAYIF % 25-50 ZAYIF % 50-75 ORTA % 75-90 İYİ % 90-100 ÇOK İYİ
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Figure A.34: Borehole log of SE-14

EMRE SONDAJ					SONDAJ LOGU		SONDAJ METODU		SONDAJ NO : S 15					
PROJE ADI GEMLİK BELEDİYESİ SONDAJ YERİ ODUN DEPO - ILICASU Y.A.S. SEVİYESİ 0,80m BAŞLAMA TARİHİ 28.08.2000 BİTİŞ TARİHİ 29.08.2000							ROTARY		SAYFA NO : 1 HEPSİ (2) SAYFA					
							MUHAFAZA BORUSU (21) METREDİR							
							SONDAJ MAKİNASI LONG YEAR							
							SONDÖRÜN ADI SOYADI Yılmaz GEREK							
					LOGU HAZIRLAYAN Geo.Müh. Edip ADANALI									
					SONDAJ MÜHENDİSİ Geo.Müh. Serdar ÖZKAŞ									
KUYU ÇAPİ (mm)	KUYU İÇİ DENEYİ	TCR % RQD %	NUMUNE	DERİNLİK m.	FORMASYON ÖZELLİKLERİ (Tanım, renk, kıvam, sıklık, nemlilik, yeraltı suyu durumu)	ZEMİN PROFİLİ	SPT DENEYİ DARBE SAYISI			STANDART PENETRASYON GRAFİĞİ N Son 30 cm darbe sayısı				
							0-15cm	15-30cm	30-45cm	10	20	30	40	50
				1.00	Nehati Toprak									
				2.00	Dolgu Zemin									
	Shelby		U1	3.00										
				4.00										
	SPT		D1	5.00	Koyu yeşil renkli kum		1	2	2					
				6.00	Koyu yeşil renkli denizel bitki - hayvan fosilli organik kil									
	Shelby		U2	7.00										
				8.00										
				9.00										
	SPT		D2	10.00			12	14	16					
				11.00										
				12.00										
	SPT		D3	13.00			11	13	15					
				14.00										
				15.00										
	SPT		D4	16.00	Koyu yeşil renkli tutturulmamış kum		5	7	10					
				17.00										
				18.00	Koyu gri - yeşil renkli bloklu kum									
				19.00										
	SPT		D5				6	6	6					
KISALTMALAR TANIMI					SPT İNCE DANELİ ZEMİN TANIMI	SPT İRİ DANELİ ZEMİN TANIMI	(R Q D) KAYA KALİTESİ TANIMI							
SPT STANDART PENETRASYON DENEYİ					N: 0-3 ÇOK YUMUŞAK	N: 0-4 ÇOK GEYREK	% 0-25 ÇOK ZAYIF							
P PRESİOMETRE DENEYİ					N: 3-4 YUMUŞAK	N: 5-10 GEYREK	% 25-30 ZAYIF							
UD ÖRSELENMEMİŞ ZEMİN ÖRNEĞİ					N: 5-8 ORTA KATI	N: 11-20 ORTA BİKİ	% 30-75 ORTA							
D ÖRSELENMİŞ ZEMİN ÖRNEĞİ					N: 9-13 KATI	N: 31-50 BİKİ	% 75-90 İYİ							
K KAROT KAYA ÖRNEĞİ					N: 16-20 ÇOK KATI	N: >50 ÇOK BİKİ	% 90-100 ÇOK İYİ							
					N: >30 SEBİT									

Figure A.35: Borehole log of SE-15

EMRE SONDAJ				SONDAJ LOGU		SONDAJ METODU		SONDAJ NO : S 15							
						ROTARY		SAYFA NO : 2							
PROJE ADI GEMLİK BELEDİYESİ						MUHAFAZA BORUSU (21) METREDİR		HEPSİ (2) SAYFA							
SONDAJ YERİ ODUN DEPO - ILICASU						SONDAJ MAKİNASI LONG YEAR									
Y.A.S. SEVİYESİ 0,80 m						SONDÖRÜN ADI SOYADI Yılmaz GEREK									
BAŞLAMA TARİHİ 28.08.2000						LOGU HAZIRLAYAN Jeo.Müh. Edip ADANALI									
BİTİŞ TARİHİ 29.08.2000						SONDAJ MÜHENDİSİ Jeo.Müh. Serdar ÖZKAŞ									
KUYU ÇAPİ (mm)	KUYU İÇİ DENEY	TCR %	RQD %	NUMUNE	DERİNLİK m.	FORMASYON ÖZELLİKLERİ (Tanım, renk, kıvam, sıklık, nemlilik, yeraltı suyu durumu)	ZEMİN PROFİLİ	SPT DENEYİ			STANDART PENETRASYON GRAFİĞİ				
								DARBE SAYISI			N Son 30 cm darbe sayısı				
								0-10m	10-20m	20-30m	10	20	30	40	50
					21.00	Koyu yeşil renkli siltli denizel fosilli kil									
					22.00	Kuyu Sonu									
					23.00										
					24.00										
					25.00										
					26.00										
					27.00										
					28.00										
					29.00										
					30.00										
					31.00										
					32.00										
					33.00										
					34.00										
					35.00										
					36.00										
					37.00										
					38.00										
					39.00										
KISALTMALAR TANIMI						SPT İNCE DANELİ ZEMİN TANIMI		SPT İNİ DANELİ ZEMİN TANIMI		R Q D KAYA KALİTESİ TANIMI					
SPT STANDART PENETRASYON DENEYİ						N: 0-5 ÇOK YUMUŞAK		N: 5-10 ÇOK GİYEK		N: 0-25 ÇOK ZATIF					
P PRESİONMETRE DENEYİ						N: 5-10 YUMUŞAK		N: 10-20 ÇOK GİYEK		N: 25-30 ZATIF					
UD ÖRSELENMİŞ ZEMİN ÖRNEĞİ						N: 10-20 ORTA KATI		N: 20-30 ÇOK GİYEK		N: 30-75 ORTA					
D ÖRSELENMİŞ ZEMİN ÖRNEĞİ						N: 10-20 KATI		N: 30-75 ÇOK GİYEK		N: 75-90 İYİ					
K KAROT KAYA ÖRNEĞİ						N: 10-20 ÇOK KATI		N: 30-75 ÇOK GİYEK		N: 90-100 ÇOK İYİ					

Figure A.35: (cont.)

EMRE SONDAJ				SONDAJ LOGU		SONDAJ METODU		SONDAJ NO : S 17							
PROJE ADI GEMLİK BELEDİYESİ SONDAJ YERİ ŞEHİT ETHEM İ.Ö. YANI Y.A.S. SEVİYESİ 0,72 m BAŞLAMA TARİHİ 03.08.2000 BİTİŞ TARİHİ 01.09.2000						ROTARY		SAYFA NO : 1 HEPSİ (1) SAYFA							
						MUHAFAZA BORUSU (12.50) METREDİR									
						SONDAJ MAKİNASI LONG YEAR									
						SONDÖRÜN ADI SOYADI Yılmaz GEREK									
				LOGU HAZIRLAYAN Jeo.Müh. Edip ADANALI											
				SONDAJ MÜHENDİSİ Jeo.Müh. Serdar ÖZKAŞ											
KUYU ÇAPİ (mm)	KUYU İÇİ DENEY	TCR % ROD %	NUMUNE	DERİNLİK m.	FORMASYON ÖZELLİKLERİ (Tanım, renk, kıvam, sıklık, nemlilik, yeraltı suyu durumu)	ZEMİN PROFİLİ	SPT DENEYİ DARBE SAYISI			STANDART PENETRASYON GRAFİĞİ N Son 30 cm darbe sayısı 10 20 30 40 50					
				1.00	Dolgu Zemin										
				2.00											
	SPT		D1	3.00	Koyu gri renkli denizel fosilli organik kil		6	7	8						
				4.00											
	SPT		D2	5.00			2	4	4						
				6.00	Yer yer kum bantlı çakıllı, bloklu seri		5	7	7						
	SPT		D3	7.00											
				8.00			10	12	14						
				9.00	Yer yer kum bantlı çakıllı, bloklu seri		14	25	27						
	SPT		D5	10.00											
				11.00			21	20	25						
				12.00	Kuyu Sonu		22	24	11						
	SPT		D7	13.00											
				14.00											
				15.00											
				16.00											
				17.00											
				18.00											
				19.00											
KISALTMALAR TANIMI					SPT İNCE DANELİ ZEMİN TANIMI	SPT İRİ DANELİ ZEMİN TANIMI	(R Q D) KAYA KALİTESİ TANIMI								
SPT STANDART PENETRASYON DENEYİ					N : 0-3 ÇOK YUMUŞAK	N : 0-4 ÇOK GEYREK	% 0-25 ÇOK ZAYIF								
P PRESİOMETRE DENEYİ					N : 3-4 YUMUŞAK	N : 5-10 GEYREK	% 25-50 ZAYIF								
UD ÖRSELENMEMİŞ ZEMİN ÖRNEĞİ					N : 5-8 ORTA KATI	N : 11-20 ORTA SIKI	% 50-75 ORTA								
D ÖRSELENMİŞ ZEMİN ÖRNEĞİ					N : 9-18 KATI	N : 21-50 SIKI	% 75-90 İYİ								
K KAROT KAYA ÖRNEĞİ					N : 19-30 ÇOK KATI	N : >30 ÇOK SIKI	% 90-100 ÇOK İYİ								
					N : >30 SERT										

Figure A.36: Borehole log of SE-17

EMRE SONDAJ					SONDAJ LOGU		SONDAJ METODU		SONDAJ NO : S 19					
PROJE ADI GEMLİK BELEDİYESİ SONDAJ YERİ ÇEKİRGE SK HAYVAN PAZARI Y.A.S. SEVİYESİ 1,13 m BAŞLAMA TARİHİ 02.08.2000 BİTİŞ TARİHİ 03.08.2000							ROTARY		SAYFA NO : 1					
							MUHAFAZA BORUSU (21) METREDİR		HEPSİ (2) SAYFA					
							SONDAJ MAKİNASI LONG YEAR		SONDÖRÜN ADI SOYADI Yılmaz GEREK					
							LOGU HAZIRLAYAN		Jeo.Müh. Edip ADANALI					
							SONDAJ MÜHENDİSİ		Jeo.Müh. Serdar ÖZKAŞ					
KUYU ÇAP (mm)	KUYU İÇİ DENEY	TCR % RQD	NUMUNE	DERİNLİK m.	FORMASYON ÖZELLİKLERİ (Tanım, renk, kıvam, sıklık, nemlilik, yeraltı suyu durumu)	ZEMİN PROFİLİ	SPT DENEYİ			STANDART PENETRASYON GRAFİĞİ				
							DARBE SAYISI			N Son 30 cm darbe sayısı				
							4-10	10-15	15-20	10	20	30	40	50
				1.00	Dolgu Zemin									
				2.00										
	Shelby		U1	3.00										
				4.00	Koyu gri renkli az ince kumlu siltli kil									
				5.00										
	SPT		D1	6.00	Koyu gri seyrek çakıllı kum		17	10	8					
				7.00										
				8.00										
	Shelby		U2	9.00										
				10.00										
	Shelby		U3	11.00	Koyu gri renkli çakıllı kum									
				12.00										
	SPT		D2	13.00			6	12	16					
				14.00										
	SPT		D3	15.00			9	17	12					
				16.00										
				17.00	Koyu yeşil renkli yüksek plastisiteli denizel fosilli kil		2	3	3					
	SPT		D4	18.00										
				19.00										
	SPT		D5				3	3	3					
	SPT		D6				3	4	3					
KISALTMALAR TANIMI					SPT İNCE DANELİ ZEMİN TANIMI		SPT İRİ DANELİ ZEMİN TANIMI		(R Q D) KAYA KALİTESİ TANIMI					
SPT STANDART PENETRASYON DENEYİ					N : 0-3 ÇOK YUMUŞAK		N : 0-4 ÇOK GEYERK		% 0-25 ÇOK ZAYIF					
P PRESİOMETRE DENEYİ					N : 3-4 YUMUŞAK		N : 5-10 GEYERK		% 25-50 ZAYIF					
UD ÖRSELENMİŞ ZEMİN ÖRNEĞİ					N : 5-8 ORTA KATI		N : 11-30 ORTA SIKI		% 50-75 ORTA					
D ÖRSELENMİŞ ZEMİN ÖRNEĞİ					N : 9-15 KATI		N : 31-50 SIKI		% 75-90 İYİ					
K KAROT KAYA ÖRNEĞİ					N : 16-30 ÇOK KATI		N : >30 ÇOK SIKI		% 90-100 ÇOK İYİ					
					N : >30 SERT									

Figure A.37: Borehole log of SE-19

EMRE SONDAJ				SONDAJ LOGU		SONDAJ METODU		SONDAJ NO : S 19		
PROJE ADI GEMLİK BELEDİYESİ SONDAJ YERİ ÇEKİRGE SK HAYVAN PAZARI Y.A.S. SEVİYESİ 1,13 m BAŞLAMA TARİHİ 02.08.2000 BİTİŞ TARİHİ 03.08.2000						ROTARY		SAYFA NO : 2		
						MUHAFAZA BORUSU (21) METREDİR		HEPSİ (2) SAYFA		
						SONDAJ MAKİNASI LONG YEAR		SONDÖRÜN ADI SOYADI Yılmaz GEREK		
						LOGU HAZIRLAYAN Jco.Müh. Edip ADANALI		SONDAJ MÜHENDİSİ Jco.Müh. Serdar ÖZKAŞ		
KUYU ÇAP (mm)	KUYU İÇİ DENEYİ	TCR %	RQD %	NUMUNE	DERİNLİK m.	FORMASYON ÖZELLİKLERİ (Tanım, renk, kıvam, sıklık, nemlilik, yeraltı suyu durumu)	ZEMİN PROFİLİ	SPT DENEYİ DARBE SAYISI	STANDART PENETRASYON GRAFİĞİ	
	SPT				21.00	Koyu yeşil renkli yüksek plastisiteli denizel fosilli kil		3 3 3		
				D7	22.00					
	SPT			D8	23.00			2 4 4		
				D9	24.00					
	SPT			D10	25.00			2 2 2		
				D11	26.00					
	SPT				27.00		2 3 3			
					28.00	Kuyu Sonu	3 3 2			
					29.00					
					30.00					
					31.00					
					32.00					
					33.00					
					34.00					
					35.00					
					36.00					
					37.00					
					38.00					
					39.00					
KİSİTLERİN TANIMI				SPT İNCE DANELİ ZEMİN TANIMI		SPT İRİ DANELİ ZEMİN TANIMI		(R Q D) KAYA KALİTESİ TANIMI		
SPT STANDART PENETRASYON DENEYİ				N: 0-3 ÇOK YUMUŞAK		N: 0-4 ÇOK YUMUŞAK		% 0-25 ÇOK ZAYIF		
F FİRELEMEYİŞ ZEMİN ÖRNEĞİ				N: 5-6 YUMUŞAK		N: 5-10 ÇEVREK		% 25-30 ZAYIF		
UD ÖRSELENMİŞ ZEMİN ÖRNEĞİ				N: 6-8 ORTA KATI		N: 11-30 ORTA KATI		% 30-75 ORTA		
D ÖRSELENMİŞ ZEMİN ÖRNEĞİ				N: 9-15 KATI		N: 31-50 KATI		% 75-90 İYİ		
K KAYOT KAYA ÖRNEĞİ				N: 16-30 ÇOK KATI		N: >30 ÇOK KATI		% 90-100 ÇOK İYİ		

Figure A.37: (cont.)

EMRE SONDAJ

EMRE SONDAJ

SONDAJ LOGU

SONDAJ METODU

ROTARY

SONDAJ NO : S 36

SAYFA NO : 1

HEPSİ (1) SAYFA

MUHAFAZA BORUSU (3) METREDİR

SONDAJ MAKİNASI LONG YEAR

SONDÖRÜN ADI SOYADI Yılmaz GEREK

LOGU HAZIRLAYAN Jeo.Müh. Edip ADANALI

SONDAJ MÜHENDİSİ Jeo.Müh. Serdar ÖZKA

PROJE ADI GEMLIK BELEDİYESİ

SONDAJ YERİ ÇUKURBAHÇE-OKUL

Y.A.S. SEVİYESİ yok

BAŞLAMA TARİHİ 06.10.2000

BİTİŞ TARİHİ 07.10.2000

SONDAJ LOGU

SONDAJ METODU

ROTARY

SONDAJ NO : S 36

SAYFA NO : 1

HEPSİ (1) SAYFA

MUHAFAZA BORUSU (3) METREDİR

SONDAJ MAKİNASI LONG YEAR

SONDÖRÜN ADI SOYADI Yılmaz GEREK

LOGU HAZIRLAYAN Jeo.Müh. Edip ADANALI

SONDAJ MÜHENDİSİ Jeo.Müh. Serdar ÖZKA

KUYU ÇAP (mm)

KUYU İÇİ DENEY

TCR % RQD %

NÜMUNE

DERİNLİK m.

FORMASYON ÖZELLİKLERİ

(Tanım, renk, kıvam, sıklık, nemlilik, yeraltı suyu durumu)

ZEMİN PROFİLİ

SPT DENEYİ

DARBE SAYISI

STANDART PENETRASYON GRAFİĞİ

N Son 30 cm darbe sayın

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Figure A.38: Borehole log of SE-36

EMRE SONDAJ

SONDAJ

LOGU

EMRE SONDAJ

SONDAJ LOGU

SONDAJ METODU

ROTARY
SONDAJ NO : S 44

SAYFA NO : 1

HEPSİ (1) SAYFA

MUHAFAZA BORUSU (1,5)
METREDİR

SONDAJ MAKİNASI
LONG YEAR

SONDÖRÜN ADI SOYADI
Yılmaz GEREK

LOGU HAZIRLAYAN
Jeo.Müh. Edip ADANALI

SONDAJ MÜHENDİSİ
Jeo.Müh. Serdar ÖZKAŞ

PROJE ADI GEMLİK BELEDİYESİ

SONDAJ YERİ MEZARLIK KARŞISI

Y.A.S. SEVİYESİ yok

BAŞLAMA TARİHİ 14.10.2000

BİTİŞ TARİHİ 15.10.2000

KUYU ÇAPı (mm)	KUYU İÇİ DENEY	TCR % RQD %	NUMUNE	DERİNLİK m.
				1.00
	SPT		D1	2.00
				3.00
	SPT		D2	4.00
				5.00
	SPT		D3	6.00
				7.00
	SPT		D4	8.00
				9.00
	SPT		D5	10.00
				11.00
	SPT		D6	12.00
				13.00
	SPT		D7	14.00
				15.00
	SPT		D8	16.00
				17.00
				18.00
				19.00

Figure A.39: Borehole log of SE-44

APPENDIX B

Table B.1: Laboratory test results.

LABORATORY TEST RESULTS																	1 / 11
BOREHOLE ID	SAMPLE Name	SAMPLE DEPTH (m)	SPT N ₆₀	Unconf. Comp. Strength (kPa)	Void Ratio, (e)	W(n) (%)	γ _n (kN/m ³)	G(s)	ATTERBERG LIMITS			SIEVE ANALYSIS				GROUP SYMBOL (UCS)	
									LL	PL	PI	Percent passing from # Sieves					
												4	10	40	200		
S-4	SPT-1	1,50 - 1,95	7														
S-4	UD-1	3,00 - 3,35		24,9		31,3	18,99		25,9	18,2	7,7	100	99,2	98,6	77,3	CL	
S-4	SPT-2	3,35 - 3,80	1														
S-4	SPT-3	4,50 - 4,95	10			13,4			24,5	19,9	4,60	57,8	48,8	37,0	25,5	GC	
S-4	UD-2	6,00 - 6,40			1,212	46,1	17,32	2,63	39	20	19,0	100	100	97,9	96,3	CL	
S-4	SPT-4	6,40 - 6,85	2														
S-4	SPT-5	7,50 - 7,95	1			41,2			35,9	17,1	18,80	98,1	96,1	94,6	89,7	CL	
S-4	UD-3	9,00 - 9,35		27,5		37,5	18,49		37,3	19,6	17,7	100	99,7	98,5	95,6	CL	
S-4	SPT-6	9,35 - 9,80	8														
S-4	SPT-7	10,50 - 10,95	12			21,1			35	16,2	18,80	88,9	72,9	39,2	26,7	SC	
S-4	UD-4	12,00 - 12,20				13,4	21,83		29,3	15,5	13,8	86,3	65,8	44,1	25,7	SC	
S-4	SPT-8	12,20 - 12,65	22														
S-4	SPT-9	13,50 - 13,95	27														
S-4	UD-5	15,00 - 15,30			0,447	18,5	21,41	2,6	40,9	18,2	22,7	73,6	64	53,4	44,2	SC	
S-4	SPT-10	15,30 - 15,75	33														
S-4	SPT-11	16,50 - 16,95	33			19,1			41	17,1	23,90	96,2	88,9	74,1	62,3	CL	
S-4	UD-6	18,00 - 18,20				15,3	21,74		38	17,2	20,8	97,9	91,1	75,7	67,5	CL	
S-4	SPT-12	18,20 - 18,48	50/13														
S-4	SPT-13	19,50 - 19,75	50/10														
S-4	SPT-14	21,00 - 21,45	63														
S-4	SPT-15	22,50 - 22,90	50/10														
S-4	SPT-16	24,00 - 24,45	70			22,2			36,9	16,1	20,80	96,0	87,7	72,0	58,7	CL	
S-4	SPT-17	25,50 - 25,79	50/14			15,6			34,8	16,2	18,6	69,1	61,9	49,1	38,0	SC	
S-4	SPT-18	27,00 - 27,23	50/8														
S-4	SPT-19	28,50 - 28,79	50/14			18,3			34,4	13,9	20,50	96,3	88,8	75,9	69,5	CL	
S-4	SPT-20	30,00 - 30,08	50/8														
S-21	SPT-1	1,00 - 1,45	33														
S-21	UD-1	2,50 - 2,90				82,1	17,62		64	30,3	33,7	100	99,7	99,1	98,3	CH	
S-21	SPT-2	2,90 - 3,35	5														
S-21	SPT-3	4,00 - 4,45	8			16,2				N-P		83,2	50,6	25,5	14,5	SM	
S-21	SPT-4	5,50 - 5,95	16														
S-21	SPT-5	7,00 - 7,45	14			20,6				N-P		82,1	70,8	44,0	17,9	SM	
S-21	SPT-6	8,50 - 8,95	20														
S-21	SPT-7	10,00 - 10,45	18			22				N-P		82,5	80,3	39,7	13,3	SM	
S-21	SPT-8	11,50 - 11,95	5			28,2				N-P		87,4	85,5	70,2	42,0	SM	
S-21	UD-2	13,00 - 13,40			1,152	44,2	17,45	2,6	38,9	20,9	18	100	100	99,8	98,2	CL	
S-21	SPT-9	13,40 - 13,85	8														
S-21	SPT-10	14,50 - 14,95	6			41				N-P		100,0	100,0	99,2	87,9	ML	
S-21	UD-3	16,00 - 16,40			1,018	38,6	17,97	2,62	43,8	19,4	24,4	100	100	100	99,1	CL	
S-21	SPT-11	16,40 - 16,85	8														
S-21	SPT-12	17,50 - 17,95	6			40,1			42,4	21,2	21,2	100,0	100,0	99,9	99,0	CL	
S-21	UD-4	19,00 - 19,30		29,7		39,2	17,86		33,5	18,2	15,3	100	100	100	99	CL	
S-21	SPT-13	19,50 - 19,95	10														
S-21	SPT-14	20,50 - 20,95	8														
S-21	UD-5	22,00 - 22,50				40,8	17,59		46	21,6	24,4	100	100	100	99,5	CL	
S-21	SPT-15	22,50 - 22,95	6														
S-21	SPT-16	23,50 - 23,95	4														
S-21	UD-6	25,00 - 25,50				39,4			44,9	20,1	24,8	100	100	100	99,8	CL	
S-21	SPT-17	25,50 - 25,95	8														
S-21	SPT-18	26,50 - 26,95	7														
S-21	SPT-19	28,00 - 28,45	13			28,40			32,2	18,5	13,7	98,7	94,1	84,6	72,3	CL	
S-21	SPT-20	29,50 - 29,95	24														
S-22	SPT-1	1,00 - 1,45	8			33,00			35,4	17	18,4	98,2	96,7	91,2	78,3	CL	
S-22	UD-1	2,50 - 3,00				31,3	20,06			N-P		100	99,6	97	61,3	ML	
S-22	SPT-2	3,00 - 3,45	6														
S-22	SPT-3	4,00 - 4,45	5			34,50			30,5	19,1	11,4	89,9	87,1	79,0	67,2	CL	
S-22	SPT-4	5,50 - 5,95	7														
S-22	SPT-5	7,00 - 7,45	8			23,20				N-P		97,9	91,9	43,9	14,2	SM	
S-22	SPT-6	8,50 - 8,95	29														
S-22	SPT-7	10,00 - 10,45	24			28,50				N-P		99,1	97,9	27,0	16,7	SM	
S-22	SPT-8	11,50 - 11,95	30														
S-22	SPT-9	13,00 - 13,45	7														
S-22	SPT-10	14,50 - 14,95	26			18,50				N-P		96,2	86,8	54,3	19,2	SM	
S-22	SPT-11	16,00 - 16,45	15														
S-22	SPT-12	17,50 - 17,95	5			31,10			21,5	16,1	5,4	100,0	99,4	96,8	74,9	ML	
S-22	SPT-13	19,00 - 19,45	6														
S-22	UD-2	20,50 - 20,90			1,023	33,8	16,58	2,52	27,7	15,6	12,1	100	99,6	96,9	84,4	CL	
S-22	SPT-14	20,70 - 21,15	6														
S-22	SPT-15	22,00 - 22,45	9			41,50			44,3	16,5	27,8	100,0	100,0	99,7	98,7	CL	
S-22	UD-3	23,50 - 23,90				40,5	17,84		44,4	20,5	23,9	100	100	100	99,3	CL	
S-22	SPT-16	23,90 - 24,35	11														
S-22	SPT-17	25,00 - 25,45	6														
S-22	UD-4	26,50 - 26,90				38,8	18,09		47,7	22,3	25,4	99,5	98,5	96,1	94	CL	
S-22	SPT-18	26,90 - 27,35	7														
S-22	SPT-19	28,00 - 28,45	8														

APPENDIX B

Table B.1: (cont.)

LABORATORY TEST RESULTS																2 / 11
BOREHOLE ID	SAMPLE Name	SAMPLE DEPTH (m)	SPT N ₃₀	Unconf. Comp. Strength (kPa)	Void Ratio, (e)	W(n) (%)	γ _n (kN/m ³)	G(s)	ATTERBERG LIMITS			SIEVE ANALYSIS				GROUP SYMBOL (UCS)
									LL	PL	PI	Percent passing from # Sieves				
												4	10	40	200	
S-22	UD-5	29.50 - 29.90				28.0			39.6	20.9	18.7	87.5	62.8	38.1	27.4	SC
S-22	SPT-20	29.90 - 30.35	19													
S-23	SPT-1	1.00 - 1.45	19													
S-23	UD-1	2.50 - 3.00				21.3	20.15		43.8	19.9	23.9	98	94.5	87.7	81.8	CL
S-23	SPT-2	3.00 - 3.45	14													
S-23	SPT-3	4.00 - 4.45	6			25.70			38.8	19.5	19.3	98.7	978.7	93.1	82.0	CL
S-23	UD-2	5.50 - 6.00			0.636	24.9	20.03	2.63	42.1	18.1	24	98.5	96.5	91.1	82.9	CL
S-23	SPT-4	6.00 - 6.45	15													
S-23	SPT-5	7.00 - 7.45	19			14.60				N-P		81.1	64.0	27.6	14.1	SM
S-23	SPT-6	8.50 - 8.95	13			26.20				N-P		91.2	84.4	70.6	30.0	SM
S-23	SPT-7	10.00 - 10.45	8													
S-23	SPT-8	11.50 - 11.95	8													
S-23	SPT-9	13.00 - 13.45	6			21.30				N-P		89.9	63.5	33.0	12.9	SM
S-23	SPT-10	14.50 - 14.95	4													
S-23	SPT-11	16.00 - 16.45	6			22.50				N-P		99.1	89.4	54.3	24.2	SM
S-23	SPT-12	17.50 - 17.95	5													
S-23	SPT-13	19.00 - 19.45	4													
S-23	SPT-14	20.50 - 20.95	7			28.70			37.9	17.7	20.2	100.0	99.9	97.4	91.2	CL
S-23	SPT-15	22.00 - 22.45	7													
S-23	UD-3	23.50 - 23.90		26.9		21.4	18.24			N-P		99.6	97.9	92.2	29.8	SM
S-23	SPT-16	23.90 - 24.35	19													
S-23	SPT-17	25.00 - 25.45	15													
S-23	UD-4	26.50 - 26.90			0.800	34.0	19.85	2.65	44.6	20.3	24.3	98.9	95.7	88.7	81.2	CL
S-23	SPT-18	26.90 - 27.35	26													
S-23	UD-5	28.00 - 28.50		85.3		22.2	20.38		38.9	18.8	20.1	90.7	77.5	56.2	41	SC
S-23	SPT-19	28.50 - 28.95	28			28.10			41.9	16.5	25.4	93.9	85.1	73.0	65.1	CL
S-23	SPT-20	30.00 - 30.45	25													
S-24	SPT-1	1.00 - 1.45	10			25.10			45.7	19.6	26.1	98.8	96.8	93.2	89.2	CL
S-24	SPT-2	2.90 - 3.35	20			10.20				N-P		38.3	27.8	18.8	12.5	GM
S-24	SPT-3	4.00 - 4.45	11													
S-24	SPT-4	5.50 - 5.95	16			18.60				N-P		78.1	66.2	26.0	14.0	SM
S-24	SPT-5	7.00 - 7.45	16													
S-24	SPT-6	8.50 - 8.95	16													
S-24	SPT-7	10.00 - 10.45	25													
S-24	SPT-8	11.50 - 11.95	8			25.10				N-P		100.0	99.4	84.5	23.0	SM
S-24	SPT-9	13.00 - 13.45	11													
S-24	SPT-10	14.50 - 14.95	10			29.90				N-P		100.0	99.9	97.3	67.6	ML
S-24	SPT-11	16.00 - 16.45	12													
S-24	UD-1	17.50 - 18.00				31.4			40.4	19.7	20.7	100	99.8	99.6	98.9	CL
S-24	SPT-12	18.00 - 18.45	5													
S-24	SPT-13	19.00 - 19.45	6			33.90			34	16.3	17.7	98.1	97.2	95.8	90.1	CL
S-24	UD-2	20.50 - 21.00			0.826	33.2	18.34	2.68	47.9	16.9	31	100	99.9	99.7	96.8	CL
S-24	SPT-14	21.00 - 21.45	8													
S-24	SPT-15	22.00 - 22.45	7													
S-24	UD-3	23.50 - 24.00		17.5	0.732	33.2	18.24	2.52	24.3	17.7	6.6	100	100	99.9	98.8	ML
S-24	SPT-16	24.00 - 24.45	8													
S-24	SPT-17	25.50 - 25.95	7			36.00			44.3	21.3	23	99.2	97.9	95.2	89.2	CL
S-24	UD-4	27.00 - 27.50				31.2			49.6	22.5	27.1	100	99.7	97.6	96.2	CL
S-24	SPT-18	27.50 - 27.95	12													
S-24	SPT-19	28.50 - 28.95	21			22.30				N-P		93.5	71.6	27.2	13.9	SM
S-24	SPT-20	29.50 - 29.95	59													
S-24	SPT-21	30.00 - 30.24	50/14													
S-25	SPT-1	1.50 - 1.95	3			19			31.7	17.7	14	90.0	77.7	59.1	37.5	SC
S-25	UD-1	3.00 - 3.30				23.7			27.5	17.7	9.8	99.4	96.1	84.6	63.2	CL
S-25	SPT-2	3.30 - 3.75	4													
S-25	SPT-3	4.50 - 4.95	6			30.1				N-P		99.1	98.4	90.0	73.5	ML
S-25	UD-2	6.00 - 6.40				16.7	21.18	2.52	23.6	13.6	10	63.9	55.2	26.2	12.2	SC
S-25	SPT-4	6.40 - 6.85	10													
S-25	SPT-5	7.50 - 7.95	17			10.8				N-P		71.3	46.6	22.5	12.7	GM
S-25	SPT-6	9.00 - 9.45	12			21.8			33.7	20.1	13.6	68.4	57.0	52.0	26.9	SC
S-25	SPT-7	10.50 - 10.95	23													
S-25	SPT-8	12.00 - 12.45	10			17				N-P		80.9	62.5	43.4	19.8	SM
S-25	SPT-9	13.50 - 13.95	4			32.6			29.6	18.2	11.4	100.0	97.8	94.6	77.9	CL
S-25	UD-3	15.00 - 15.40			1.018	37.3	13.58	2.7	53.1	25.7	27.4	99.3	89.4	68.7	58	CH
S-25	SPT-10	15.40 - 15.85	4													
S-25	SPT-11	16.50 - 16.95	5													
S-25	UD-4	18.00 - 18.40				27.9	19.58			N-P		100	97.9	93	30.7	SM
S-25	SPT-12	18.40 - 18.85	8													
S-25	SPT-13	19.50 - 19.95	8													
S-25	SPT-14	21.00 - 21.45	6			35.8			38.6	19	19.6	100.0	100.0	99.1	94.7	CL
S-25	UD-5	22.50 - 22.80		53.9		34.6	18.59		39.1	18.9	20.2	100	99.8	97.6	94.8	CL
S-25	SPT-15	22.80 - 23.25	3													
S-25	SPT-16	24.00 - 24.45	6			38.1			46.5	24	22.5	100.0	99.9	97.1	94.3	CL
S-25	UD-6	25.50 - 25.85			1.043	37.9	18.18	2.64	43.4	22.3	21.1	100	99	95.6	93.6	CL
S-25	SPT-17	25.85 - 26.30	7													

APPENDIX B

Table B.1: (cont.)

LABORATORY TEST RESULTS																	3 / 11
BOREHOLE ID	SAMPLE Name	SAMPLE DEPTH (m)	SPT N ₃₀	Unconf. Comp. Strength (kPa)	Void Ratio, (e)	W(n) (%)	γ _n (kN/m ³)	G(s)	ATTERBERG LIMITS			SIEVE ANALYSIS				GROUP SYMBOL (UCS)	
									LL	PL	PI	Percent passing from # Sieves					
												4	10	40	200		
S-25	SPT-18	27,00 - 27,45	9														
S-25	UD-7	28,50 - 28,80		84,8	1,223	38,5	18,43	2,66	45,2	21,1	24,1	100	97,8	96	93,9	CL	
S-25	SPT-19	28,80 - 29,25	12														
S-25	SPT-20	30,00 - 30,45	10														
S-26	SPT-1	3,00 - 3,45	13														
S-26	SPT-2	4,50 - 4,95	14			12,2				N-P		78,6	59,8	33,6	16,3	SM	
S-26	SPT-3	6,00 - 6,45	10			10,6				N-P		69,8	53,3	28,5	12,7	SM	
S-26	SPT-4	7,50 - 7,95	16														
S-26	SPT-5	9,00 - 9,45	15														
S-26	SPT-6	10,50 - 10,95	17														
S-26	SPT-7	12,00 - 12,45	17														
S-26	SPT-8	13,50 - 13,95	14			23,5				N-P		99,5	98,4	95,5	34,6	SM	
S-26	SPT-9	15,00 - 15,45	8														
S-26	SPT-10	16,50 - 16,95	11														
S-26	SPT-11	18,20 - 18,65	9														
S-26	SPT-12	19,20 - 19,65	7			30,7				N-P		100,0	100,0	92,7	49,6	SM	
S-26	UD-1	21,00 - 21,40				44,3	18,94		41,2	17,5	23,7	100	99,9	97,1	87,6	CL	
S-26	SPT-13	21,40 - 21,85	7														
S-26	SPT-14	22,50 - 22,95	6														
S-26	SPT-15	24,40 - 24,85	7														
S-26	SPT-16	25,50 - 25,95	6														
S-26	UD-3	27,00 - 27,35		53,2	1,096	48,2	17,99	2,6	39,5	16,9	22,6	100	100	100	99,5	CL	
S-26	SPT-17	27,35 - 27,80	8			37,5			43,1	19,1	24	100,0	100,0	100,0	98,9	CL	
S-26	SPT-18	28,50 - 28,95	8														
S-26	SPT-19	30,40 - 30,85	6														
S-27	SPT-1	1,50 - 1,95	7														
S-27	SPT-2	3,00 - 3,45	7														
S-27	SPT-3	4,50 - 4,95	2			25,6				N-P		79,2	74,9	60,6	21,1	SM	
S-27	SPT-4	6,00 - 6,45	2														
S-27	SPT-5	7,50 - 7,95	3														
S-27	SPT-6	9,00 - 9,45	5														
S-27	SPT-7	10,50 - 10,95	2														
S-27	SPT-8	12,00 - 12,45	6			54,1			32,3	15,1	17,2	100,0	99,4	97,5	78,5	CL	
S-27	SPT-9	13,50 - 13,95	6														
S-27	SPT-10	15,00 - 15,45	2														
S-27	UD-1	16,50 - 16,90				32,4	19,26			N-P		100	93,6	85	49	SM	
S-27	SPT-11	16,90 - 17,35	3														
S-27	SPT-12	18,00 - 18,45	3														
S-27	SPT-13	19,50 - 19,95	5														
S-27	SPT-14	21,50 - 21,95	9														
S-27	SPT-15	22,50 - 22,95	8			47,70			47,7	22,3	25,4	100,0	100,0	99,1	97,4	CL	
S-27	UD-3	24,00 - 24,50		12,6	1,252	48,2	16,73	2,65	43,4	23	20,4	100	99,8	96,8	93,2	CL	
S-27	SPT-16	24,50 - 24,95	10														
S-27	SPT-17	25,50 - 25,95	10														
S-27	SPT-18	27,50 - 27,95	11														
S-27	SPT-19	28,50 - 28,95	10														
S-27	UD-5	30,00 - 30,50				41,8			48,4	23,7	24,7	100	100	99,9	99,3	CL	
S-27	SPT-20	30,50 - 30,95	4														
S-29	SPT-1	1,50 - 1,95	8			31			48,5	21,6	26,9	100,0	99,0	94,3	90,4	CL	
S-29	UD-1	3,00 - 3,40				36,2	18,46		49,4	22,5	26,9	92,4	87	71,4	58,9	CL	
S-29	SPT-2	3,40 - 3,85	5														
S-29	SPT-3	4,50 - 4,95	7			50,8			42,9	25,8	17,1	86,4	77,7	67,3	54,6	CL	
S-29	SPT-4	6,00 - 6,45	18			11,4				N-P		60,1	45,6	24,3	14,6	GM	
S-29	UD-2	7,50 - 7,80		22,4	0,949	37,9	18,11	2,58	30,7	20,5	10,2	100	99,3	96,8	78,3	CL	
S-29	SPT-5	7,80 - 8,25	3														
S-29	SPT-6	9,00 - 9,45	4														
S-29	UD-3	10,50 - 11,00		25,7		26,5	18,99		31,4	17,3	14,1	100	100	99,7	77,9	CL	
S-29	SPT-7	11,00 - 11,45	3														
S-29	SPT-8	12,00 - 12,45	3			39,7			34,7	18,8	15,9	100,0	100,0	99,9	93,8	CL	
S-29	UD-4	13,50 - 13,90			1,211	42,6	18,8	2,62	40,4	20,7	19,7	100	100	100	98,4	CL	
S-29	SPT-9	13,90 - 14,35	4														
S-29	SPT-10	15,00 - 15,45	5														
S-29	UD-5	16,50 - 16,85				35,9	18,53		41,4	17,7	23,7	100	100	99,7	93,6	CL	
S-29	SPT-11	16,85 - 17,30	5														
S-29	SPT-12	18,00 - 18,45	4			39,6			37,1	18,4	18,7	100,0	100,0	99,9	95,5	CL	
S-29	UD-6	19,50 - 19,75			0,867	36,9	18,85	2,58	37	19,1	17,9	100	100	99,8	95,4	CL	
S-29	SPT-13	19,75 - 20,20	4														
S-29	SPT-14	21,00 - 21,45	5			40,1			39,8	18,1	21,7	100,0	99,9	99,7	96,0	CL	
S-29	UD-7	22,50 - 22,80		34,5		33,5	18,24		38,9	18,1	20,8	100	100	99,9	98,2	CL	
S-29	SPT-15	22,80 - 23,25	5														
S-29	SPT-16	24,00 - 24,45	5														
S-29	UD-8	25,50 - 26,00			1,007	35,3	17,4	2,59	35,7	19,7	16	100	99,3	97,6	94	CL	
S-29	SPT-17	26,00 - 26,45	4														
S-29	SPT-18	27,00 - 27,45	3			42,7			45,3	21,7	23,6	99,6	99,1	98,4	96,9	CL	
S-29	UD-9	28,50 - 29,00				37,8	18,03		49,2	19,9	29,3	100	100	100	99,8	CL	

APPENDIX B

Table B.1: (cont.)

LABORATORY TEST RESULTS															4 / 11	
BOREHOLE ID	SAMPLE Name	SAMPLE DEPTH (m)	SPT N ₃₀	Unconf. Comp. Strength (kPa)	Void Ratio, (e)	W(n) (%)	γ _n (kN/m³)	G(s)	ATTERBERG LIMITS			SIEVE ANALYSIS				GROUP SYMBOL (UCS)
									LL	PL	PI	Percent passing from # Sieves				
												4	10	40	200	
S-29	SPT-19	29.00 - 29.45	6													
S-29	SPT-20	30.00 - 30.45	3													
S-30	SPT-1	1.50 - 1.95	12													
S-30	UD-1	3.00 - 3.40				26,3	20,09		31,1	18	13,1	100	99	95,6	81,6	CL
S-30	SPT-2	3.40 - 3.85	6													
S-30	SPT-3	4.50 - 4.95	4													
S-30	UD-2	6.00 - 6.30				15,1				N-P		95,8	74	27,7	16	SM
S-30	SPT-4	6.30 - 6.75	26													
S-30	SPT-5	7.50 - 7.95	19													
S-30	SPT-6	9.20 - 9.65	29			12,20				N-P		74,1	51,2	25,3	16,5	SM
S-30	UD-3	10.50 - 10.90		33,4		36,6	18,36		31,2	16,4	14,8	100	99,8	98,6	84,3	CL
S-30	SPT-7	10.90 - 11.35	7													
S-30	SPT-8	12.00 - 12.45	4			43,00			44,9	20,7	24,2	100,0	100,0	99,5	96,1	CL
S-30	UD-4	13.50 - 13.90			0,836	32,3	17,52	2,57	32,7	18,9	13,8	100	100	99,4	84,9	CL
S-30	SPT-9	13.90 - 14.35	4													
S-30	SPT-10	15.00 - 15.45	4													
S-30	UD-5	16.50 - 16.90				43,7	17,46		49,5	19,2	30,3	100	100	99,8	99,2	CL
S-30	SPT-11	16.90 - 17.35	5													
S-30	SPT-12	18.00 - 18.45	6			45,80			46	20,6	25,4	100,0	100,0	99,9	99,6	CL
S-30	UD-6	19.50 - 19.80			1,140	42,0	17,53	2,64	45,2	20,8	24,4	100	99,9	99,4	96,9	CL
S-30	SPT-13	19.80 - 20.25	4													
S-30	SPT-14	21.00 - 21.45	5													
S-30	SPT-15	22.50 - 22.95	4			30,60			49,3	21,3	28	100,0	100,0	99,8	99,4	CL
S-30	UD-7	24.00 - 24.40		31,8		40,9	17,61		44,3	19,3	25	100	100	99,8	98,5	CL
S-30	SPT-16	24.40 - 24.85	6													
S-30	SPT-17	25.50 - 25.95	6													
S-30	UD-8	27.00 - 27.40		69,0	1,150	39,7	18,24	2,76	95,6	21,2	74,4	100	100	100	99,8	CH
S-30	SPT-18	27.40 - 27.85	3													
S-30	SPT-19	28.50 - 28.95	4			29,80			46,8	20,5	26,3	100,0	99,9	99,7	98,2	CL
S-30	SPT-20	30.00 - 30.45	4													
S-31	SPT-1	1.50 - 1.95	5													
S-31	UD-1	3.00 - 3.35		44,5		25,7	20,13		31	18,1	12,9	99,8	98,7	93,2	78,9	CL
S-31	SPT-2	3.35 - 3.80	4													
S-31	SPT-3	4.50 - 4.95	6			30,60			40,6	15,9	24,7	100,0	98,8	94,0	81,5	CL
S-31	SPT-4	6.00 - 6.45	37			11,90			21,8	16,9	4,9	61,2	49,6	36,2	28,7	GC
S-31	SPT-5	7.50 - 7.95	13			16,00				N-P		61,7	51,5	28,7	16,1	SM
S-31	SPT-6	9.00 - 9.45	18													
S-31	SPT-7	10.50 - 10.95	8													
S-31	UD-2	12.00 - 12.40			0,971	37,2	17,87	2,56	32	21,7	10,3	100	100	99,3	94,6	CL
S-31	SPT-8	12.40 - 12.85	9			27,40			31	20,4	10,6	100,0	100,0	99,6	88,4	CL
S-31	SPT-9	13.50 - 13.95	4													
S-31	UD-3	15.00 - 15.45		26,5		31,3	18,87		26,2	20,4	5,8	100	99,9	97,8	77,9	ML
S-31	SPT-10	15.45 - 15.90	6													
S-31	SPT-11	16.50 - 16.95	3													
S-31	SPT-12	18.40 - 18.85	4			30,80			34,6	17,7	16,9	100,0	100,0	99,6	88,7	CL
S-31	SPT-13	19.50 - 19.95	0													
S-31	UD-4	21.00 - 21.40			1,109	39,9	17,86	2,7	51,7	21,1	30,6	100	100	99,9	99,7	CH
S-31	SPT-14	21.40 - 21.85	2													
S-31	SPT-15	22.50 - 22.95	4			35,10			51,5	21,1	30,4	100,0	100,0	99,9	99,7	CH
S-31	UD-5	24.00 - 24.40				40,8	17,96		50,8	21,3	29,5	100	100	100	99,8	CH
S-31	SPT-16	24.40 - 24.85	3													
S-31	SPT-17	25.50 - 25.95	4													
S-31	UD-6	27.00 - 27.40			1,002	38,8	18,19	2,63	49,9	23,9	26	100	99,6	98,9	98	CL
S-31	SPT-18	27.40 - 27.85	4			36,80			49,4	21,3	28,1	100,0	100,0	99,7	99,1	CL
S-31	SPT-19	28.50 - 28.95	5													
S-31	UD-7	30.00 - 30.40				42,5	17,59		48,2	23	25,2	100	99,6	97,2	95,5	CL
S-31	SPT-20	30.40 - 30.85	7													
S-32	SPT-1	1.50 - 1.95	5			29,90			38,7	21	17,7	100,0	99,0	89,3	69,8	CL
S-32	UD-1	3.00 - 3.50				28,3	19,59		37,9	18,9	19	97	92,6	84,1	66,1	CL
S-32	SPT-2	3.50 - 3.95	4													
S-32	SPT-3	4.50 - 4.95	4			32,10			29,5	20,6	8,9	98,8	96,6	92,2	85,8	CL
S-32	UD-2	6.00 - 6.50		26,7	0,674	36,7	18,74	2,55	31,5	26,1	5,4	97,9	95	83,5	73,4	ML
S-32	SPT-4	6.50 - 6.95	16													
S-32	SPT-5	7.50 - 7.95	28			13,40			22,3	18	4,3	100,0	99,1	97,6	94,5	ML
S-32	SPT-6	9.00 - 9.45	16			13,70				N-P		49,1	41,6	30,6	14,8	GM
S-32	SPT-7	10.50 - 10.95	19			22,80				N-P		99,0	97,0	82,2	36,4	SM
S-32	SPT-8	12.00 - 12.45	18													
S-32	UD-3	13.50 - 13.90				25,9	17,9		35,3	17,6	17,7	99,8	99,7	99,5	94,2	CL
S-32	SPT-9	13.90 - 14.35	8													
S-32	SPT-10	15.00 - 15.45	8			33,80			26,7	15,2	11,5	100,0	99,5	98,5	86,3	CL
S-32	UD-4	16.50 - 16.90			0,873	44,4	19,42	2,51	27,5	15,4	12,1	100	100	100	99,4	CL
S-32	SPT-11	16.90 - 17.35	5													
S-32	SPT-12	18.00 - 18.45	6													
S-32	UD-5	19.50 - 20.00				36,6	17,84		43,4	18,7	24,7	100	100	99,9	99,3	CL
S-32	SPT-13	20.00 - 20.45	4													

APPENDIX B

Table B.1: (cont.)

LABORATORY TEST RESULTS																5 / 11	
BOREHOLE ID	SAMPLE Name	SAMPLE DEPTH (m)	SPT N ₃₀	Unconf. Comp. Strength (kPa)	Void Ratio, (e)	W(n) (%)	γ _n (kN/m ³)	G(s)	ATTERBERG LIMITS			SIEVE ANALYSIS				GROUP SYMBOL (UCS)	
									LL	PL	PI	Percent passing from # Sieves					
												4	10	40	200		
S-32	SPT-14	21.00 - 21.45	5														
S-32	UD-6	22.50 - 22.90				41,1	17,52		54,8	21,6	33,2	100	100	100	99,5	CH	
S-32	SPT-15	22.90 - 23.35	4														
S-32	SPT-16	24.00 - 24.45	5														
S-32	UD-7	25.50 - 25.80		30,0	0,986	38,0	17,86	2,7	54,9	21,1	33,8	100	100	99,6	98,5	CH	
S-32	SPT-17	25.80 - 26.25	4														
S-32	SPT-18	27.00 - 27.45	13			38,60			44,6	21,2	23,4	80,7	68,9	54,2	47,4	SC	
S-32	UD-8	28.50 - 29.00		39,7		45,9	16,35		60,9	26,1	34,8	100	97,5	93	90,3	CH	
S-32	SPT-19	29.00 - 29.45	10														
S-32	SPT-20	30.00 - 30.45	19			20,00				N-P		99,7	98,9	92,1	24,2	SM	
S-33	SPT-1	1.50 - 1.95	4														
S-33	UD-1	3.00 - 3.40				30,1			36,1	20,6	15,5	99,4	98,6	94,8	77,9	CL	
S-33	SPT-2	3.40 - 3.85	3														
S-33	SPT-3	4.50 - 4.95	4			23,70			42,9	19,1	23,8	100,0	99,0	97,8	94,9	CL	
S-33	UD-2	6.00 - 6.40		31,9		35,4	18,74		49	20,2	28,8	99,1	98,1	97	94,3	CL	
S-33	SPT-4	6.40 - 6.85	5														
S-33	SPT-5	7.50 - 7.95	6			45,40			63,7	25,2	38,5	100,0	98,5	97,4	96,5	CH	
S-33	UD-3	9.00 - 9.40		8,5		34,8	18,24		50,6	21,2	29,4	100	99	98,4	98	CH	
S-33	SPT-6	9.40 - 9.85	8														
S-33	SPT-7	10.50 - 10.95	4														
S-33	UD-4	12.00 - 12.40			0,987	33,0	16,96	2,5	29,5	21,1	8,4	100	99,8	98,3	81,5	CL	
S-33	SPT-8	12.40 - 12.85	5														
S-33	SPT-9	13.50 - 13.95	7			28,50			55,2	23	32	100,0	99,6	99,1	98,5	CH	
S-33	UD-5	15.00 - 15.50				39,6			35,7	17,4	18,3	100	100	99,9	99,5	CL	
S-33	SPT-10	15.50 - 15.95	3														
S-33	SPT-11	16.50 - 16.95	3														
S-33	UD-6	18.00 - 18.50		23,0	0,976	29,4	17,23	2,62	51,4	20,4	31	100	100	99,9	99,5	CH	
S-33	SPT-12	18.50 - 18.95	1														
S-33	SPT-13	19.50 - 19.95	2			27,30			39,6	18,5	21,1	100,0	100,0	100,0	99,8	CL	
S-33	UD-7	21.00 - 21.40				37,1			53,6	21,1	32,5	100	100	99,7	99,3	CH	
S-33	SPT-14	21.40 - 21.85	2														
S-33	SPT-15	22.50 - 22.95	3														
S-33	UD-8	24.00 - 24.50			1,074	41,6	17,09	2,57	46,4	17,6	28,8	100	100	100	99,8	CL	
S-33	SPT-16	24.50 - 24.95	4														
S-33	SPT-17	25.50 - 25.95	4			25,10			50,6	21,3	29,3	100,0	99,7	99,2	98,8	CH	
S-33	UD-9	27.00 - 27.50				42,4	17,59		48,8	20,4	28,4	100	99,1	95,1	92,4	CL	
S-33	SPT-18	27.50 - 27.95	6														
S-33	SPT-19	28.50 - 28.95	5			23,20			50,4	20,7	29,7	100,0	99,7	99,5	99,0	CH	
S-33	UD-10	30.00 - 30.50			1,117	39,0	17,71	2,59	46,3	20,2	26,1	100	100	99,7	98,9	CL	
S-33	SPT-20	30.50 - 30.95	7														
S-34	SPT-1	1.50 - 1.95	10			24,10			34,7	20	14,7	100,0	97,7	92,0	79,4	CL	
S-34	UD-1	3.00 - 3.30				24,7	19,78		36,9	20,8	16,1	97,9	95	90,6	78,6	CL	
S-34	SPT-2	3.30 - 3.75	8														
S-34	SPT-3	4.50 - 4.95	9			34,90			42,7	22,2	20,5	100,0	99,4	97,5	91,3	CL	
S-34	UD-2	6.00 - 6.50		28,9	1,617	69,8	16,35	2,57	27,1	19,7	7,4	100	95,9	92,1	87,8	CL	
S-34	SPT-4	6.50 - 6.95	4														
S-34	SPT-5	7.50 - 7.95	2			39,50			40,4	21,4	19	92,2	90,0	84,1	73,1	CL	
S-34	UD-3	9.00 - 9.50		17,2		69,5	15,09		56,1	25,6	30,5	100	99,8	98,2	96,2	CH	
S-34	SPT-6	9.50 - 9.95	8														
S-34	SPT-7	10.50 - 10.95	3														
S-34	UD-4	12.00 - 12.50			1,266	46,6	17,49	2,71	56,5	25,5	31	100	100	100	99,9	CH	
S-34	SPT-8	12.50 - 12.95	3														
S-34	SPT-9	13.50 - 13.95	3			45,70			54,2	22	32,2	100,0	100,0	98,2	93,8	CH	
S-34	UD-5	15.00 - 15.50				42,4	17,34		37	18,1	18,9	100	100	99,9	99,6	CL	
S-34	SPT-10	15.50 - 15.95	1														
S-34	SPT-11	16.50 - 16.95	2			43,90			41	17,6	23,4	100,0	100,0	99,6	98,2	CL	
S-34	UD-6	18.00 - 18.50			0,944	40,3	18,09	2,57	41,8	18,5	23,3	100	100	100	99,7	CL	
S-34	SPT-12	18.50 - 18.95	4														
S-34	SPT-13	19.50 - 19.95	1			44,70			40,2	19	21,2	100,0	99,5	98,2	97,3	CL	
S-34	UD-7	21.00 - 21.50		23,3		39,1	17,74		42,4	17,2	25,2	100	100	98,5	92,2	CL	
S-34	SPT-14	21.50 - 21.95	8														
S-34	SPT-15	22.50 - 22.95	6														
S-34	UD-8	24.00 - 24.50			0,802	35,1	19,55	2,6	37	19,1	17,9	100	98,6	97	91	CL	
S-34	SPT-16	24.50 - 24.95	5														
S-34	SPT-17	25.50 - 25.95	5														
S-34	UD-9	27.00 - 27.50				26,3	19,15		26,2	19,1	7,1	100	99,1	96	67,1	CL	
S-34	SPT-18	27.50 - 27.95	19														
S-34	SPT-19	28.50 - 28.95	12														
S-34	UD-10	30.00 - 30.50				15,6	20,46		28,9	14,4	14,9	62,9	51,9	39,4	29,2	SC	
S-34	SPT-20	30.50 - 30.95	14			15,90			26,3	13,9	12,4	86,1	76,2	65,6	50,5	CL	
S-35	SPT-1	1.50 - 1.95	15			6,50			23,7	16,8	6,9	84,8	66,7	42,5	26,9	SC	
S-35	UD-1	3.00 - 3.40				9,2			27,9	17,2	10,7	94,1	85,3	69,5	56,9	CL	
S-35	SPT-2	3.40 - 3.85	9														
S-35	SPT-3	4.50 - 4.95	14			8,20				N-P		79,9	68,3	50,3	25,8	SM	
S-35	UD-2	6.00 - 6.40		145,3	0,322	12,1	21,38	2,52	27,4	17,4	10	96,3	88,3	63	42,4	SC	

APPENDIX B

Table B.1: (cont.)

LABORATORY TEST RESULTS																6 / 11	
BOREHOLE ID	SAMPLE Name	SAMPLE DEPTH (m)	SPT N ₃₀	Unconf. Comp. Strength (kPa)	Void Ratio, (e)	W(n) (%)	γ _n (kN/m ³)	G(s)	ATTERBERG LIMITS			SIEVE ANALYSIS				GROUP SYMBOL (UCS)	
									LL	PL	PI	Percent passing from # Sieves					
												4	10	40	200		
S-35	SPT-4	6,40 - 6,85	35														
S-35	SPT-5	7,50 - 7,95	35			5,20			22,6	16,9	5,7	52,8	38,0	22,0	14,2	GC	
S-35	SPT-6	9,20 - 9,60	50/10														
S-35	SPT-7	10,50 - 10,95	56			7,70			25,9	15,9	10	62,4	54,9	32,8	14,8	SC	
S-35	SPT-8	12,10 - 12,55	53														
S-35	SPT-9	13,50 - 13,95	22														
S-35	SPT-10	15,30 - 15,75	26			7,10			22,7	15	7,7	63,3	52,4	39,7	27,1	SC	
S-35	SPT-11	16,50 - 16,95	26			10,60			26,1	19	7,1	79,8	66,7	51,6	36,6	SC	
S-35	SPT-12	18,00 - 18,45	23														
S-35	SPT-13	19,70 - 19,90	50/5														
S-35	SPT-14	21,00 - 21,05	50/5														
S-35	SPT-15	24,00 - 24,26	50/11														
S-35	SPT-16	25,50 - 25,95	41														
S-35	SPT-17	27,00 - 27,45	70			8,10			33,7	14,1	19,6	94,9	86,1	68,6	51,1	CL	
S-35	SPT-18	28,50 - 28,57	50/7														
S-35	SPT-19	30,00 - 30,45	61														
S-36	SPT-1	1,50 - 1,95	15														
S-36	UD-1	3,00 - 3,40				30,9	19,09		34,9	19,1	15,8	99,8	96,8	86,1	70,5	CL	
S-36	SPT-2	3,40 - 3,85	4														
S-36	SPT-3	4,50 - 4,95	4			31,00			28,2	17,2	11	91,7	86,6	75,8	54,9	CL	
S-36	UD-2	6,00 - 6,40			0,622	24,5	19,72	2,55	28,2	19,7	8,5	100	99,3	96,9	69,3	CL	
S-36	SPT-4	6,40 - 6,85	11														
S-36	SPT-5	7,50 - 7,95	5														
S-36	UD-3	9,00 - 9,30				20,4	20,7			N-P		95,5	84,9	32,5	14,1	SM	
S-36	SPT-6	9,30 - 9,75	12														
S-36	SPT-7	10,50 - 10,95	14			19,80				N-P		95,4	83,3	42,7	19,6	SM	
S-36	SPT-8	12,00 - 12,45	21														
S-36	SPT-9	13,50 - 13,95	6														
S-36	UD-4	15,00 - 15,40			1,062	40,5	17,94	2,64	46,7	20,8	25,9	100	99,9	96,4	93,1	CL	
S-36	SPT-10	15,40 - 15,85	4														
S-36	SPT-11	16,50 - 16,95	4			40,40			39,2	18,9	20,3	100,0	98,8	88,7	79,8	CL	
S-36	SPT-12	18,00 - 18,45	9			21,20			35,5	17,2	18,3	71,5	59,3	46,3	38,2	SC	
S-36	UD-5	19,50 - 19,70		90,8		16,4	19,67		30,6	22,2	8,4	70,9	61,5	48,3	38,1	SC	
S-36	SPT-13	19,70 - 20,15	12														
S-36	SPT-14	21,00 - 21,45	15														
S-36	SPT-15	22,50 - 22,95	22			10,70				N-P		58,1	33,0	19,0	13,0	GM	
S-36	SPT-16	24,20 - 24,65	23														
S-36	SPT-17	25,50 - 25,95	26														
S-36	SPT-18	27,30 - 27,75	26			18,50			35,6	15,6	20	76,8	72,3	62,7	51,6	CL	
S-36	SPT-19	28,50 - 28,95	26														
S-36	SPT-20	30,00 - 30,45	34			17,30			36,5	15,1	21,4	77,5	71,0	59,0	46,1	SC	
S-37	SPT-1	1,50 - 1,95	9			25,80			34,5	20,5	14	100,0	98,8	84,9	70,9	CL	
S-37	SPT-2	3,00 - 3,45	8														
S-37	SPT-3	4,50 - 4,95	3			34,20			33,5	15,1	18,4	99,7	98,1	88,5	80,4	CL	
S-37	UD-1	6,00 - 6,35			0,772	28,6	19,62	2,57	28,7	19,9	8,8	99,4	97,3	87,9	68,8	CL	
S-37	SPT-4	6,35 - 6,80	5														
S-37	SPT-5	7,50 - 7,95	9														
S-37	SPT-6	9,00 - 9,45	5														
S-37	SPT-7	10,50 - 10,95	6			29,70			29,1	18,1	11	99,0	96,6	91,4	81,5	CL	
S-37	UD-2	12,00 - 12,40				50,1	16,84		62,5	25,9	36,6	100	99,1	98,4	97,5	CH	
S-37	SPT-8	12,40 - 12,85	6														
S-37	SPT-9	13,50 - 13,95	5														
S-37	UD-3	15,00 - 15,40				30,5			31,2	18	13,2	100	100	99	91,5	CL	
S-37	SPT-10	15,40 - 15,85	20														
S-37	SPT-11	16,50 - 16,95	25			29,10			33,1	19,8	13,3	68,5	58,7	34,2	19,2	SC	
S-37	UD-4	18,00 - 18,30				40,0			32,7	19,3	13,4	100	97,9	95,2	89,6	CL	
S-37	SPT-12	18,30 - 18,75	23														
S-37	SPT-13	19,50 - 19,95	25			24,2			25,6	15,7	9,9	70,8	61,6	49,8	23,1	SC	
S-37	UD-5	21,00 - 21,35		94,1		30,1	18,85		49,2	20	29,2	99,2	95,4	91,5	86,3	CL	
S-37	SPT-14	21,35 - 21,80	15														
S-37	SPT-15	22,50 - 22,95	17			27,8			50	18,8	31,2	99,0	95,1	87,1	79,9	CH	
S-37	UD-6	24,00 - 24,25		271,5	0,523	18,5	21,18	2,62	43,1	17,5	25,6	100	96,4	86,8	76,7	CL	
S-37	SPT-16	24,25 - 24,70	15														
S-37	SPT-17	25,50 - 25,95	23														
S-37	SPT-18	27,00 - 27,45	68														
S-37	SPT-19	28,00 - 28,45	55														
S-37	SPT-20	30,00 - 30,09	50/9														
S-38	SPT-1	1,50 - 1,95	12														
S-38	SPT-2	3,00 - 3,45	9			20,9			28,9	16,9	12,6	71,8	59,2	47,2	32,0	SC	
S-38	SPT-3	4,50 - 4,95	11														
S-38	SPT-4	6,00 - 6,45	10			15,4			24,2	13,2	11	50,4	41,4	30,3	19,9	GC	
S-38	UD-1	7,50 - 8,00				36,2	17,9		43,1	20,1	23	100	99,6	92,1	84,9	CL	
S-38	SPT-5	8,00 - 8,45	9														
S-38	SPT-6	9,00 - 9,45	11			32,2			46,8	20,9	25,9	100,0	99,1	97,6	95,3	CL	
S-38	UD-2	10,50 - 10,90		57,3	0,910	33,7	18,98	2,68	51	22,1	28,9	100	99,7	99,2	99	CH	

APPENDIX B

Table B.1: (cont.)

LABORATORY TEST RESULTS																	7 / 11
BOREHOLE ID	SAMPLE Name	SAMPLE DEPTH (m)	SPT N ₃₀	Unconf. Comp. Strength (kPa)	Void Ratio, (e)	W(n) (%)	γ _n (kN/m ³)	G(s)	ATTERBERG LIMITS			SIEVE ANALYSIS				GROUP SYMBOL (UCS)	
									LL	PL	PI	Percent passing from # Sieves					
												4	10	40	200		
S-38	SPT-7	10.90 - 11.35	13														
S-38	SPT-8	12.00 - 12.45	7			32.9			36.4	18.1	18.3	100.0	98.1	87.7	75.5	CL	
S-38	SPT-9	13.75 - 14.20	25														
S-38	SPT-10	15.20 - 15.65	44			9.9				N-P		46.7	32.8	19.6	12.4	GM	
S-38	SPT-11	16.50 - 16.95	28														
S-38	SPT-12	18.00 - 18.45	39														
S-38	SPT-13	19.30 - 19.75	43			12.8				N-P		71.2	58.6	45.9	28.7	SM	
S-38	UD-3	21.00 - 21.40				33.3	18.03		30.5	20.6	9.9	100	99.8	97.9	79.3	CL	
S-38	SPT-14	21.40 - 21.85	17														
S-38	SPT-15	22.50 - 22.95	9														
S-38	UD-4	24.00 - 24.40			0.806	20.9	19.9	2.6	41.4	16.6	24.8	69.7	56.7	42.4	29.6	SC	
S-38	SPT-16	24.40 - 24.85	54														
S-38	SPT-17	25.50 - 25.95	56														
S-38	UD-5	27.00 - 27.50		27.8		25.8	19.62		29.3	18.5	10.8	98.9	96.7	82.4	54.4	CL	
S-38	SPT-18	27.50 - 27.95	14														
S-38	SPT-19	28.50 - 28.95	13														
S-38	SPT-20	30.00 - 30.45	22			27.1			39.2	22.4	16.8	93.9	90.8	87.3	82.7	CL	
S-39	SPT-1	1.00 - 1.45	18			23.6			32.5	17.8	14.7	74.3	67.8	58.5	48.0	SC	
S-39	SPT-2	2.00 - 2.45	14			12.9			25	18.5	6.5	60.5	52.3	40.8	33.3	SC	
S-39	UD-1	4.00 - 4.50				28.5			32.7	18.5	14.2	97.5	97.1	91.8	69.8	CL	
S-39	SPT-3	4.50 - 4.95	15														
S-39	SPT-4	5.50 - 5.95	2			32.1			34	18.2	15.8	100.0	97.9	88.5	77.2	CL	
S-39	UD-2	7.00 - 7.50			0.776	30.7	19.15	2.6	38.9	19.2	19.7	100	99.7	96.5	91.1	CL	
S-39	SPT-5	7.50 - 7.95	11														
S-39	SPT-6	8.50 - 8.95	10														
S-39	SPT-7	10.00 - 10.45	22			17.6			20.3	17.2	3.1	83.3	68.8	42.0	27.4	SC	
S-39	SPT-8	11.50 - 11.95	20														
S-39	SPT-9	13.00 - 13.45	16			22.3				N-P		99.8	98.8	62.3	22.6	SM	
S-39	SPT-10	14.50 - 14.95	8														
S-39	SPT-11	16.00 - 16.45	13			26.5				N-P		99.7	96.8	80.5	55.7	ML	
S-39	SPT-12	17.50 - 17.95	10														
S-39	SPT-13	19.00 - 19.45	12			23.5				N-P		97.9	94.0	69.0	39.9	SM	
S-39	UD-3	20.50 - 21.00				28.2	20.3			N-P		99.3	98.4	86.1	46.2	SM	
S-39	SPT-14	21.00 - 21.45	7														
S-39	SPT-15	22.00 - 22.45	13														
S-39	SPT-16	23.50 - 23.95	19			24.3				N-P		85.8	78.5	55.5	12.8	SM	
S-39	UD-4	25.00 - 25.50			1.491	52.9	16.24	2.63	44.4	18.4	26	100	98	87.3	80.9	CL	
S-39	SPT-17	25.50 - 25.95	22														
S-39	SPT-18	26.50 - 26.95	21														
S-39	UD-5	28.00 - 28.50				23.1			38.6	19.7	18.9	100	95.5	71.9	60.3	CL	
S-39	SPT-19	28.50 - 28.95	26														
S-39	SPT-20	30.00 - 30.28	50/13			17.1				N-P		58.9	51.8	29.2	15.4	SM	
S-40	SPT-1	1.50 - 1.95	4			28.1			31	18.9	12.1	95.1	90.5	79.8	58.1	CL	
S-40	UD-1	3.00 - 3.40				29.9	19.34		34.2	19.9	14.3	100	100	95.8	79.2	CL	
S-40	SPT-2	3.40 - 3.85	4														
S-40	SPT-3	4.50 - 4.95	5														
S-40	SPT-4	6.00 - 6.45	19			7.8				N-P		38.6	28.4	18.1	14.4	GM	
S-40	SPT-5	7.50 - 7.95	26														
S-40	SPT-6	9.00 - 9.45	17			12.9				N-P		72.8	47.6	22.3	13.1	GM	
S-40	SPT-7	10.50 - 10.95	18														
S-40	SPT-8	12.00 - 12.45	12			27.9			40.6	18.5	22.1	99.2	96.7	89.0	74.2	CL	
S-40	SPT-9	13.50 - 13.95	10														
S-40	UD-2	15.00 - 15.30			0.784	23.6	20.62	2.5		N-P		100	98.7	90.6	26.6	SM	
S-40	SPT-10	15.30 - 15.75	12														
S-40	SPT-11	16.50 - 16.95	18			28.3				N-P		100.0	97.3	88.1	52.4	ML	
S-40	UD-3	18.00 - 18.40				31.9			29.5	20.1	9.4	100	99.8	99.3	86.5	CL	
S-40	SPT-12	18.40 - 18.85	10														
S-40	SPT-13	19.50 - 19.95	8														
S-40	SPT-14	21.00 - 21.45	23			15.1			27.2	18.6	8.6	44.9	35.8	24.4	15.9	GC	
S-40	SPT-15	22.50 - 22.95	18														
S-40	SPT-16	24.00 - 24.45	24			19.2				N-P		77.1	62.6	37.3	15.8	SM	
S-40	SPT-17	25.50 - 25.95	19														
S-40	SPT-18	27.20 - 27.65	32														
S-40	SPT-19	28.50 - 28.95	31														
S-40	SPT-20	30.00 - 30.45	35														
S-41	SPT-1	1.50 - 1.95	11														
S-41	UD-1	3.00 - 3.35				27.1			37.6	16.3	21.3	100	99.7	97.9	86.1	CL	
S-41	SPT-2	3.35 - 3.80	10														
S-41	SPT-3	4.50 - 4.95	4			26.5			28.9	17.4	11.5	99.6	97.5	88.1	69.3	CL	
S-41	UD-2	6.00 - 6.30		31.2		26.5	19.5		30.9	16.9	14	100	99.9	94.6	66.9	CL	
S-41	SPT-4	6.30 - 6.75	7														
S-41	SPT-5	7.50 - 7.95	12														
S-41	UD-3	9.00 - 9.30			0.546	25.4	19.97	2.5	28.3	17.8	10.5	100	99.4	92.2	75.8	CL	
S-41	SPT-6	9.30 - 9.75	7														
S-41	SPT-7	10.50 - 10.95	5			33.6			34.2	16.5	17.7	98.7	98.5	97.4	91.3	CL	

APPENDIX B

Table B.1: (cont.)

LABORATORY TEST RESULTS																	8 / 11
BOREHOLE ID	SAMPLE Name	SAMPLE DEPTH (m)	SPT N ₃₀	Unconf. Comp. Strength (kPa)	Void Ratio, (e)	W(n) (%)	γ _n (kN/m ³)	G(s)	ATTERBERG LIMITS			SIEVE ANALYSIS				GROUP SYMBOL (UCS)	
									LL	PL	PI	Percent passing from # Sieves					
												4	10	40	200		
S-41	UD-4	12.00 - 12.40		101,0		23,1	20,13		33,6	15	18,6	100	97	87,3	65,5	CL	
S-41	SPT-8	12.40 - 12.85	10														
S-41	SPT-9	13.50 - 13.95	11														
S-41	UD-5	15.00 - 15.35			0,912	38	18,19	2,63	54,5	22,1	32,4	99,7	99,2	98,8	97,1	CH	
S-41	SPT-10	15.35 - 15.80	6														
S-41	SPT-11	16.50 - 16.95	6			33,5			37,8	19,3	18,5	100,0	99,9	98,8	93,7	CL	
S-41	UD-6	18.00 - 18.40				21,9	20,94			N-P		98,3	79	44,6	37,8	SM	
S-41	SPT-12	18.40 - 18.85	24														
S-41	SPT-13	19.50 - 19.95	38			10,1				N-P		48,4	34,4	20,3	13,4	GM	
S-41	SPT-14	21.00 - 21.45	15														
S-41	UD-7	22.50 - 22.85		54,2	1,273	49,9	16,6	2,61	50,1	24,7	25,4	100	97,7	95,1	92,6	CH	
S-41	SPT-15	22.85 - 23.30	16														
S-41	SPT-16	24.00 - 24.45	13			22,7			38,1	16,4	21,7	86,3	77,5	65,0	53,9	CL	
S-41	SPT-17	25.50 - 25.95	44														
S-41	SPT-18	27.00 - 27.45	42			13,9			24,6	18,8	5,8	79,3	67,4	43,1	34,5	SC	
S-41	SPT-19	28.50 - 28.95	66														
S-41	SPT-20	30.00 - 30.45	25			18,4			29,6	14,1	15,5	99,5	92,5	71,9	56,8	CL	
S-42	SPT-1	1.50 - 1.95	8			6,2			24,3	16,1	8,20	61,9	51,8	40,6	32,8	SC	
S-42	UD-1	3.00 - 3.30				16,5	20,46		45,5	19,6	25,9	80,9	69,7	50,8	39,5	SC	
S-42	SPT-2	3.30 - 3.75	9														
S-42	SPT-3	4.50 - 4.95	19														
S-42	SPT-4	6.00 - 6.45	29														
S-42	SPT-5	7.50 - 7.95	7			27,2			38,4	16,5	21,90	99,3	98,1	96,5	91,8	CL	
S-42	SPT-6	9.00 - 9.45	7														
S-42	UD-2	10.50 - 10.90		91,1	0,813	32,7	19,12	2,6	49	19,5	29,5	100	97,9	82,3	74,1	CL	
S-42	SPT-7	10.90 - 11.35	6														
S-42	SPT-8	12.00 - 12.45	11			28,5			48,1	18,7	29,40	90,6	86,0	74,6	63,9	CL	
S-42	SPT-9	13.50 - 13.95	15														
S-42	UD-3	15.00 - 15.30		233,5		20,7	20,59		47,3	18,8	28,5	87,4	79,3	64,8	55,9	CL	
S-42	SPT-10	15.30 - 15.75	38														
S-42	SPT-11	16.50 - 16.95	38														
S-42	SPT-12	18.00 - 18.45	21			14,6				N-P		57,7	40,2	26,6	19,8	GM	
S-42	SPT-13	19.50 - 19.95	5														
S-42	UD-4	21.00 - 21.30		1,385	25,7	19,83	2,58	37,6	17,6	20,0	100	97,8	86,4	65,3		CL	
S-42	SPT-14	21.30 - 21.75	6														
S-42	SPT-15	22.50 - 22.95	5														
S-42	SPT-16	24.00 - 24.45	22			20,9			63,2	17,1	46,10	85,3	74,2	62,2	50,4	CH	
S-42	UD-5	25.50 - 25.80				21,3			30,9	21,9	9,0	87,9	80,6	68,6	52,4	CL	
S-42	SPT-17	25.80 - 26.25	23														
S-42	SPT-18	27.00 - 27.45	23														
S-42	SPT-19	28.50 - 28.95	22														
S-42	SPT-20	30.00 - 30.45	68			6,8				N-P		49,9	39,2	30,6	21,6	GM	
S-43	SPT-1	1.50 - 1.95	16														
S-43	SPT-2	3.00 - 3.45	55			6,7			29,4	16,6	12,8	86,2	59,9	26,1	14,0	SC	
S-43	SPT-3	4.50 - 4.95	13														
S-43	SPT-4	6.30 - 6.75	31														
S-43	SPT-5	7.50 - 7.95	31														
S-43	SPT-6	9.20 - 9.65	14														
S-43	SPT-7	10.50 - 10.95	29														
S-43	SPT-8	12.00 - 12.45	14			14,2				N-P		64,7	53,1	32,4	18,4	SM	
S-43	UD-1	13.50 - 13.90		0,878	33,2	18,69	2,61	39,7	23,5	16,2	100	100	98,8	93,1		CL	
S-43	SPT-9	13.90 - 14.35	16			29,6			37	18,7	18,30	98,9	97,7	94,8	84,1	CL	
S-43	SPT-10	15.00 - 15.45	26														
S-43	UD-2	16.50 - 16.90		133,3		29,7	19,47		42,1	19,4	22,7	100	99,8	87,4	78,2	CL	
S-43	SPT-11	16.90 - 17.35	54														
S-43	SPT-12	18.00 - 18.45	76														
S-43	SPT-13	19.50 - 19.95	16			17,5				N-P		54,8	47,1	28,1	15,2	GM	
S-43	SPT-14	21.00 - 21.45	17														
S-43	SPT-15	22.50 - 22.95	16														
S-43	SPT-16	24.00 - 24.45	19			19,7			42,1	16,6	25,50	63,4	51,4	48,4	43,8	SC	
S-43	UD-3	25.50 - 25.90				26,6	19,75		46,8	21,1	25,7	100	97,7	92,6	84,2	CL	
S-43	SPT-17	25.90 - 26.35	12														
S-43	SPT-18	27.00 - 27.45	45														
S-43	SPT-19	28.50 - 28.95	39			8			25	16,4	8,60	66,2	49,3	30,6	20,4	GC	
S-43	SPT-20	30.00 - 30.45	34														
S-44	SPT-1	1.50 - 1.95	16														
S-44	UD-1	3.00 - 3.40				23,7	19,84		28,2	17,1	11,1	100	99,2	94,9	71,4	CL	
S-44	SPT-2	3.40 - 3.85	8														
S-44	SPT-3	4.50 - 4.95	9			26,7			37,3	18	19,30	98,1	96,1	90,9	74,3	CL	
S-44	SPT-4	6.00 - 6.45	34														
S-44	SPT-5	7.80 - 8.25	39			16,9			29,5	15,5	14	88,7	78,1	61,0	44,8	SC	
S-44	UD-2	9.00 - 9.45		0,615	27,7	20,26	2,57	37,9	17	20,9	98,8	97,2	90,2	76,5		CL	
S-44	SPT-6	9.45 - 9.90	12														
S-44	SPT-7	10.50 - 10.95	11			20			43	18	25	94,6	89,1	81,3	72,1	CL	
S-44	SPT-8	12.00 - 12.45	47														

APPENDIX B

Table B.1: (cont.)

LABORATORY TEST RESULTS															9 / 11	
BOREHOLE ID	SAMPLE Name	SAMPLE DEPTH (m)	SPT N ₃₀	Unconf. Comp. Strength (kPa)	Void Ratio, (e)	W(n) (%)	γ _n (kN/m ³)	G(s)	ATTERBERG LIMITS			SIEVE ANALYSIS				GROUP SYMBOL (UCS)
									LL	PL	PI	Percent passing from # Sieves				
												4	10	40	200	
S-44	SPT-9	13.50 - 13.95	34			10.2			25.7	15	10.70	52.9	37.6	24.1	14.7	GC
S-44	UD-3	15.00 - 15.50				24.1	19.72		36.9	18	18.9	93.9	89.9	76.6	67.4	CL
S-44	SPT-10	15.50 - 15.95	20													
S-44	SPT-11	16.50 - 16.95	22			14.7			29.5	19.1	10.4	89.5	75.4	46.1	40.5	SC
S-44	UD-4	18.00 - 18.35		66.3	0.853	29.1	19.11	2.66	44.8	19.3	25.5	92.3	85.9	76	65.7	CL
S-44	SPT-12	18.35 - 18.80	12													
S-44	SPT-13	19.50 - 19.95	23													
S-44	UD-5	21.00 - 21.40		299.9		18	21.26		45.9	17.5	28.4	95.8	91.6	78.6	63.6	CL
S-44	SPT-14	21.40 - 21.84	50/14													
S-44	SPT-15	22.50 - 22.90	50/10			16.6			41	17.2	23.80	92.5	87.1	75.9	67.8	CL
S-44	SPT-16	24.00 - 24.45	69													
S-44	SPT-17	25.50 - 25.64	50/14			12.9			35.4	17.7	17.70	65.8	53.4	35.2	25.8	SC
S-44	SPT-18	27.00 - 27.10	50/10													
S-44	SPT-19	28.50 - 28.58	50/8													
S-45	SPT-1	3.00 - 3.45	1													
S-45	SPT-2	4.50 - 4.95	24													
S-45	SPT-3	6.00 - 6.45	51			8				N-P		52.3	37.7	24.2	13.7	GM
S-45	SPT-4	7.50 - 7.95	12													
S-45	SPT-5	9.00 - 9.45	10													
S-45	SPT-6	10.50 - 10.95	19													
S-45	SPT-7	12.00 - 12.45	14													
S-45	SPT-8	13.50 - 13.95	22			25.2				N-P		99.5	97.3	80.5	22.1	SM
S-45	SPT-9	15.00 - 15.45	20													
S-45	SPT-10	16.50 - 16.95	17													
S-45	SPT-11	18.00 - 18.45	14													
S-45	SPT-12	19.50 - 19.95	14													
S-45	SPT-13	21.00 - 21.45	25													
S-45	SPT-14	22.50 - 22.95	15													
S-45	UD-1	24.00 - 24.40				24.9	21.34			N-P		100	92.5	75.6	34.2	SM
S-45	SPT-15	24.40 - 24.85	21			29.1			26	18.9	7.10	97.4	96.0	91.5	64.8	CL
S-45	SPT-16	25.50 - 25.95	23													
S-45	UD-2	27.00 - 27.40				30.6	21.18			N-P		100	93.6	81.7	37.5	SM
S-45	SPT-17	27.40 - 27.85	27													
S-45	SPT-18	28.50 - 28.95	24													
S-45	SPT-19	30.40 - 30.85	25													
S-46	SPT-1	1.50 - 1.95	9													
S-46	UD-1	3.00 - 3.30				21.1	21.5			N-P		95.8	90	55.4	34.7	SM
S-46	SPT-2	3.30 - 3.75	16													
S-46	SPT-3	4.50 - 4.95	8													
S-46	UD-2	6.00 - 6.30		42.7		21.3	19.12		37	20.8	16.2	85.1	75.2	56.7	39.9	SC
S-46	SPT-4	6.30 - 6.75	18													
S-46	SPT-5	7.50 - 7.95	36			10.4			26.6	17.5	9.1	69.0	56.6	40.7	27.3	SC
S-46	SPT-6	9.00 - 9.45	48													
S-46	SPT-7	10.50 - 10.95	53													
S-46	SPT-8	12.00 - 12.45	58			11.2			22.9	15.5	7.4	83.4	70.9	48.6	32.2	SC
S-46	SPT-9	13.50 - 13.95	54													
S-46	SPT-10	15.00 - 15.45	48													
S-46	SPT-11	16.50 - 16.95	54			8.7			24.1	15.5	8.6	80.2	71.6	54.6	37.6	SC
S-46	SPT-12	18.00 - 18.45	60													
S-46	SPT-13	19.50 - 19.95	60													
S-46	SPT-14	21.00 - 21.45	66													
S-46	SPT-15	22.50 - 22.95	70													
S-46	SPT-16	24.00 - 24.45	67													
S-46	SPT-17	25.50 - 25.55	50/5													
S-46	SPT-18	27.00 - 27.45	25													
S-46	SPT-19	28.50 - 28.95	29													
S-46	SPT-20	30.00 - 30.45	36													
S-51	SPT-1	1.50 - 1.95	7													
S-51	SPT-2	3.40 - 3.85	2													
S-51	SPT-3	4.50 - 4.95	4													
S-51	SPT-4	6.30 - 6.75	22			12.30				N-P		56.9	40.9	26.3	15.1	GM
S-51	SPT-5	7.50 - 7.95	11			33.60				N-P		100.0	99.0	85.8	46.6	SM
S-51	SPT-6	9.20 - 9.65	1													
S-51	SPT-7	10.50 - 10.95	8													
S-51	UD-2	12.00 - 12.30			1.631	56.5	16.46	2.61	42.9	20.2	22.7	100	99.6	99	93.5	CL
S-51	SPT-8	12.30 - 12.75	2													
S-51	SPT-9	13.50 - 13.95	3			41.70			39.7	19.4	20.3	100.0	100.0	99.7	97.9	CL
S-51	SPT-10	15.40 - 15.85	1													
S-51	SPT-11	16.50 - 16.95	2													
S-51	UD-4	18.00 - 18.40		32.5		49.0	16.98		47.5	23.3	24.2	100	100	99.6	99	CL
S-51	SPT-12	18.40 - 18.85	1													
S-51	SPT-13	19.50 - 19.95	2			50.80			39.3	19.6	19.7	100.0	100.0	99.7	99.1	CL
S-51	SPT-14	21.40 - 21.85	3													
S-51	SPT-15	22.50 - 22.95	4													
S-51	UD-6	24.00 - 24.40				42.3			48	23.7	24.3	100	99	95.4	89.3	CL

APPENDIX B

Table B.1: (cont.)

LABORATORY TEST RESULTS														10 / 11		
BOREHOLE ID	SAMPLE Name	SAMPLE DEPTH (m)	SPT N ₃₀	Unconf. Comp. Strength (kPa)	Void Ratio, (e)	W(n) (%)	γ _n (kN/m ³)	G(s)	ATTERBERG LIMITS			SIEVE ANALYSIS				GROUP SYMBOL (UCS)
									LL	PL	PI	Percent passing from # Sieves				
												4	10	40	200	
S-51	SPT-16	24,40 - 24,85	1													
S-51	SPT-17	25,50 - 25,95	4													
S-51	SPT-18	27,40 - 27,85	5													
S-51	SPT-19	28,50 - 28,95	5													
S-51	UD-8	30,00 - 30,50				59,7			43,8	22,7	21,1	99,6	98,7	98,1	97,4	CL
S-51	SPT-20	30,50 - 30,95	22													
SE-4	SPT-1	1,50 - 1,95	7			37,99			52	31,68	20,32					OL-M
SE-4	SPT-2	3,00 - 3,45	17									78,0	57,0	30,0	2,0	
SE-4	SPT-3	4,50 - 4,95	11									74,4	51,0	16,5	1,1	
SE-4	SPT-4	9,50 - 9,95	6			43,47			48,5	35,19	13,31					OL-ML
SE-4	SPT-5	10,50 - 10,95	7													
SE-4	SPT-6	12,00 - 12,45	6			45,05			57	41,7	15,3					OL-ML
SE-4	SPT-7	18,50 - 18,95	7			34,88			52,3	30,6	21,7					CH
SE-5	SPT-1	3,00 - 3,45	17									49,0	32,1	14,9	2,7	
SE-5	SPT-2	4,50 - 4,95	5									74,4	47,0	10,0	1,1	
SE-5	SPT-3	6,00 - 6,45	14													
SE-5	SPT-4	10,50 - 10,95	11									46,7	30,9	17,9	3,8	
SE-5	SPT-5	12,00 - 12,45	10									75,4	49,4	28,9	5,0	
SE-11	SPT-1	3,00 - 3,45	3													
SE-11	SPT-2	4,50 - 4,95	5													
SE-11	SPT-3	6,00 - 6,45	15													
SE-11	SPT-4	11,50 - 11,95	17									100,0	100,0	98,7	2,2	
SE-11	SPT-5	13,50 - 13,95	16									100,0	100,0	89,7	5,6	
SE-11	SPT-6	15,50 - 15,95	14									95,8	84,6	69,0	3,3	
SE-12	SPT-1	2,50 - 2,95	8													
SE-12	SPT-2	4,50 - 4,95	12									89,8	70,1	27,0	1,7	
SE-12	SPT-3	6,50 - 6,95	6									96,2	80,2	33,5	2,8	
SE-12	SPT-4	8,50 - 8,95	9									91,6	77,3	35,5	3,5	
SE-12	SPT-5	10,50 - 10,95	6			47,84			50,8	34,98	15,82					OL-ML
SE-12	UD-2	12,50 - 13,00				50,28			49,2	27,05	22,15					CL
SE-12	UD-4	16,00 - 16,50				53,24			43,1	32,25	10,85					OL-ML
SE-12	SPT-6	18,50 - 18,95	18			37,32			51,4	39,9	11,5					OL-ML
SE-14	UD-1	2,50 - 3,00				35,42			38,2	32,63	5,57					OL-ML
SE-14	SPT-1	4,00 - 4,45	7			29,7			38,5	29,32	9,18					OL-ML
SE-14	UD-2	5,50 - 6,00				43,61			52,64	36,04	16,36					OL-ML
SE-14	SPT-2	8,50 - 8,95	19									86,2	74,6	43,0	4,1	
SE-14	SPT-3	10,50 - 10,95	11									88,8	61,0	19,0	2,2	
SE-14	SPT-4	12,00 - 12,45	2			30,5			43	28,27	14,73					OL-ML
SE-14	SPT-5	13,50 - 13,95	2													
SE-14	UD-3	15,00 - 15,50				41,76			42	34,49	7,51					OL-ML
SE-15	UD-1	3,00 - 3,50										97,7	72,3	35,6	8,1	
SE-15	SPT-1	4,50 - 4,95	4			30			42	28,95	13,05					OL-ML
SE-15	SPT-2	9,00 - 9,45	30									96,3	85,1	44,0	2,0	
SE-15	SPT-3	12,00 - 12,45	28													
SE-15	SPT-4	15,00 - 15,45	17									92,7	85,8	55,0	0,6	
SE-15	SPT-5	19,00 - 19,45	12			30			44,5	34,12	10,38					OL-ML
SE-17	SPT-1	3,00 - 3,45	15			31			49	28,53	20,47					OL-ML
SE-17	SPT-2	4,50 - 4,95	8			40,4			48	33,33	14,67					OL-ML
SE-17	SPT-3	6,00 - 6,45	14									85,4	65,2	43,5	0,8	
SE-17	SPT-4	7,50 - 7,95	26													
SE-17	SPT-5	9,00 - 9,45	52									72,0	57,0	33,8	1,1	
SE-17	SPT-6	10,50 - 10,95	45									90,6	67,7	33,6	0,7	
SE-17	SPT-7	12,00 - 12,45	35													
SE-19	UD-1	3,00 - 3,50				31,24			44	30,44	13,56					OL-ML
SE-19	SPT-1	5,00 - 5,45	18									66,1	41,4	18,5	2,0	
SE-19	UD-2	8,00 - 8,50										100,0	100,0	85,4	2,0	
SE-19	SPT-2	12,00 - 12,45	28									70,6	56,7	30,6	1,2	
SE-19	SPT-3	13,50 - 13,95	29													
SE-19	SPT-4	16,50 - 16,95	6			45,86			43,9	35,35	8,55					OL-ML
SE-19	SPT-5	18,00 - 18,45	6													
SE-19	SPT-6	19,50 - 19,95	7													
SE-19	SPT-7	21,00 - 21,45	6			35,65			36,4	26,77	9,63					OL-ML
SE-19	SPT-8	22,50 - 22,95	8													
SE-19	SPT-9	24,00 - 24,45	4			44,02			40,1	31,07	9,03					OL-ML
SE-19	SPT-10	25,50 - 25,95	6													
SE-19	SPT-11	27,00 - 27,45	5													
SE-36	SPT-1	1,50 - 1,95	12													
SE-36	SPT-2	3,00 - 3,45	4													
SE-36	SPT-3	4,50 - 4,95	3													
SE-36	SPT-4	6,00 - 6,45	22													
SE-36	SPT-5	7,50 - 7,95	19													
SE-36	SPT-6	9,00 - 9,45	23													
SE-36	SPT-7	10,50 - 10,95	24													
SE-44	SPT-1	2,00 - 2,45	16													
SE-44	SPT-2	4,50 - 4,95	16													

Table B.1: (cont.)

LABORATORY TEST RESULTS														11 / 11			
BOREHOLE ID	SAMPLE Name	SAMPLE DEPTH (m)	SPT N ₃₀	Unconf. Comp. Strength (kPa)	Void Ratio, (e)	W(n) (%)	γ _n (kN/m ³)	G(s)	ATTEBERG LIMITS			SIEVE ANALYSIS				GROUP SYMBOL (UCS)	
									LL	PL	PI	Percent passing from # Sieves					
												4	10	40	200		
SE-44	SPT-3	6.00 - 6.45	15														
SE-44	SPT-4	7.50 - 7.95	21														
SE-44	SPT-5	9.00 - 9.45	24														
SE-44	SPT-6	10.50 - 10.95	55														
SE-44	SPT-7	12.00 - 12.45	44														
SE-44	SPT-8	14.50 - 14.95	37														

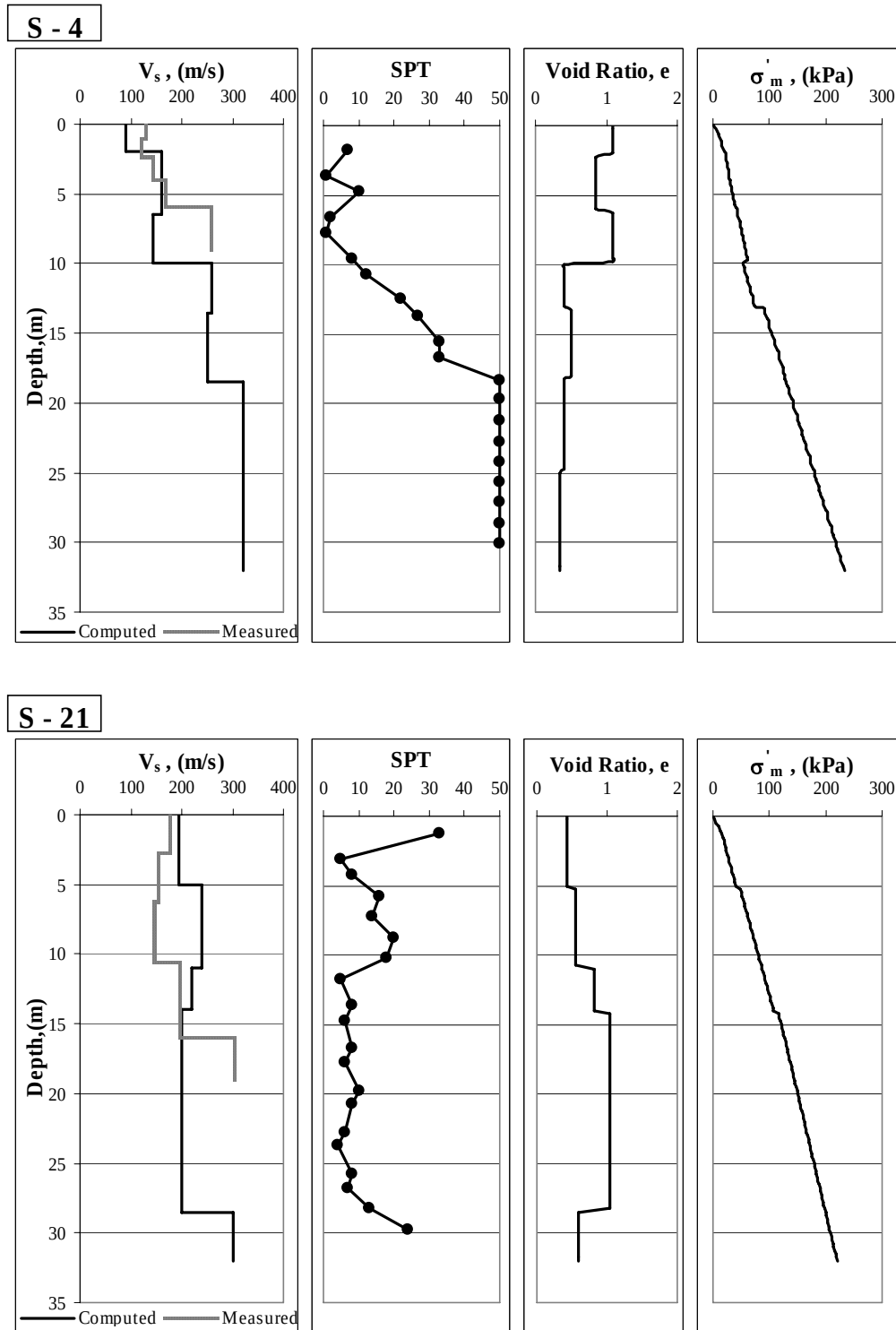
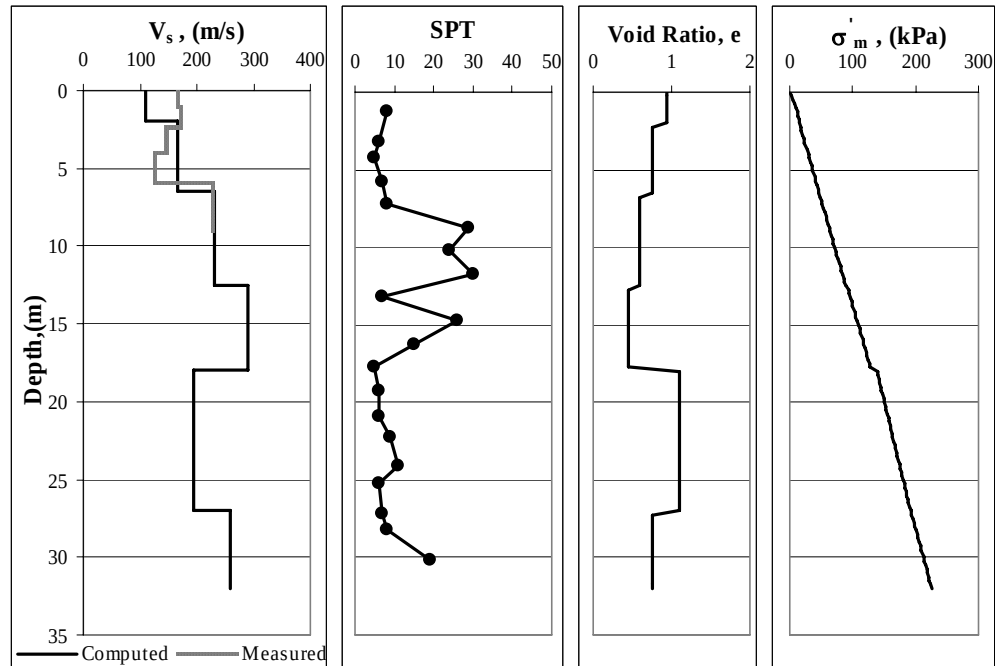
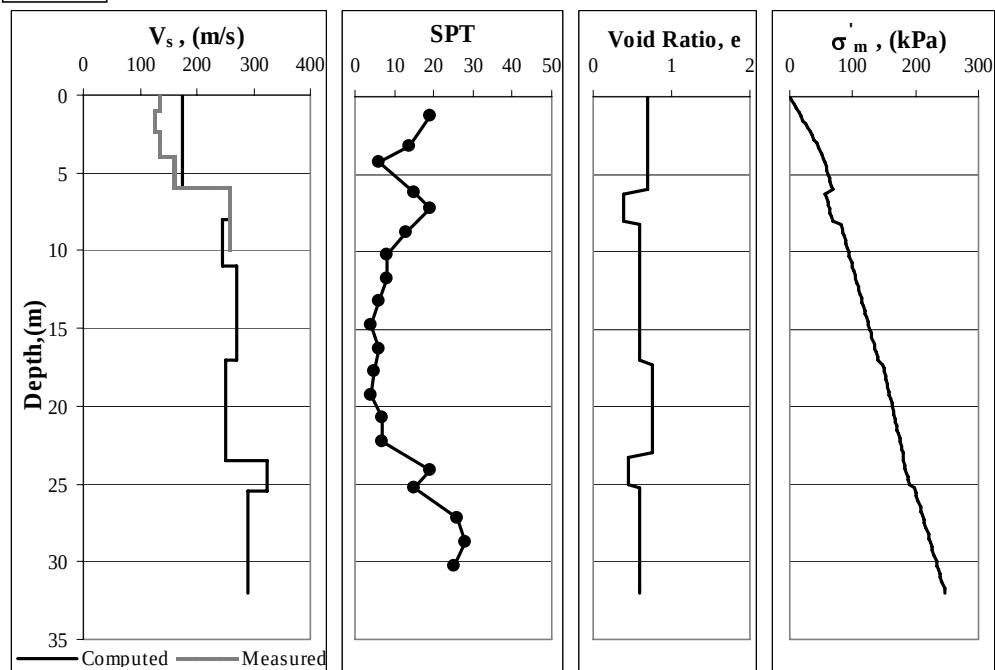
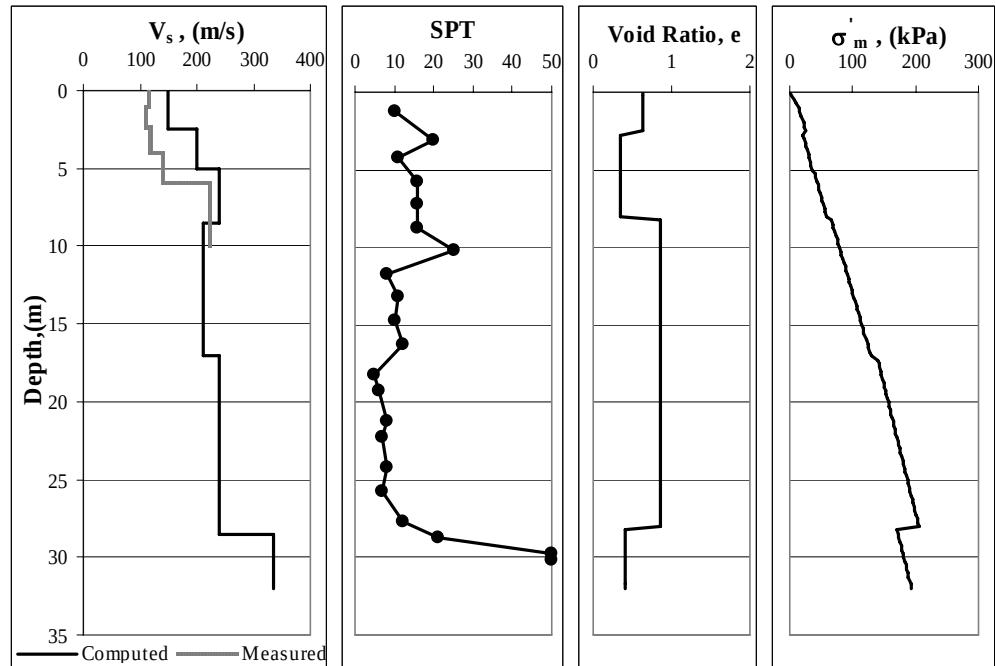
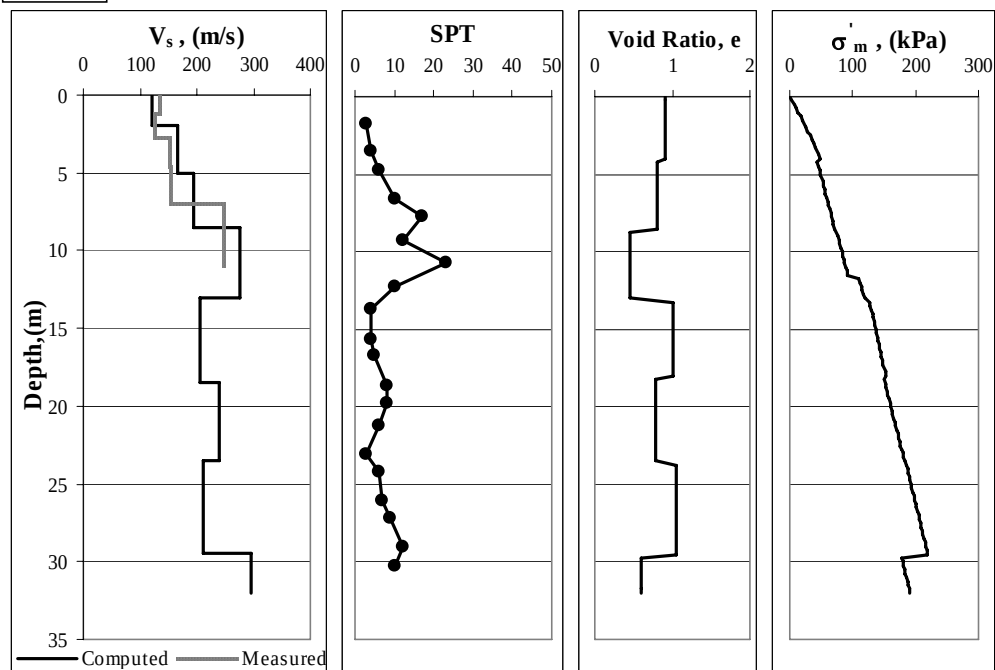
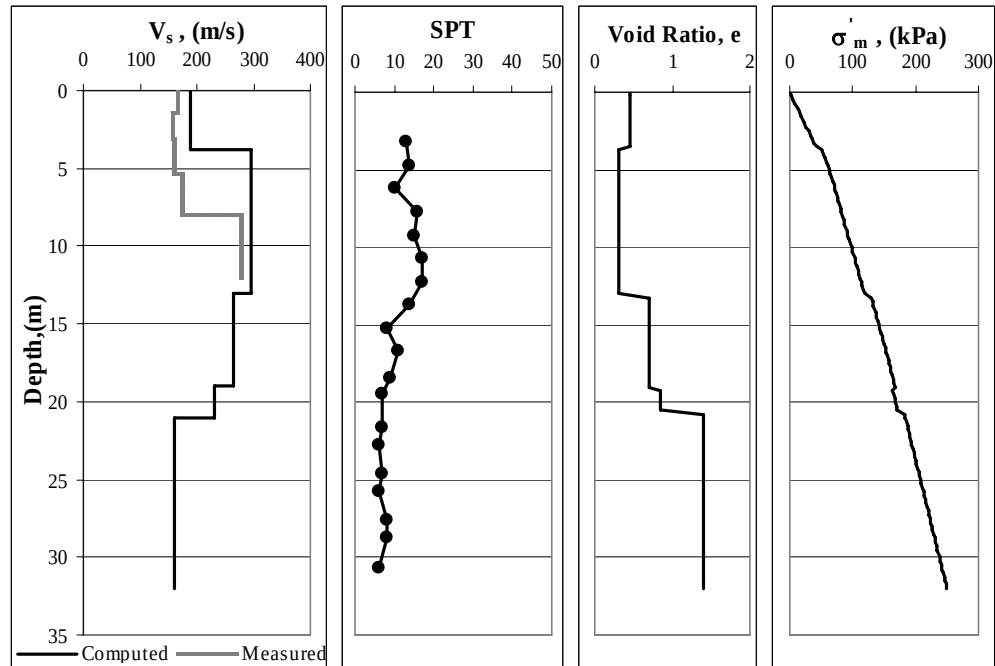
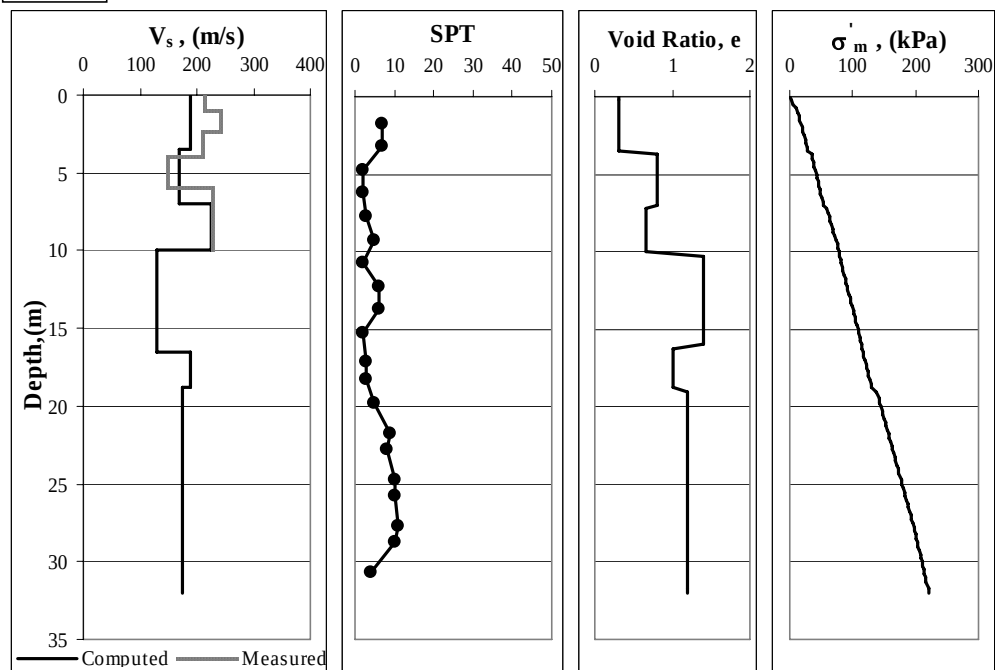
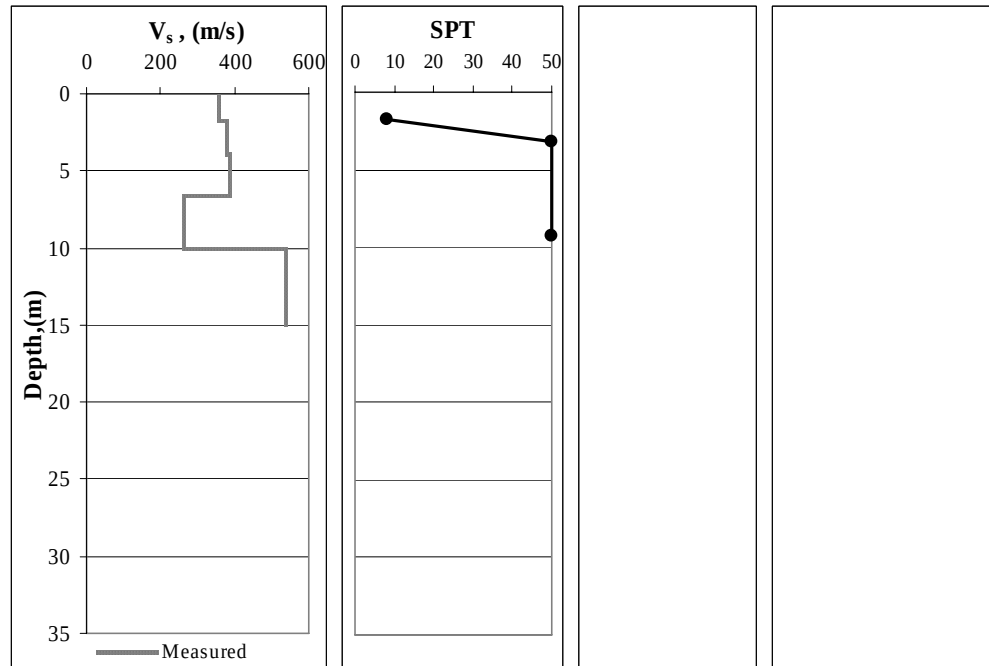
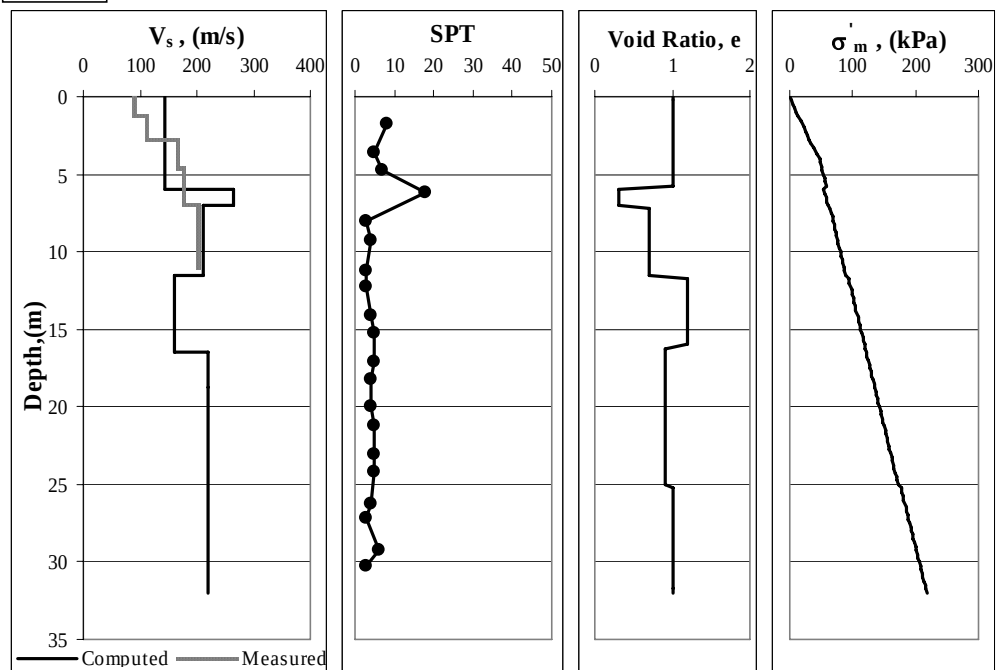


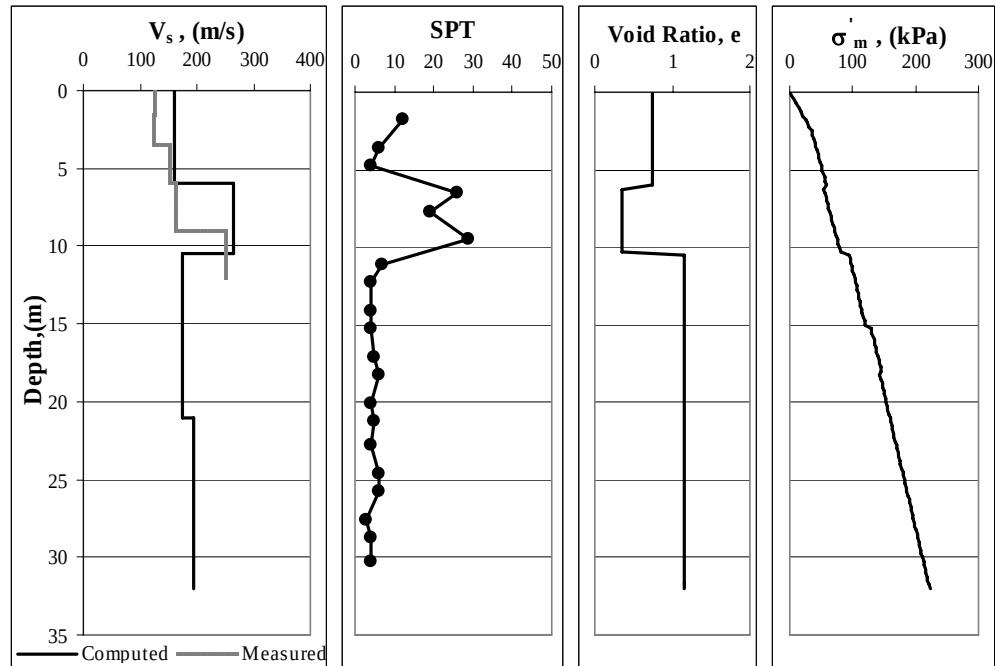
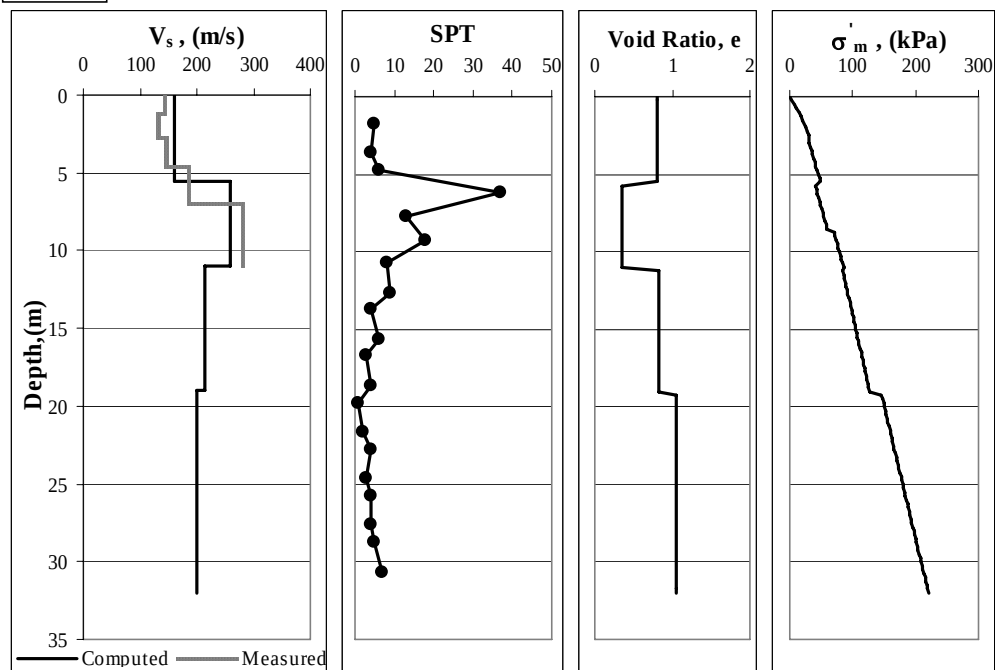
Figure C.1: SPT blow count and V_s profiles for S-4 and S-21

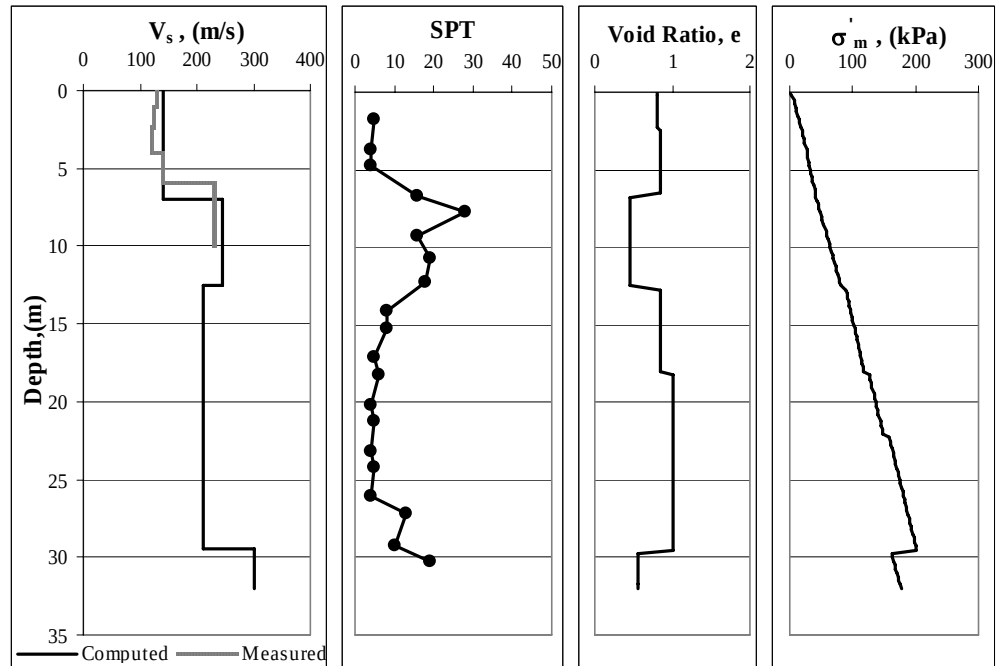
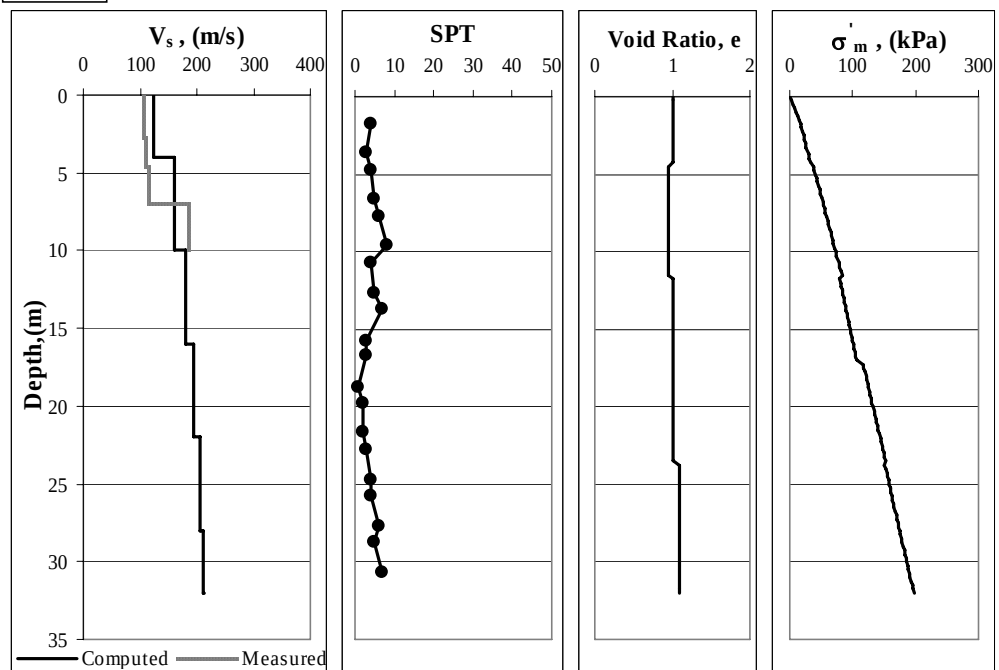
S - 22**S - 23****Figure C.2:** SPT blow count and V_s profiles for S-22 and S-23

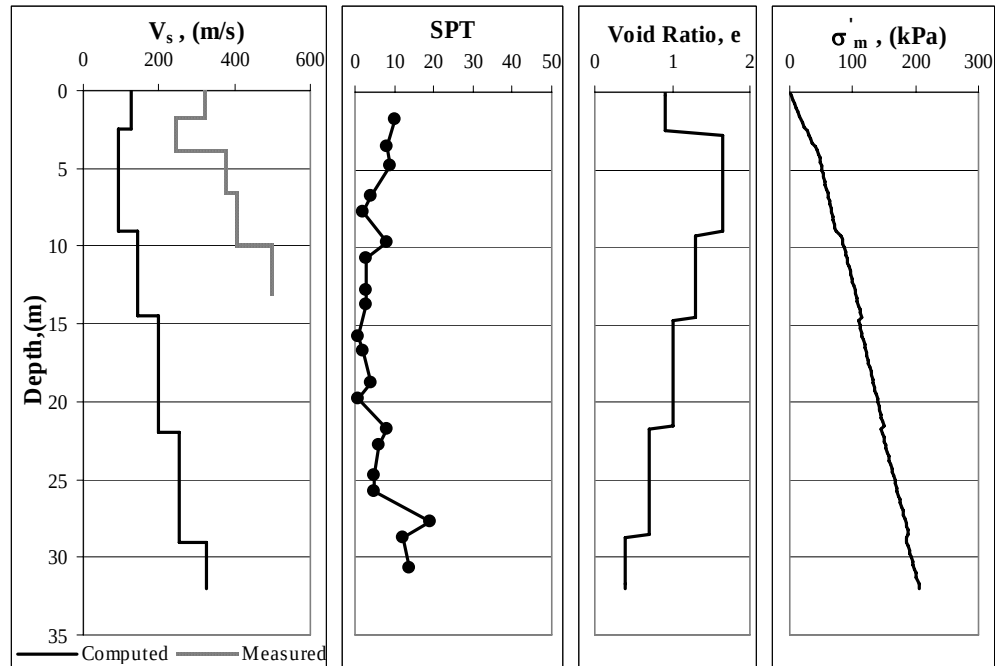
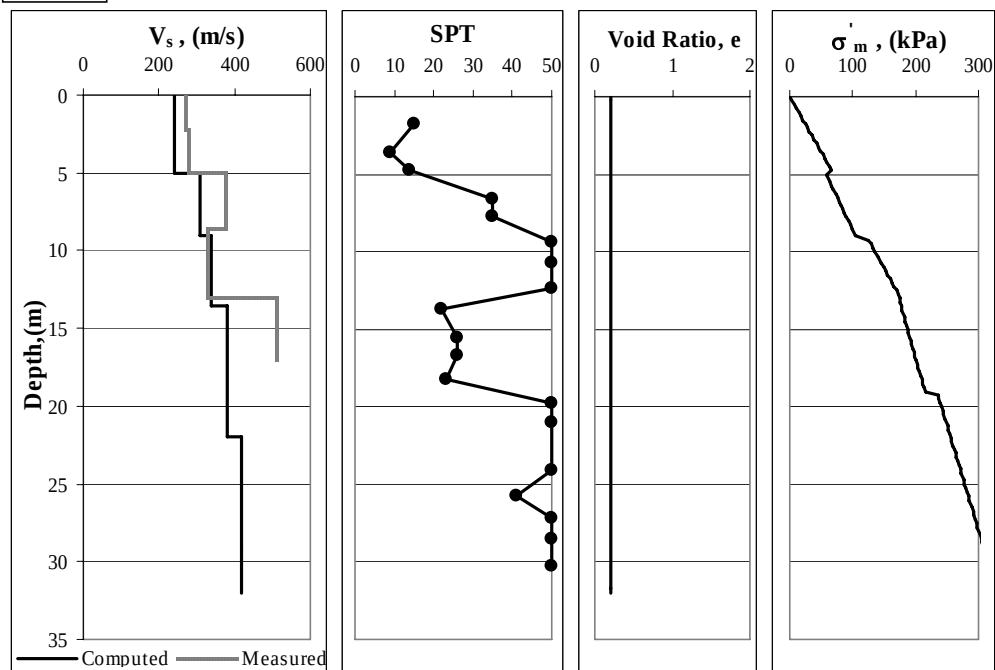
S - 24**S - 25****Figure C.3:** SPT blow count and V_s profiles for S-24 and S-25

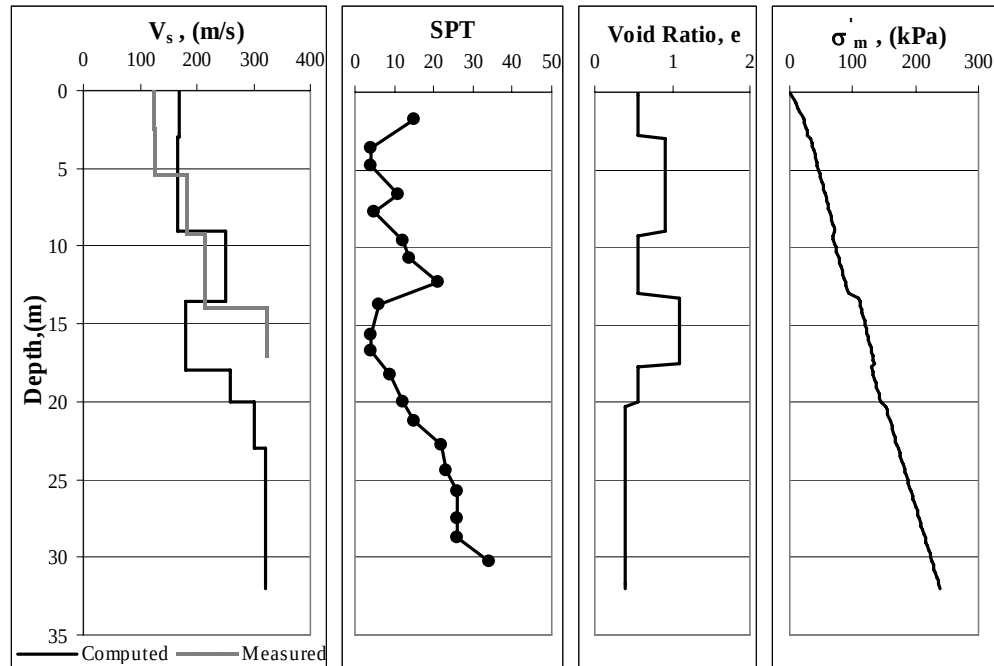
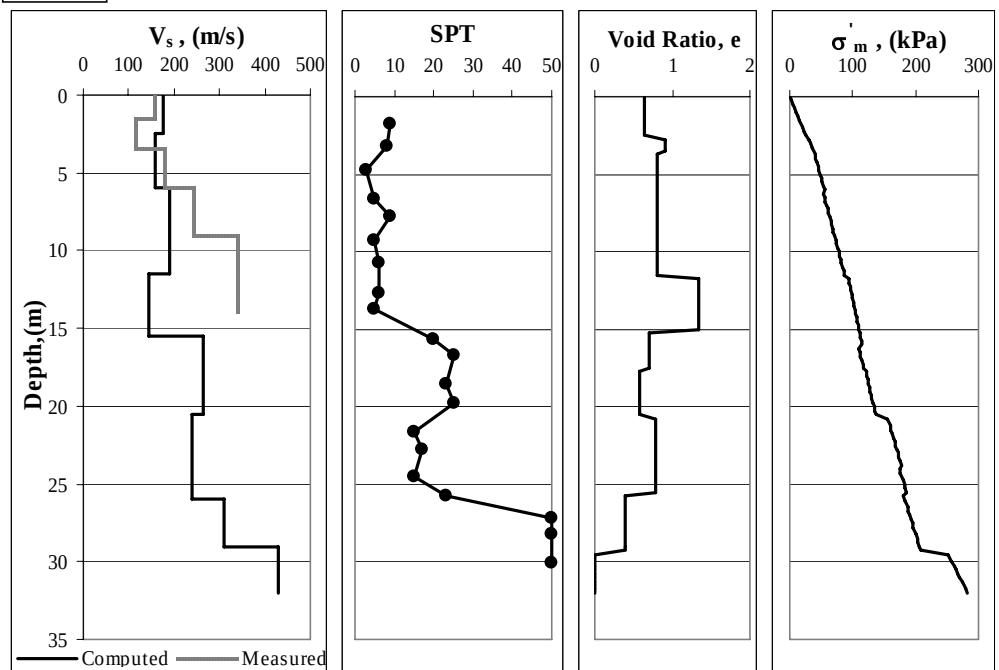
S - 26**S - 27****Figure C.4:** SPT blow count and V_s profiles for S-26 and S-27

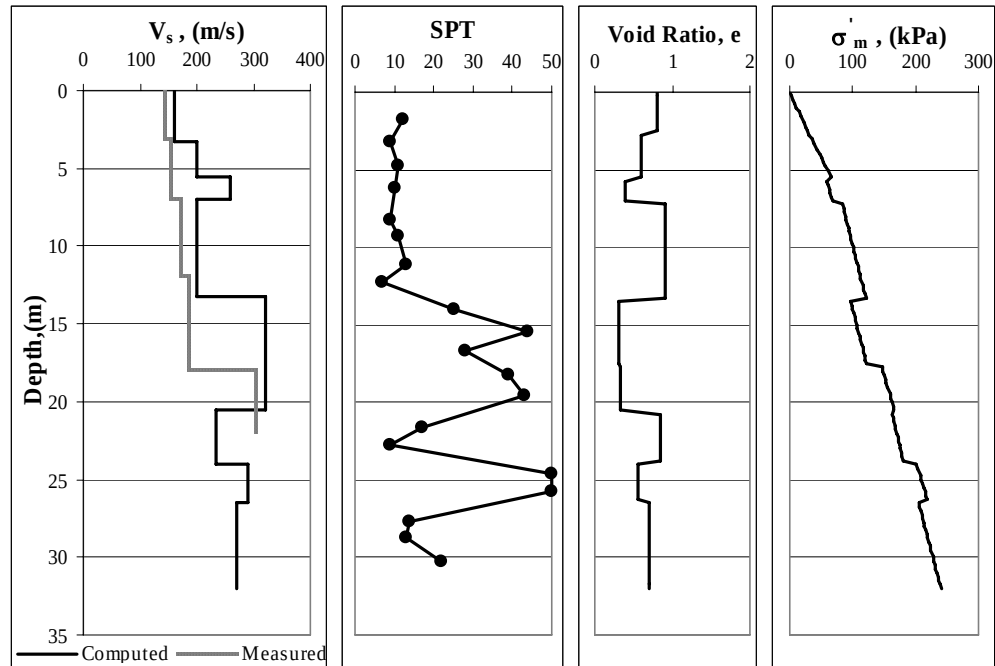
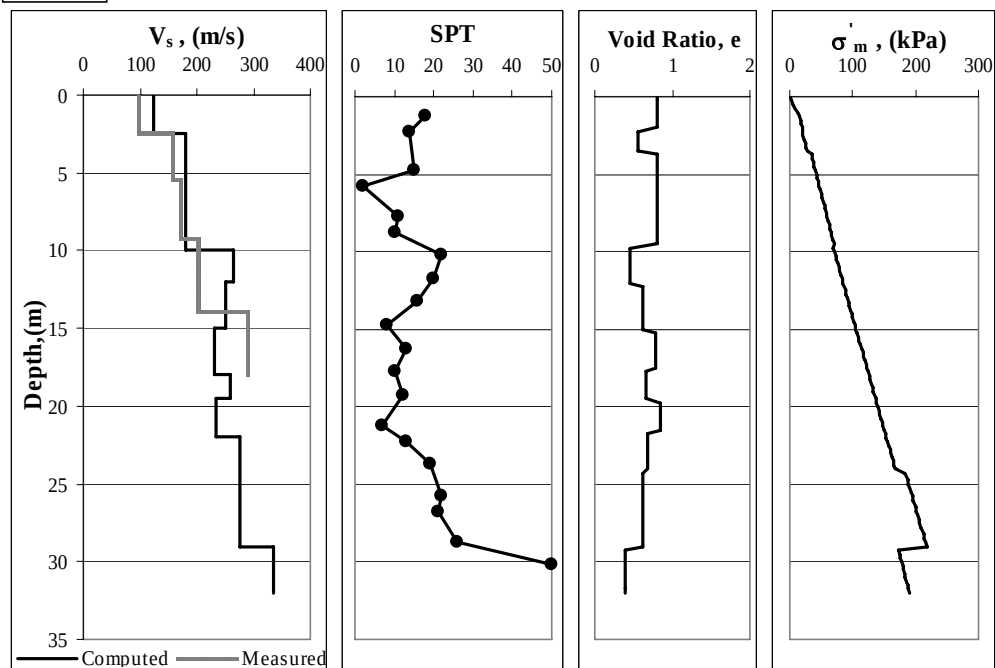
S - 28**S - 29****Figure C.5: SPT blow count and V_s profiles for S-28 and S-29**

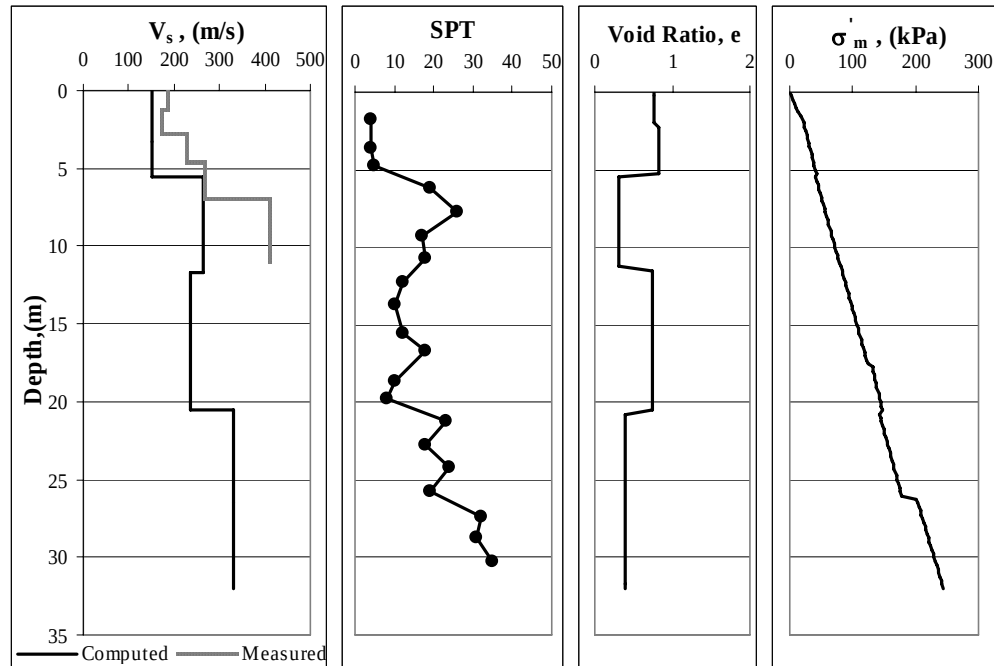
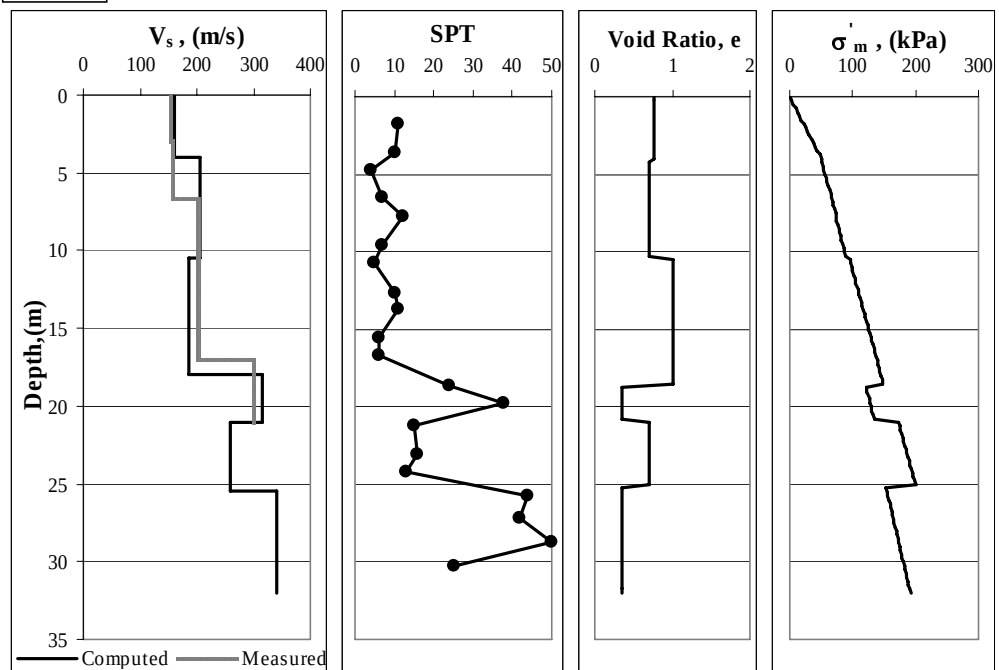
S - 30**S - 31****Figure C.6:** SPT blow count and V_s profiles for S-30 and S-31

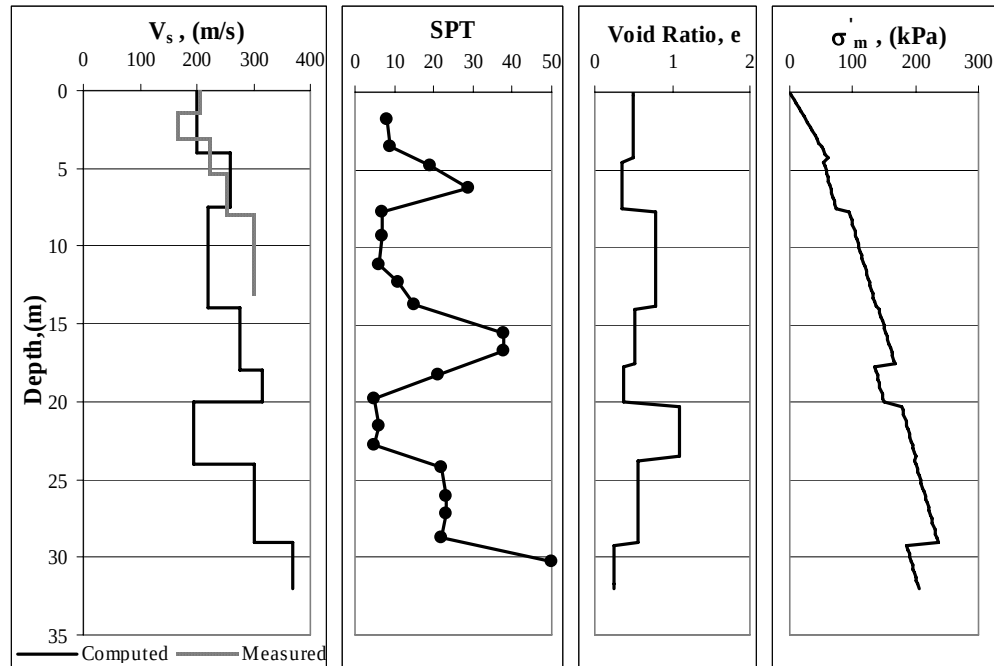
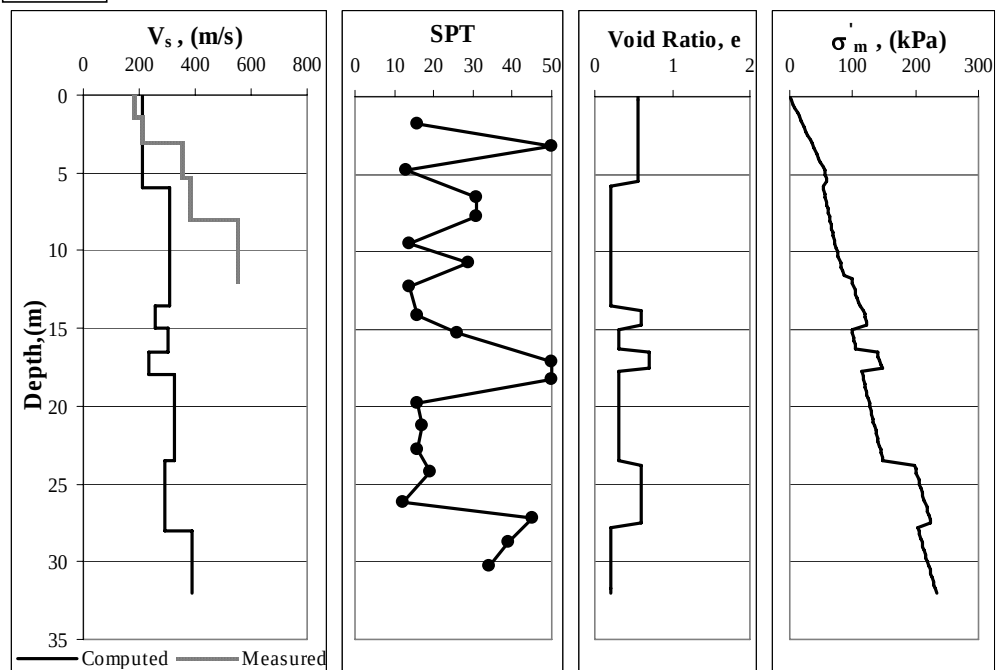
S - 32**S - 33****Figure C.7: SPT blow count and V_s profiles for S-32 and S-33**

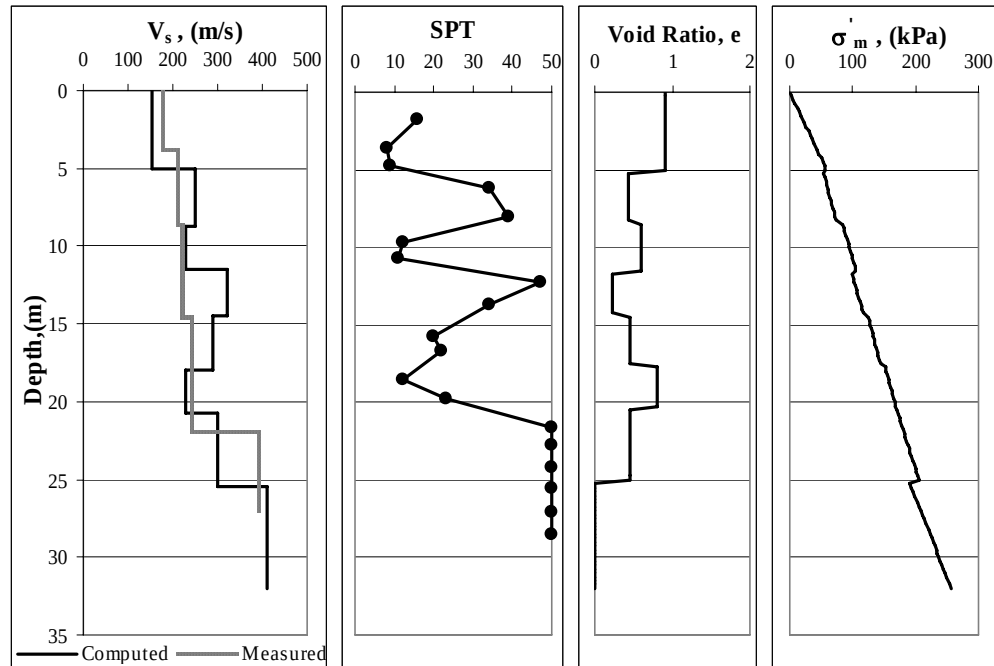
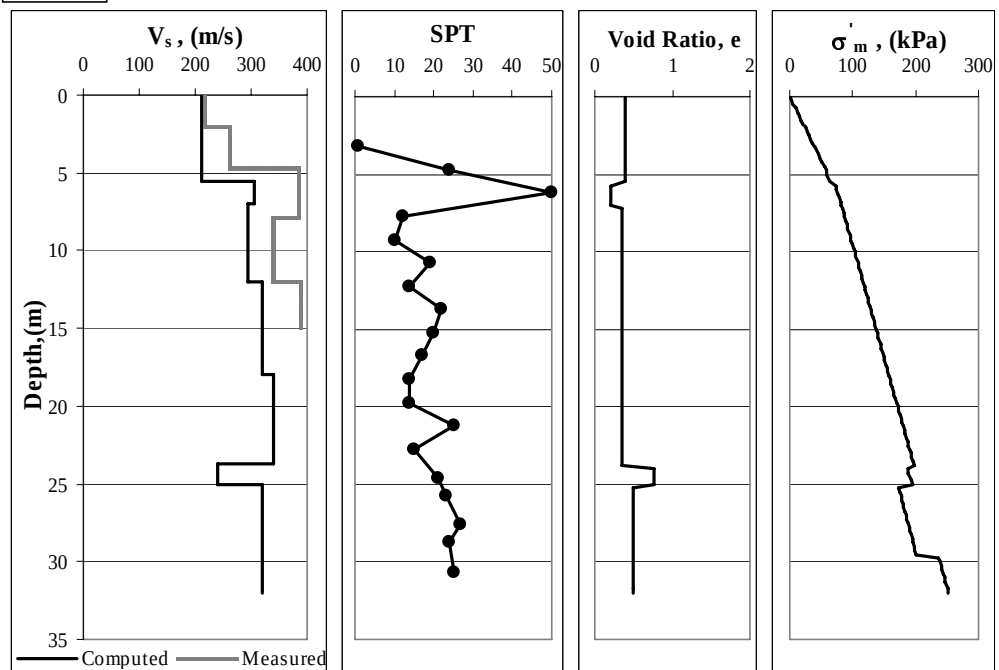
S - 34**S - 35****Figure C.8:** SPT blow count and V_s profiles for S-34 and S-35

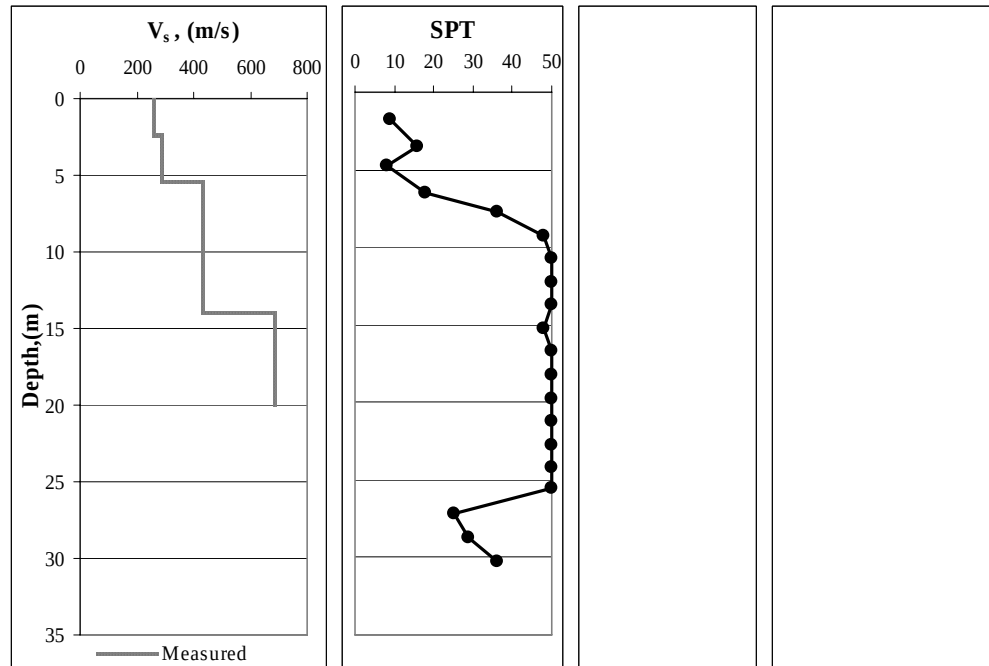
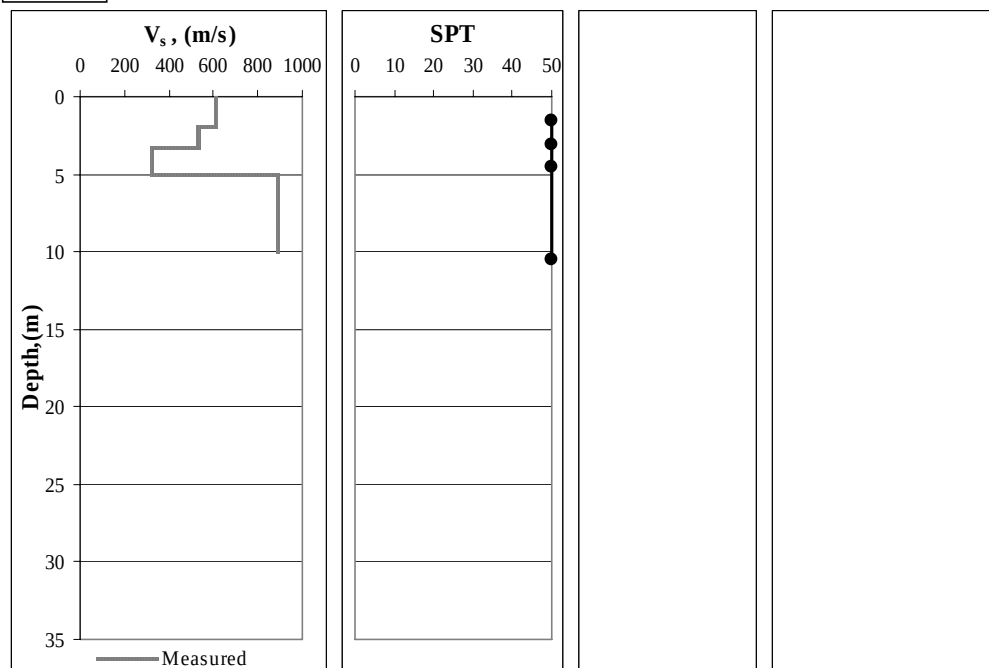
S - 36**S - 37****Figure C.9: SPT blow count and V_s profiles for S-36 and S-37**

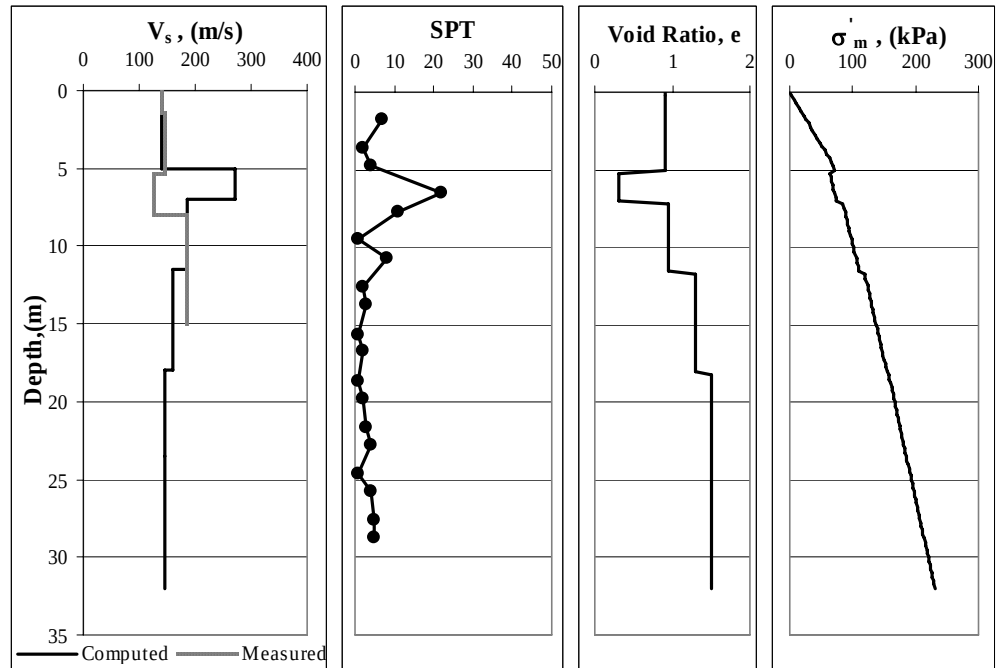
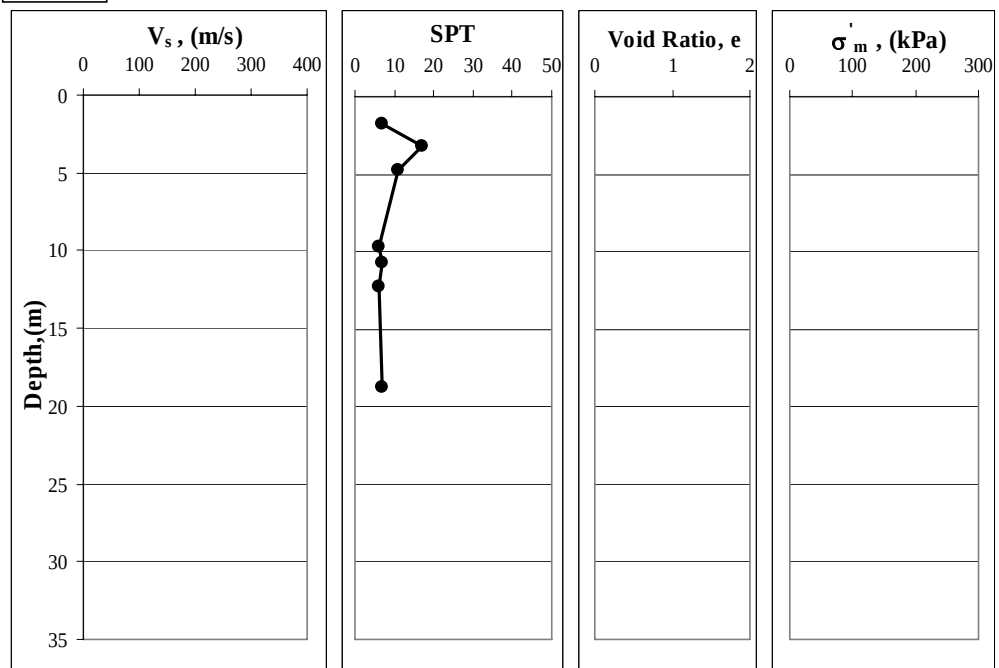
S - 38**S - 39****Figure C.10:** SPT blow count and V_s profiles for S-38 and S-39

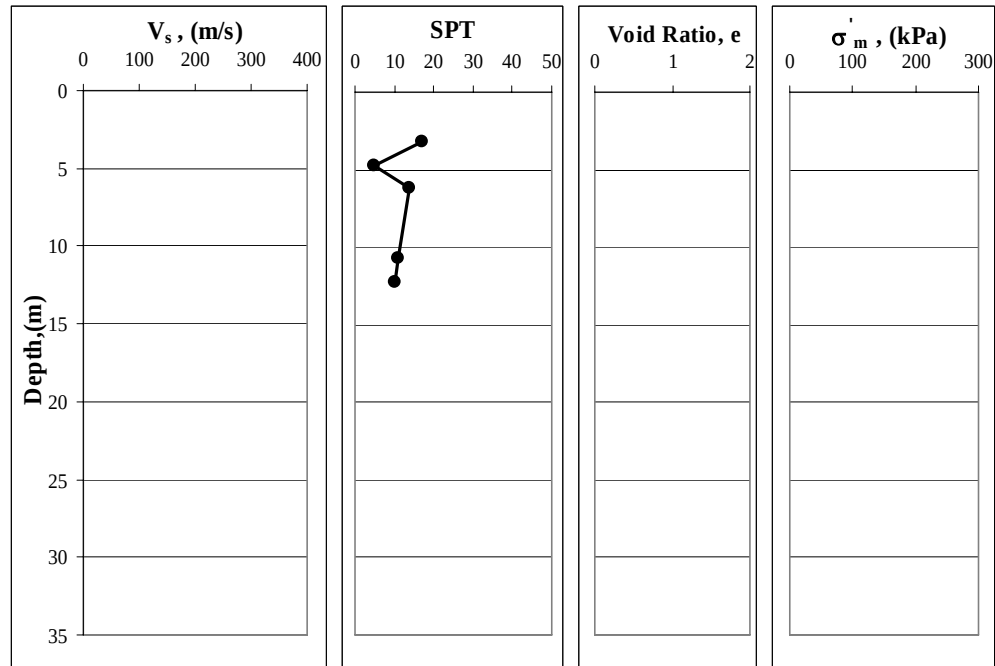
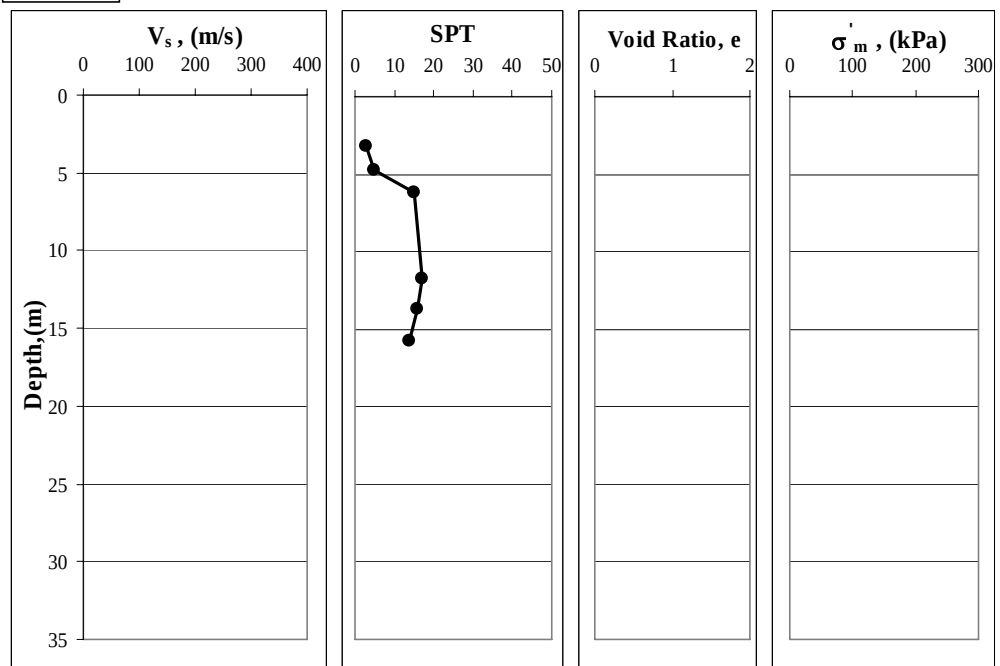
S - 40**S - 41****Figure C.11:** SPT blow count and V_s profiles for S-40 and S-41

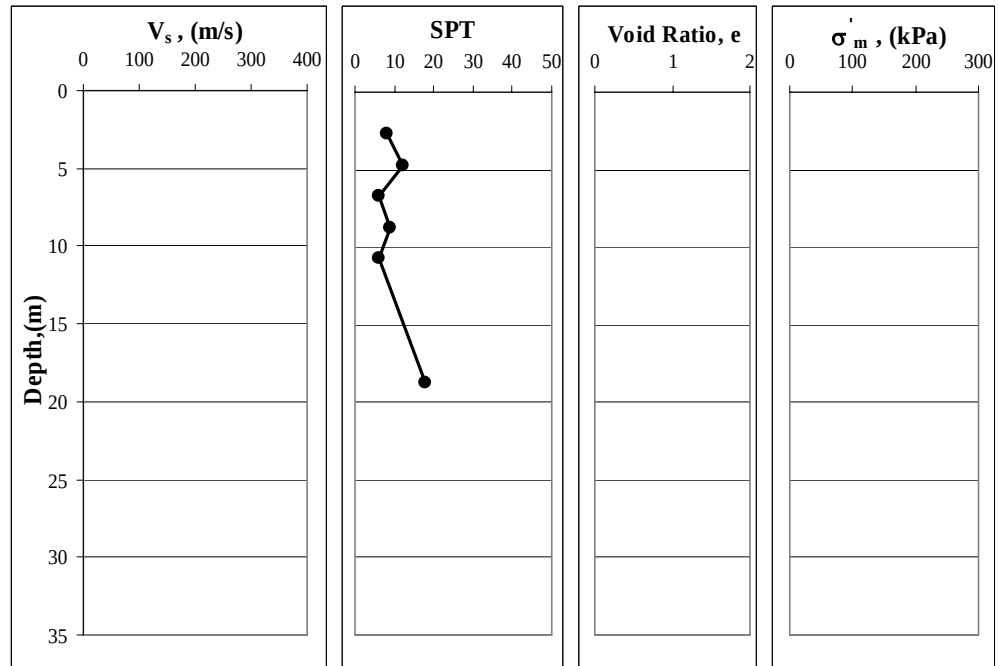
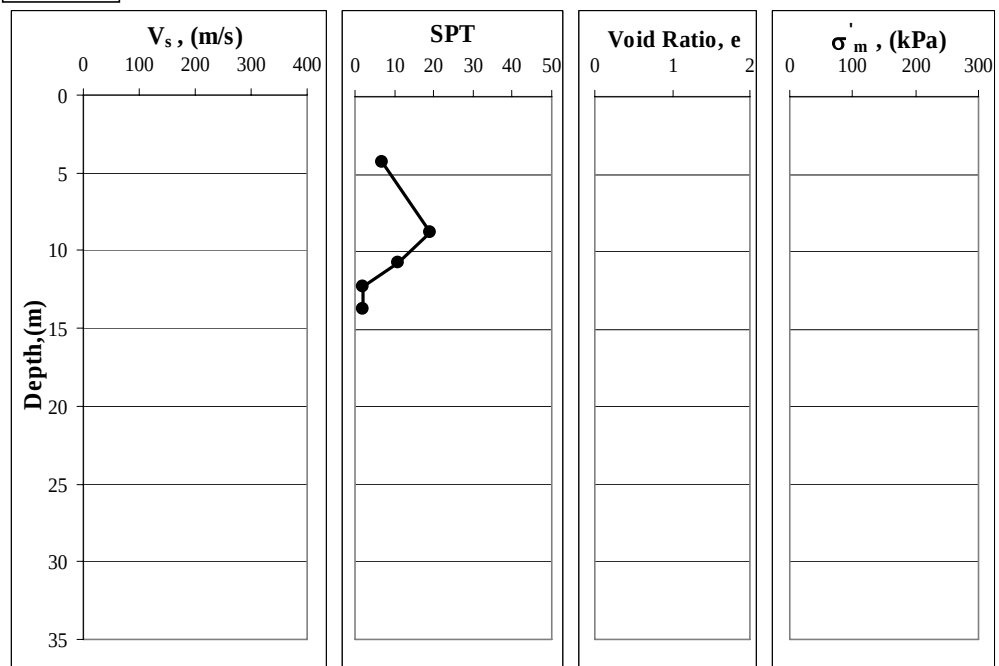
S - 42**S - 43****Figure C.12:** SPT blow count and V_s profiles for S-42 and S-43

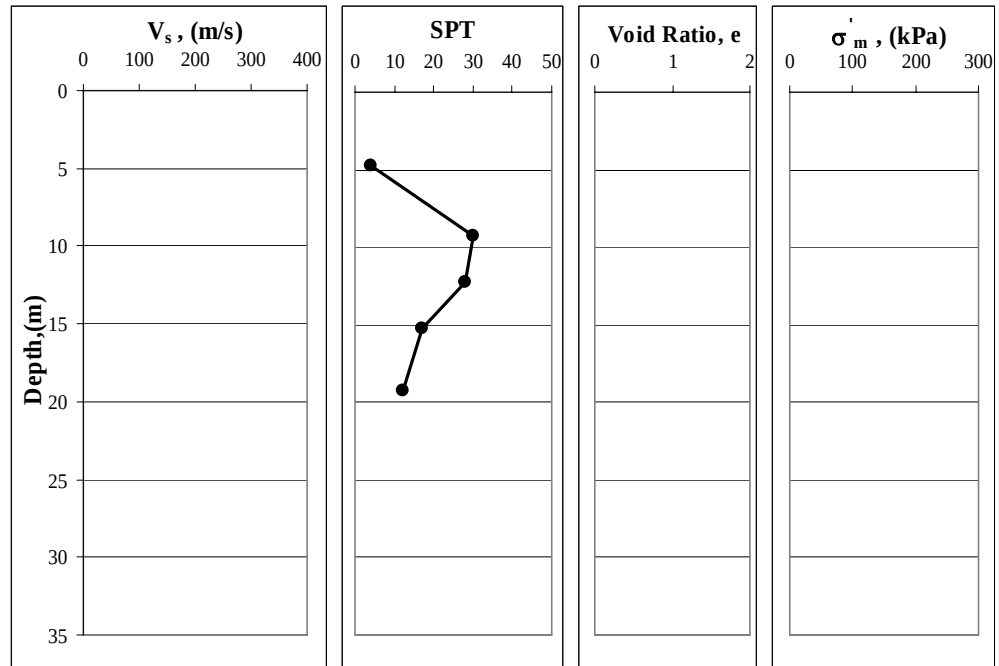
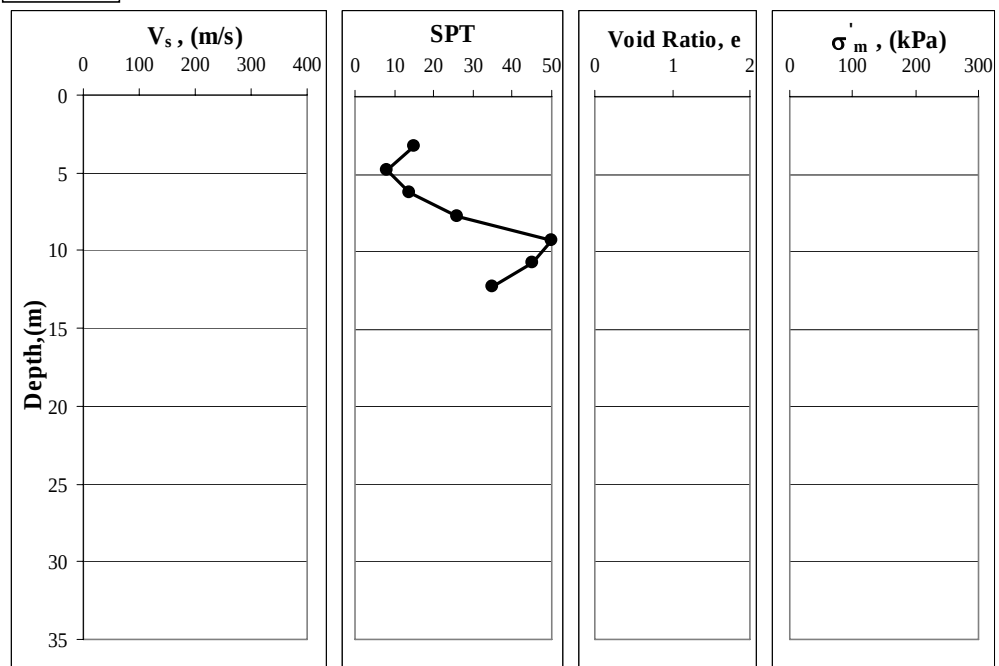
S - 44**S - 45****Figure C.13:** SPT blow count and V_s profiles for S-44 and S-45

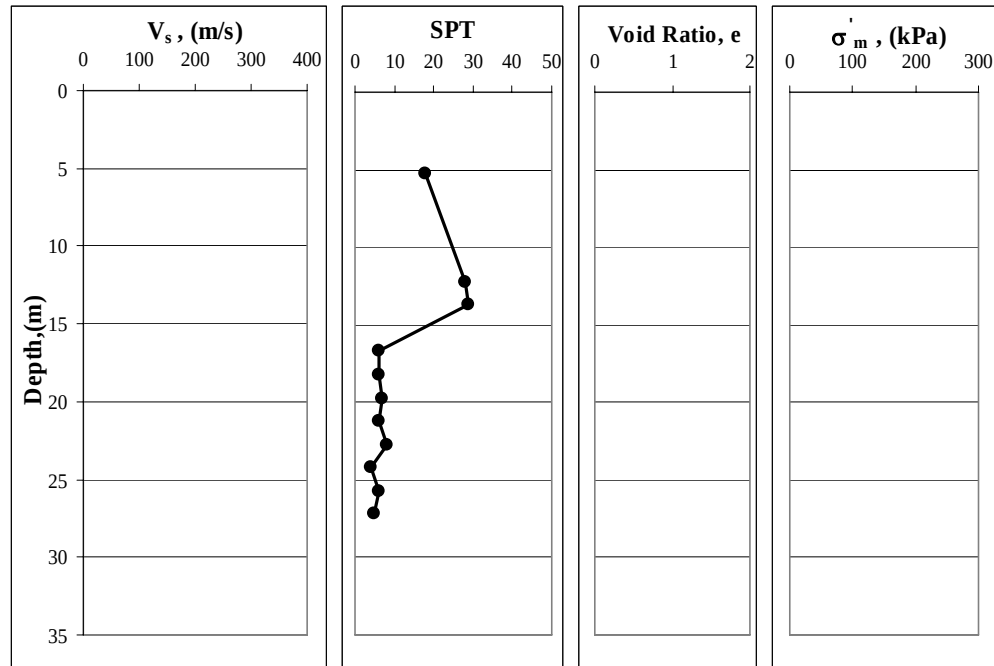
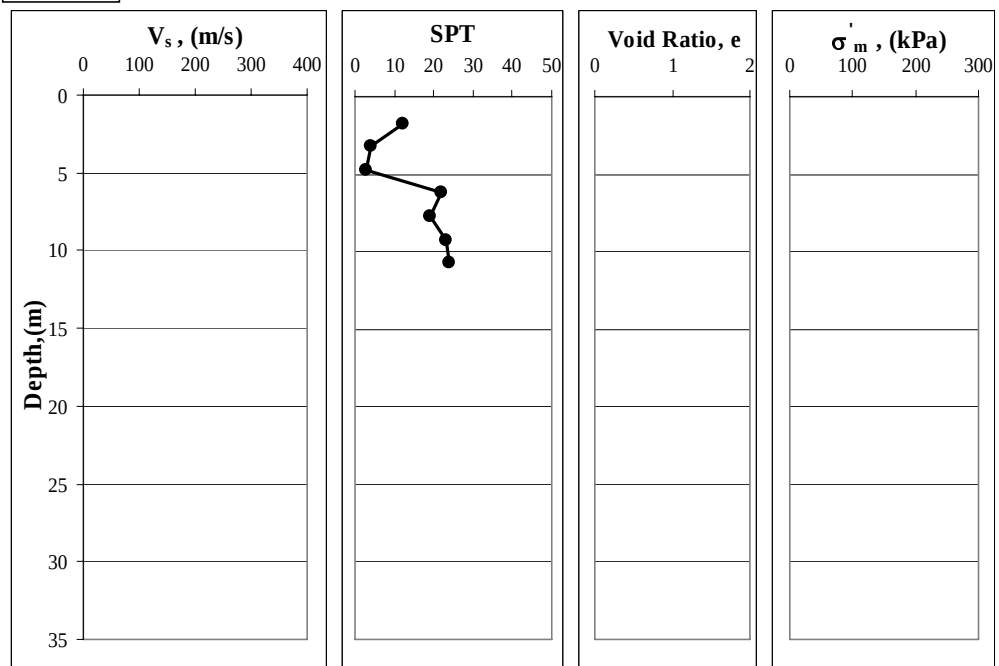
S - 46**S - 50****Figure C.14:** SPT blow count and V_s profiles for S-46 and S-50

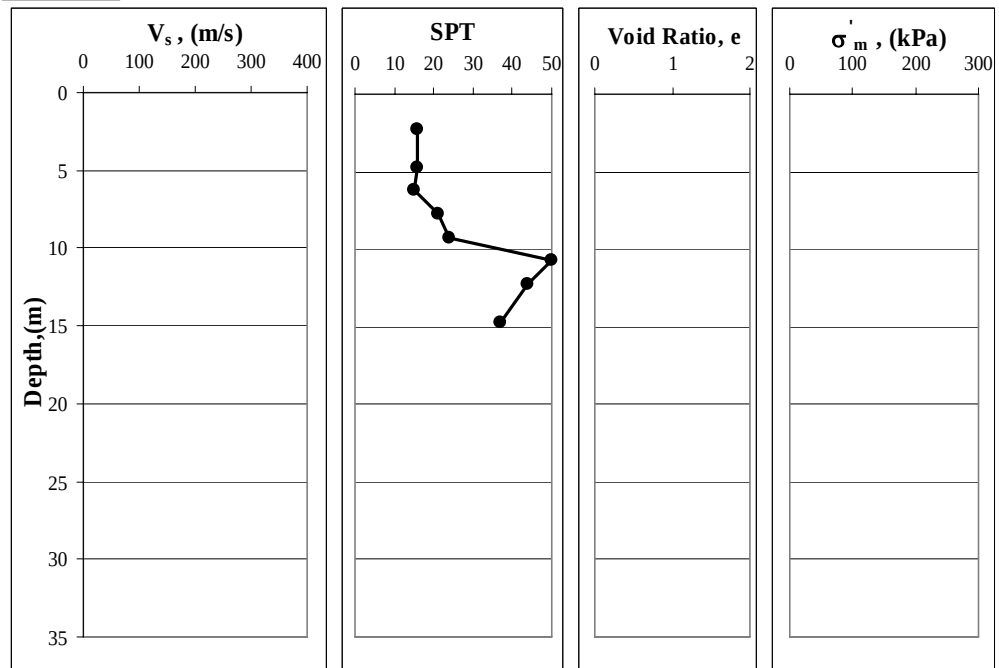
S - 51**SE - 4****Figure C.15:** SPT blow count and V_s profiles for S-51 and SE-4

SE - 5**SE - 11****Figure C.16:** SPT blow count and V_s profiles for SE-5 and SE-11

SE - 12**SE - 14****Figure C.17:** SPT blow count and V_s profiles for SE-12 and SE-14

SE - 15**SE - 17****Figure C.18:** SPT blow count and V_s profiles for SE-15 and SE-17

SE - 19**SE - 36****Figure C.19:** SPT blow count and V_s profiles for SE-19 and SE-36

SE - 44**Figure C.20:** SPT blow count and V_s profile for SE-44

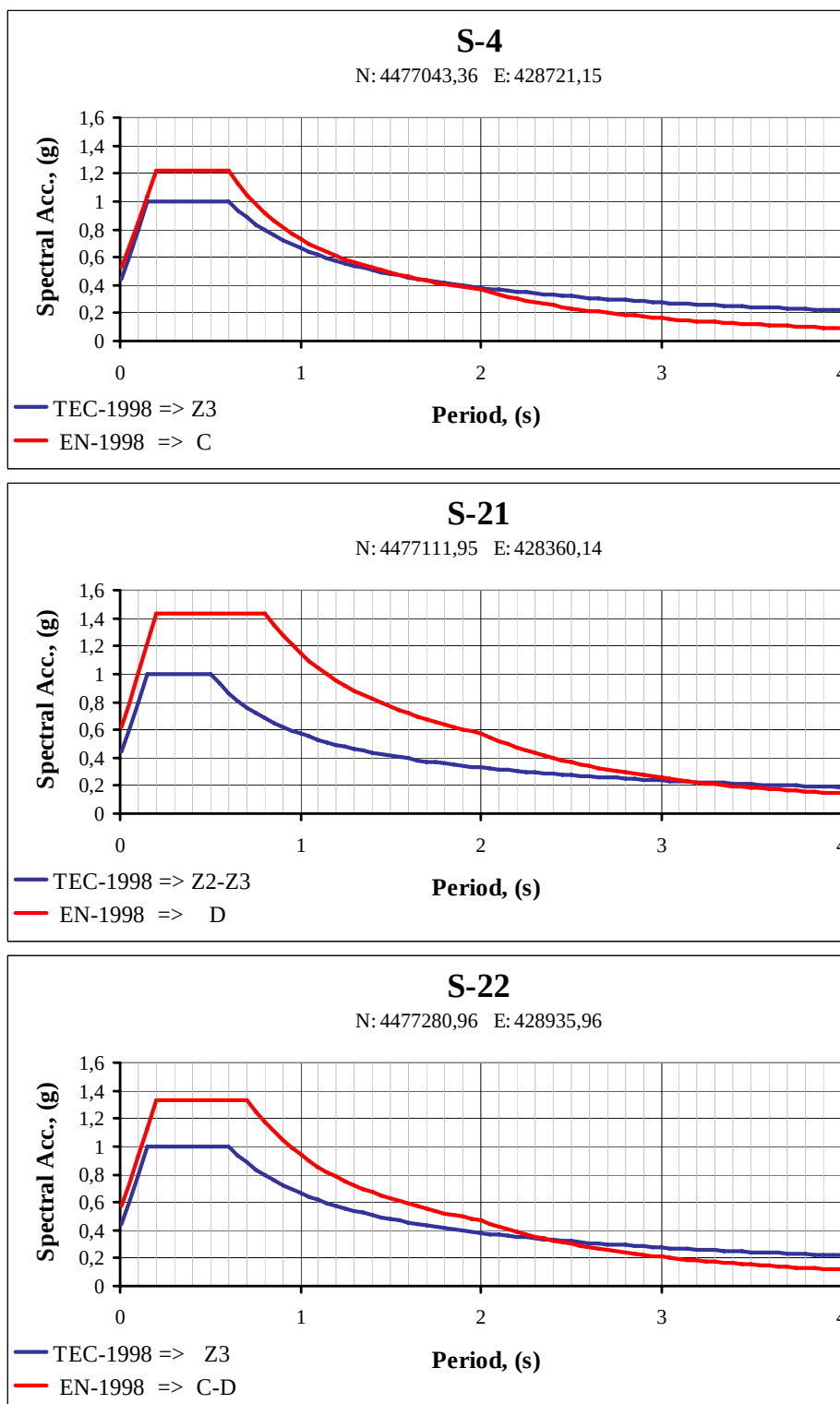


Figure D.1: Elastic response spectra for S-4, S-21 and S-22

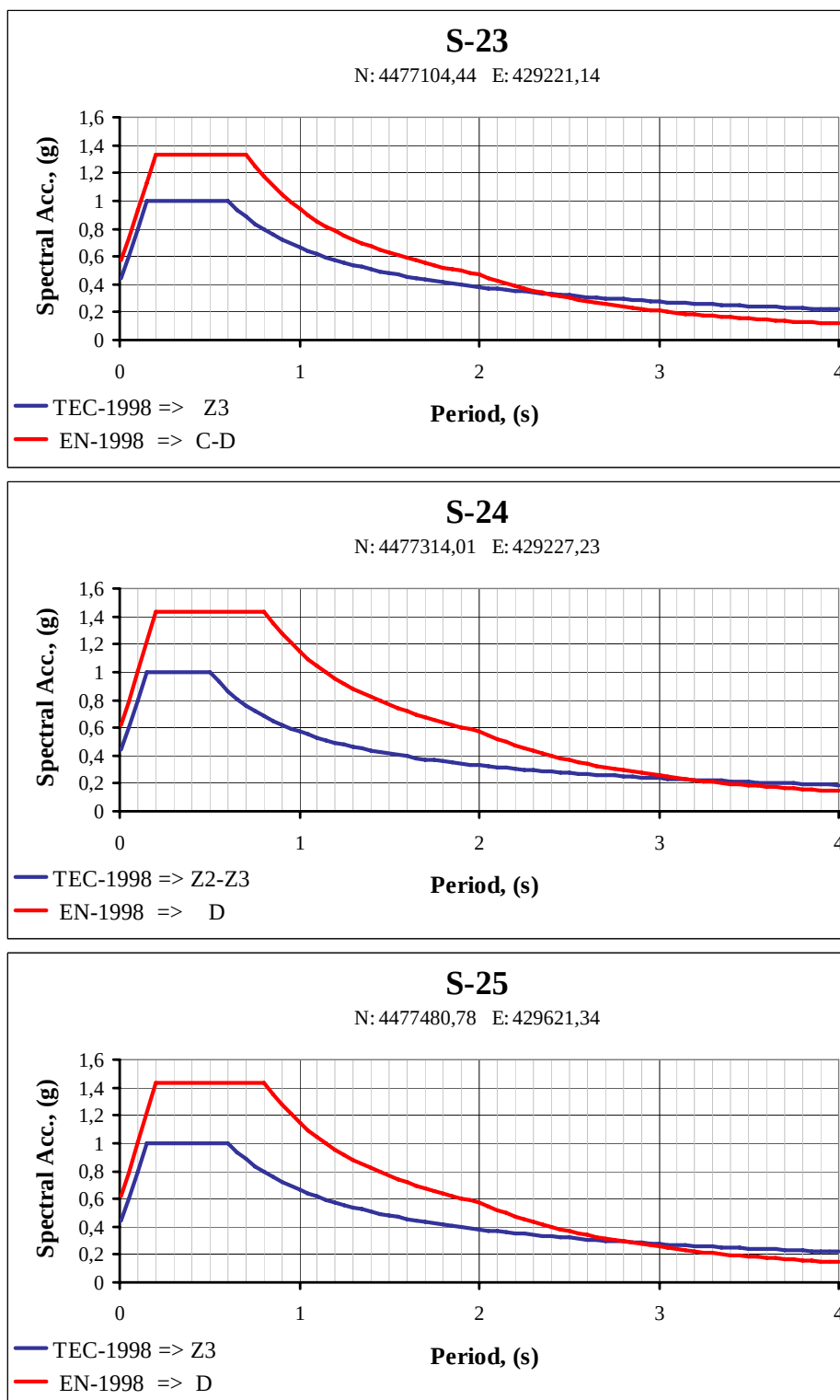


Figure D.2: Elastic response spectra for S-23, S-24 and S-25

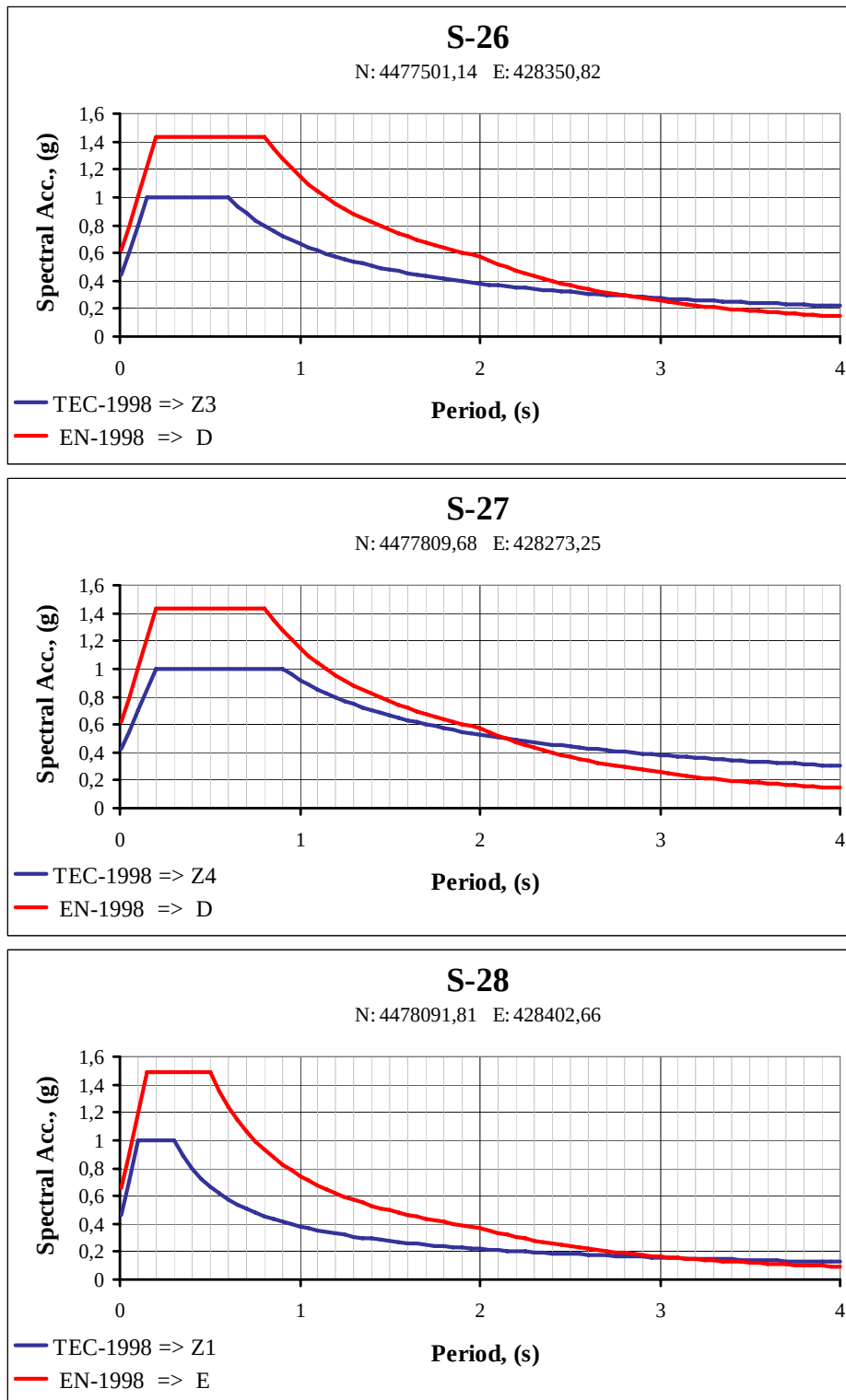


Figure D.3: Elastic response spectra for S-26, S-27 and S-28

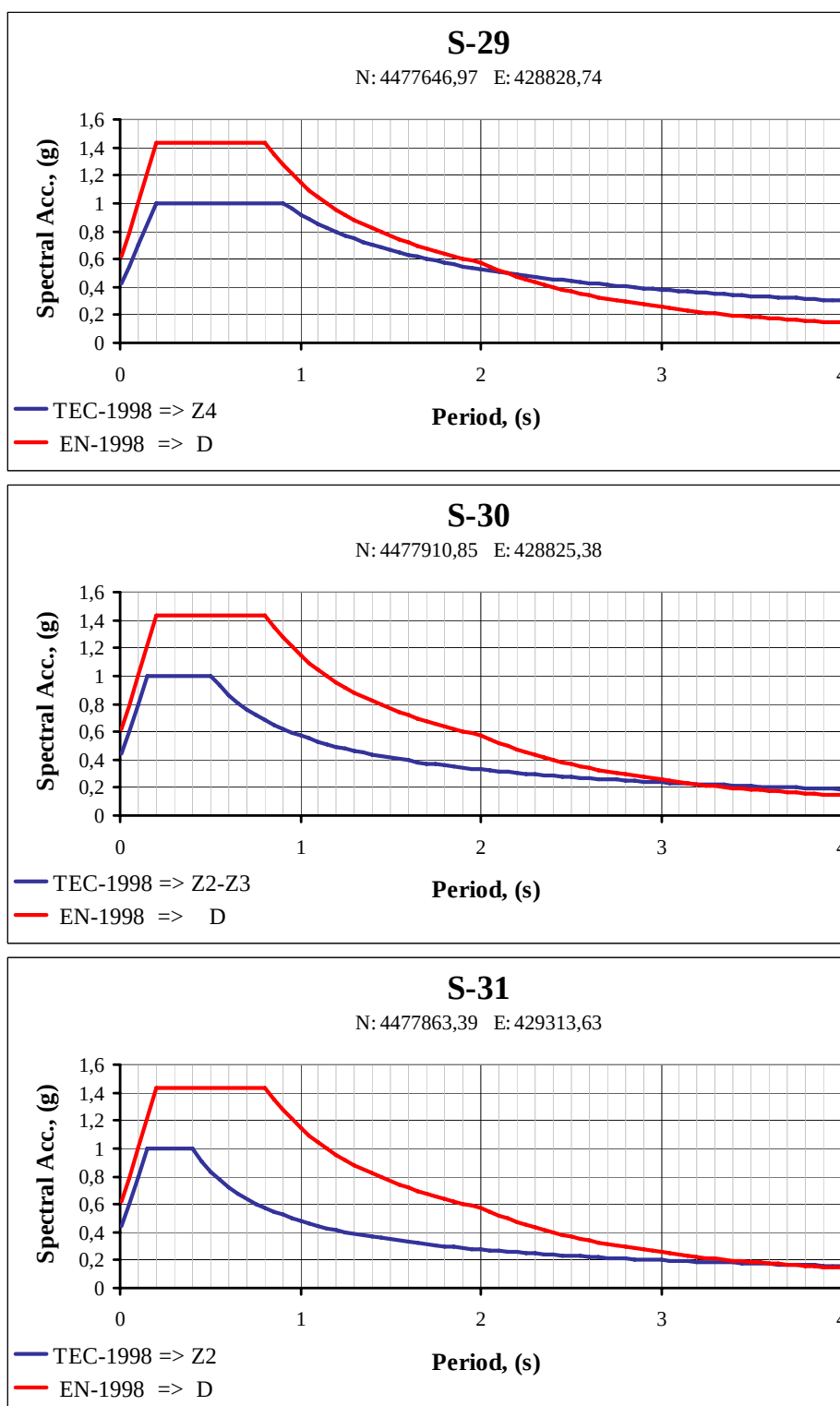


Figure D.4: Elastic response spectra for S-29, S-30 and S-31

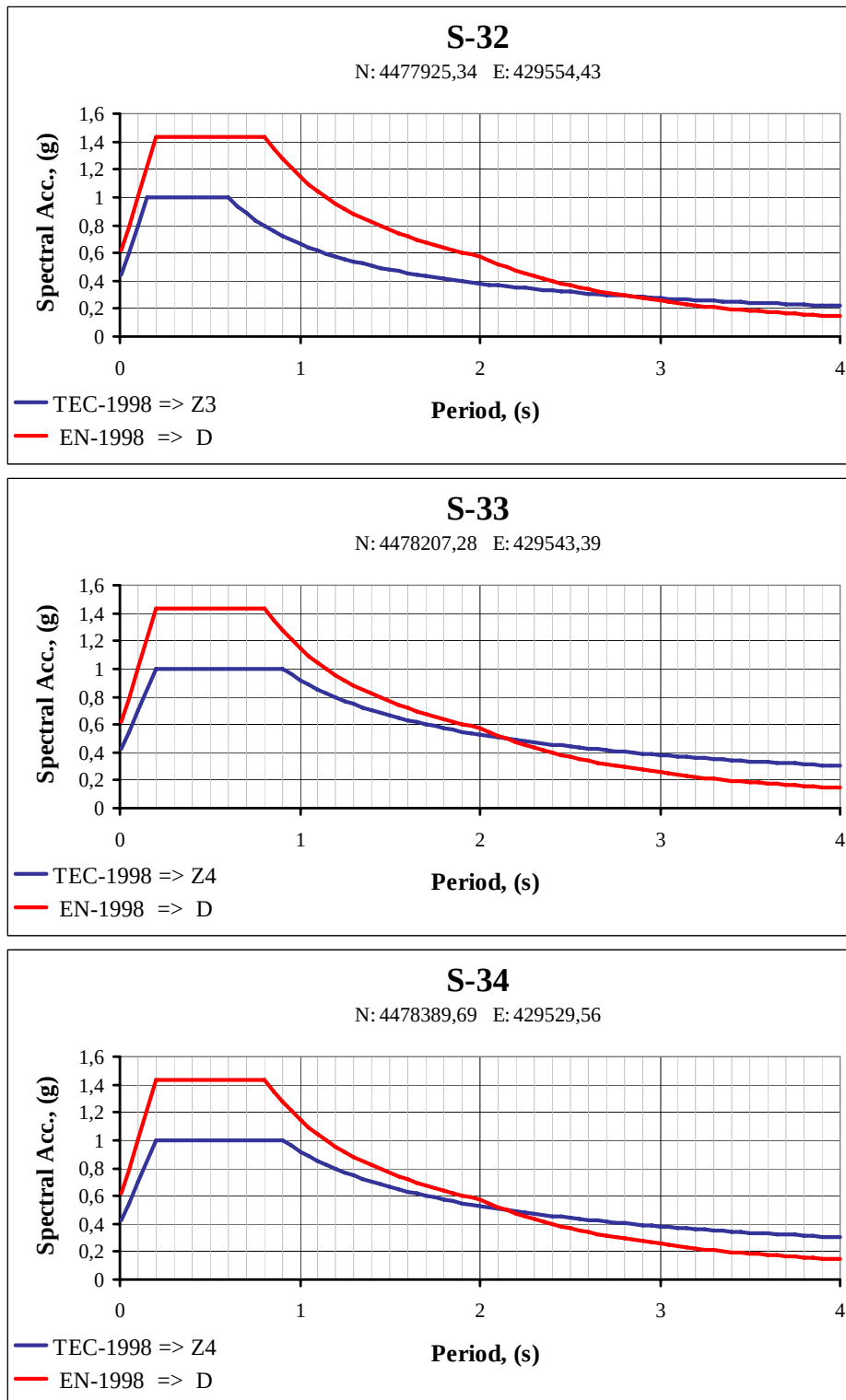


Figure D.5: Elastic response spectra for S-32, S-33 and S-34

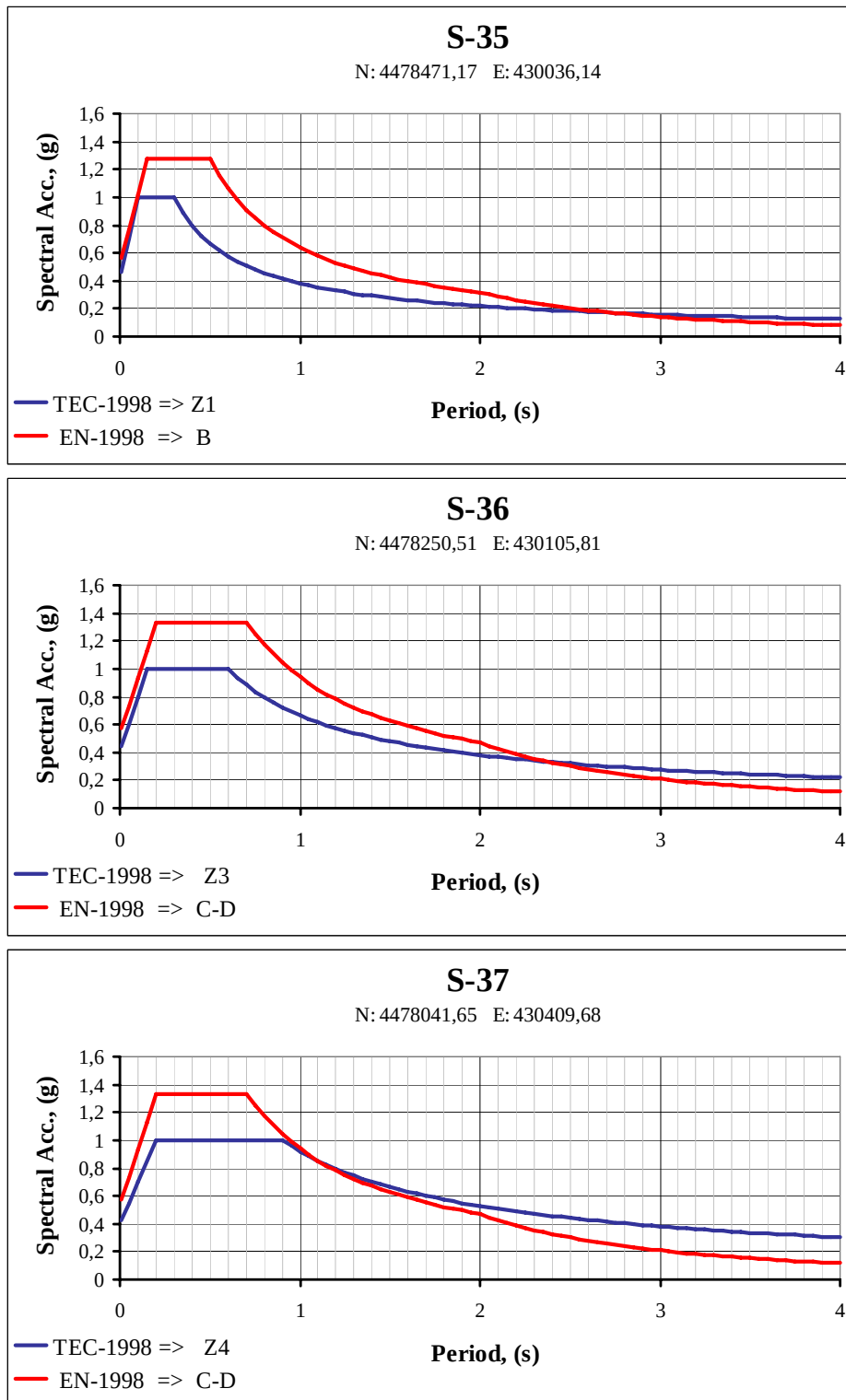


Figure D.6: Elastic response spectra for S-35, S-36 and S-37

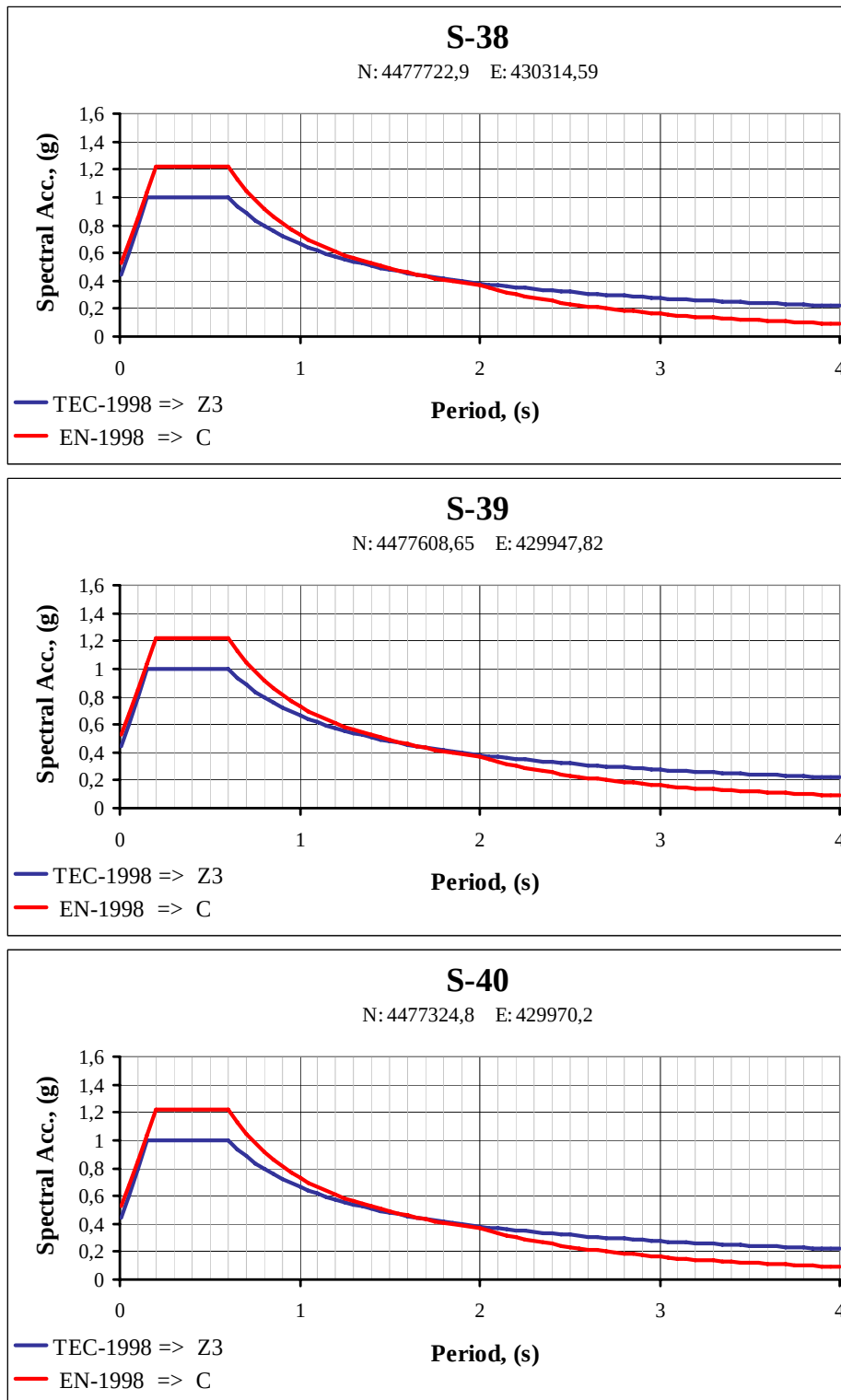


Figure D.7: Elastic response spectra for S-38, S-39 and S-40

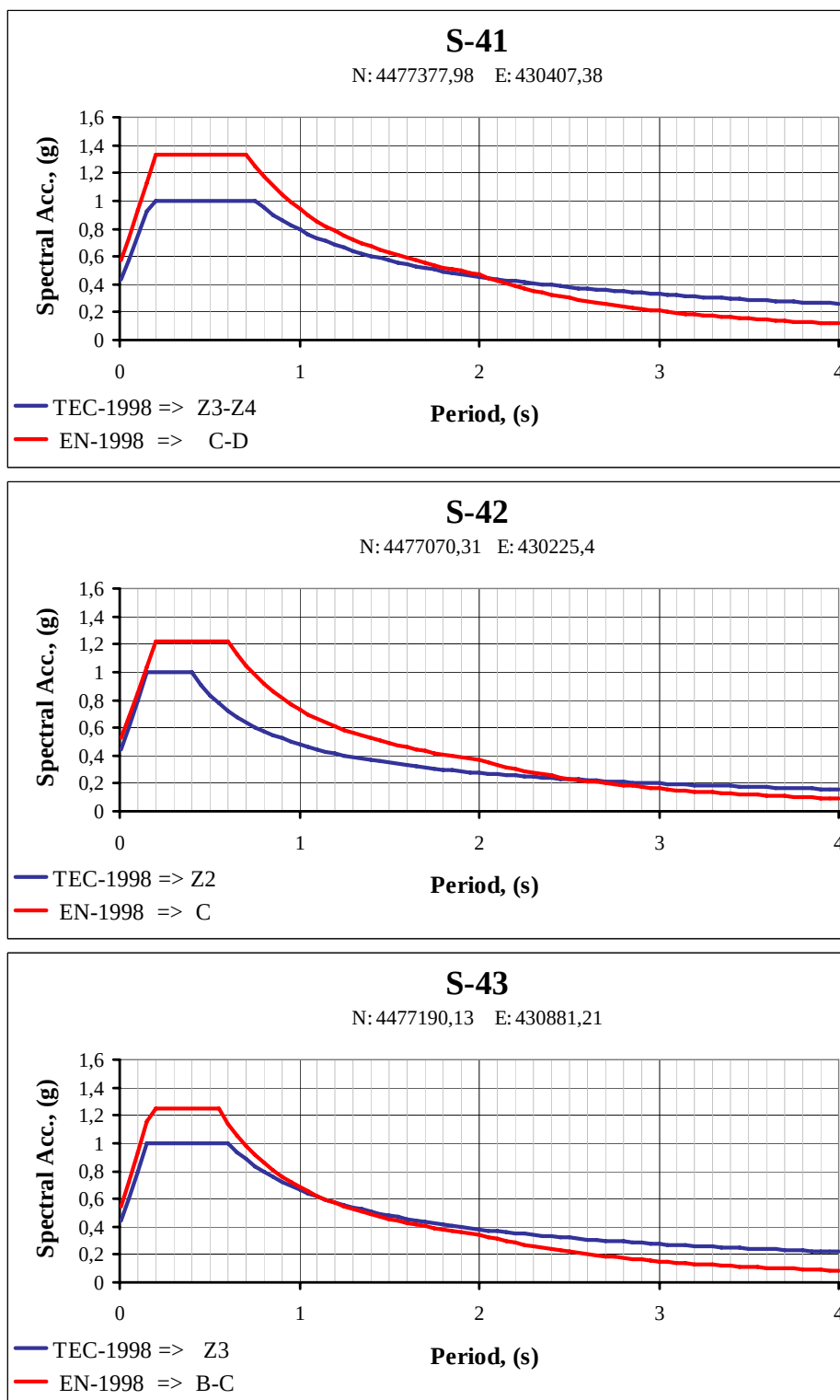


Figure D.8: Elastic response spectra for S-41, S-42 and S-43

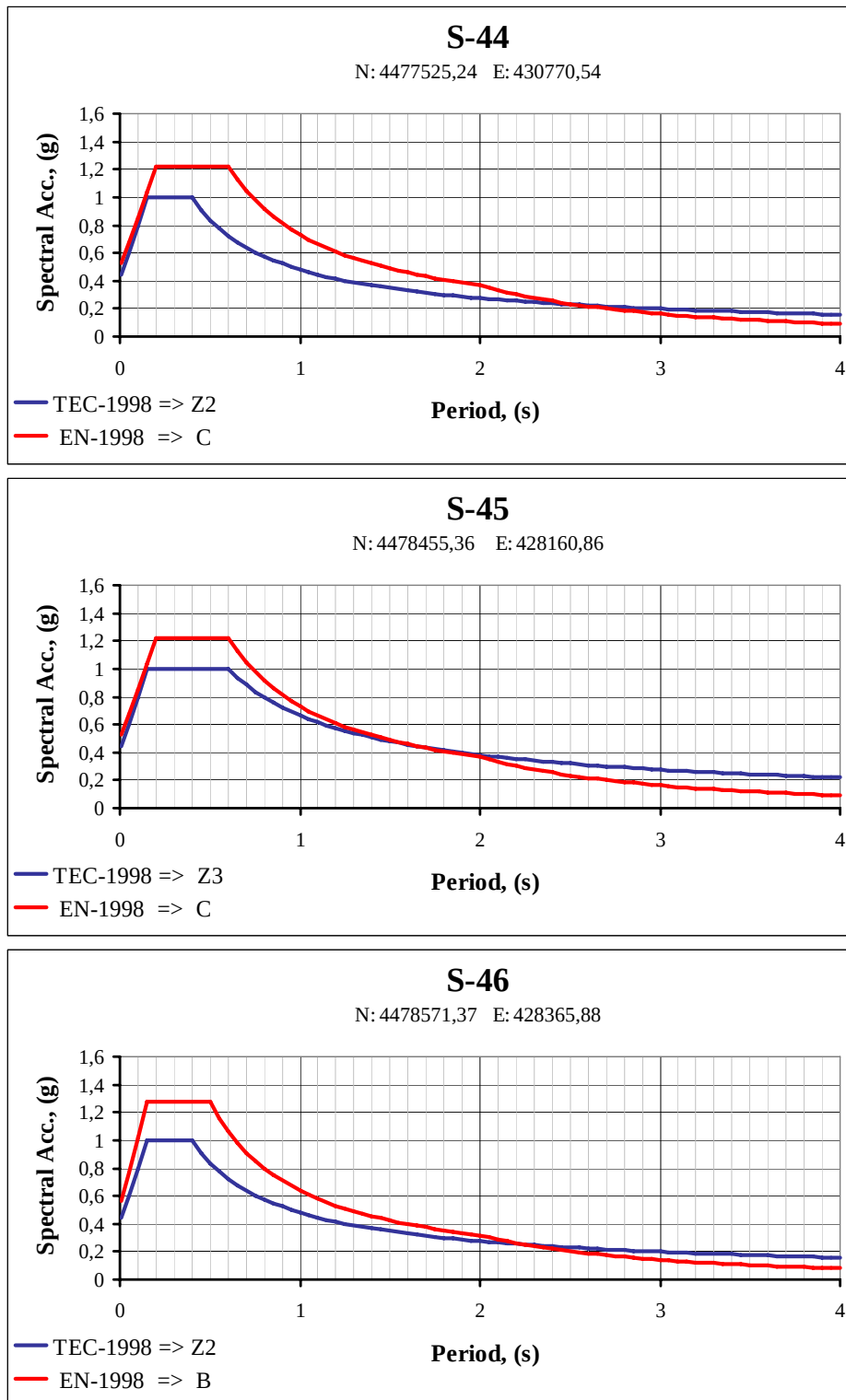


Figure D.9: Elastic response spectra for S-44, S-45 and S-46

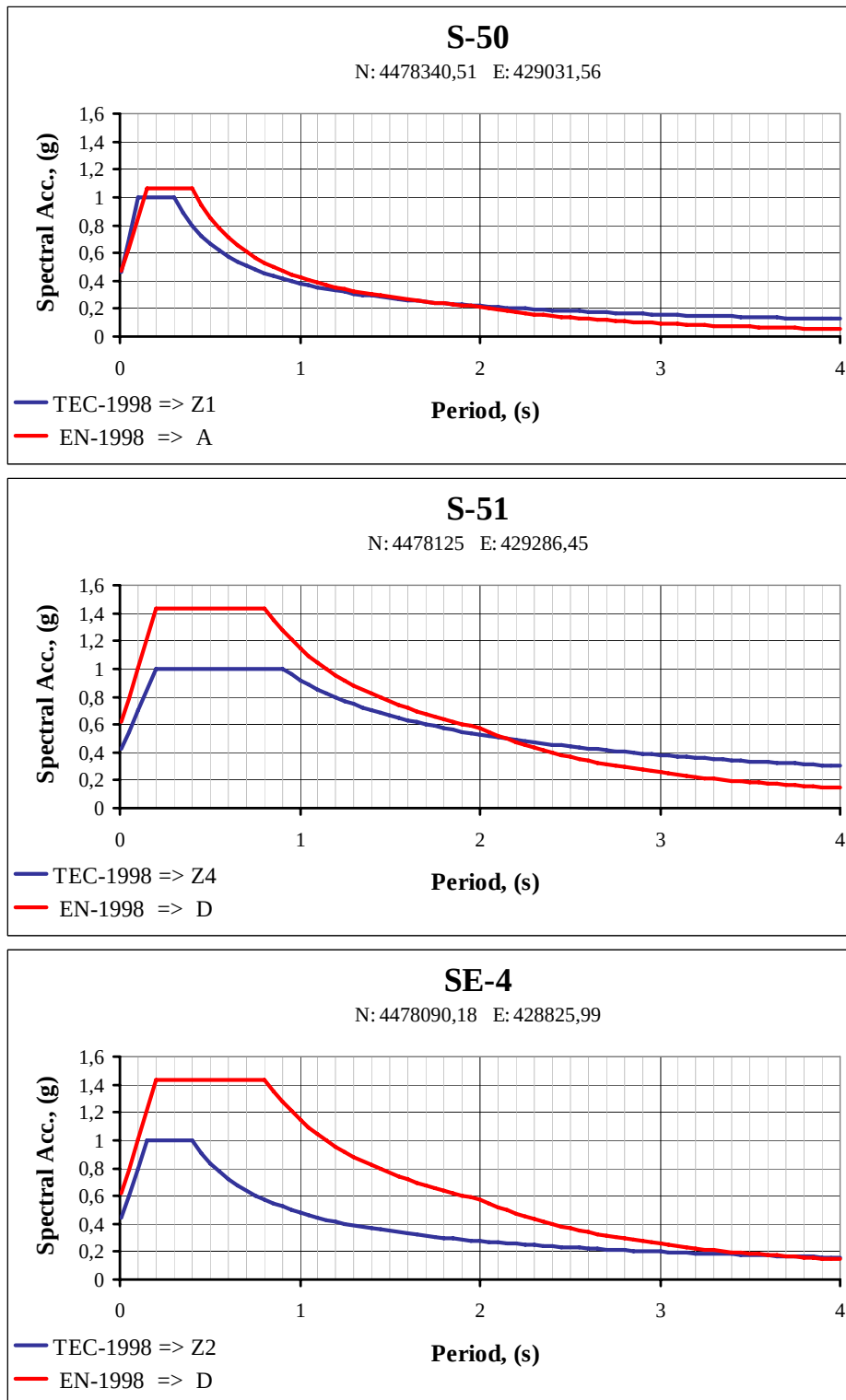


Figure D.10: Elastic response spectra for S-50, S-51 and SE-4

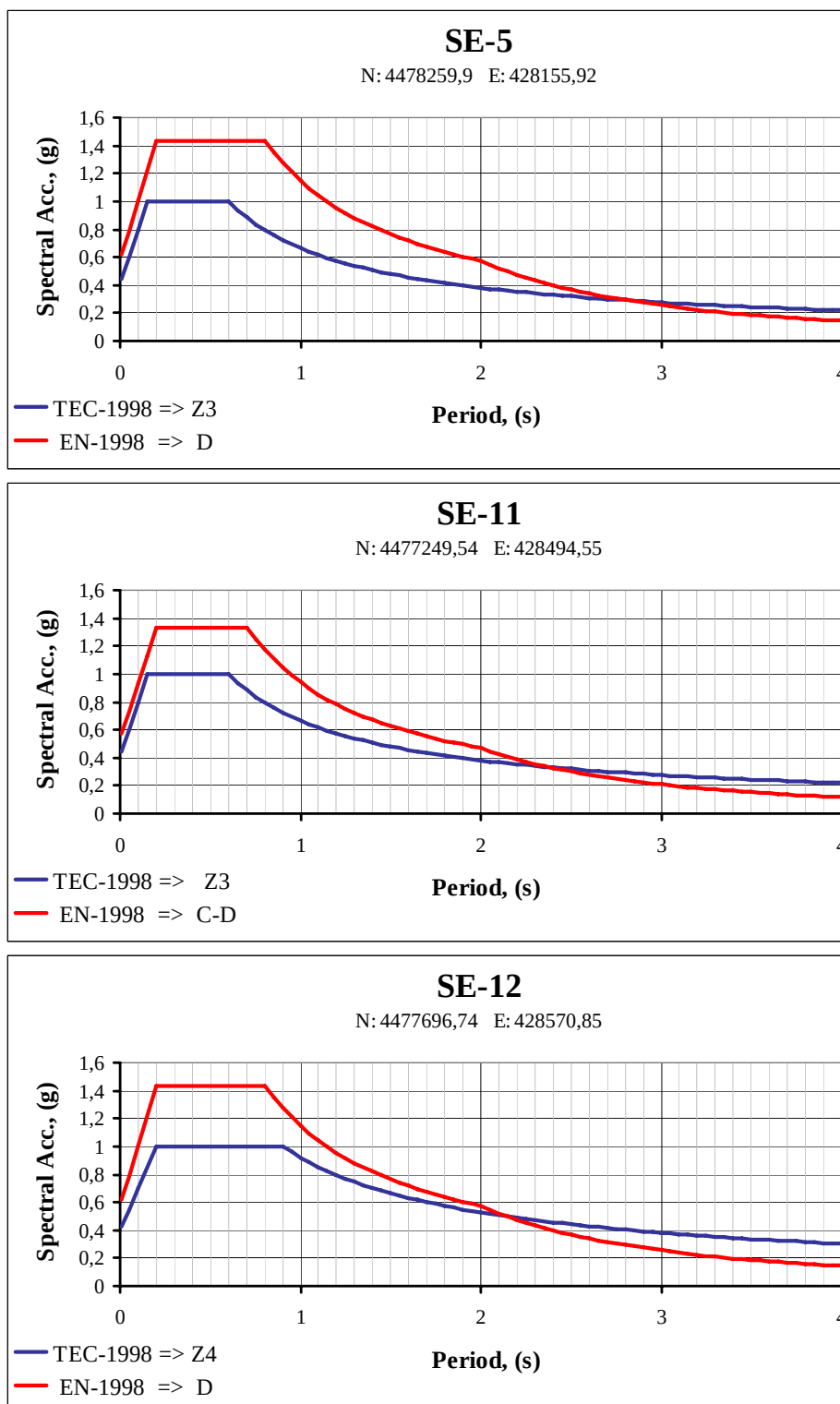


Figure D.11: Elastic response spectra for SE-5, SE-11 and SE-12

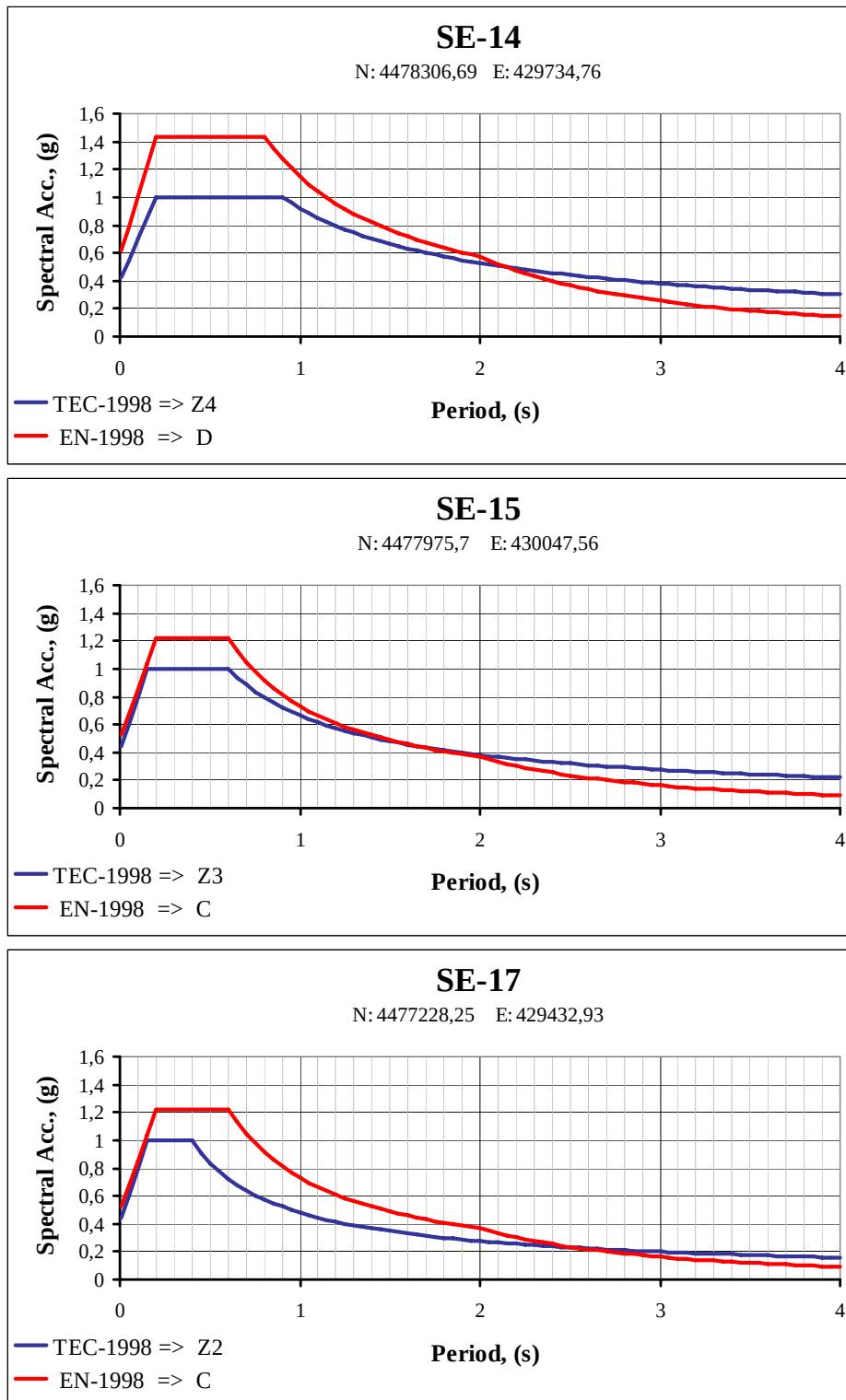


Figure D.12: Elastic response spectra for SE-14, SE-15 and SE-17

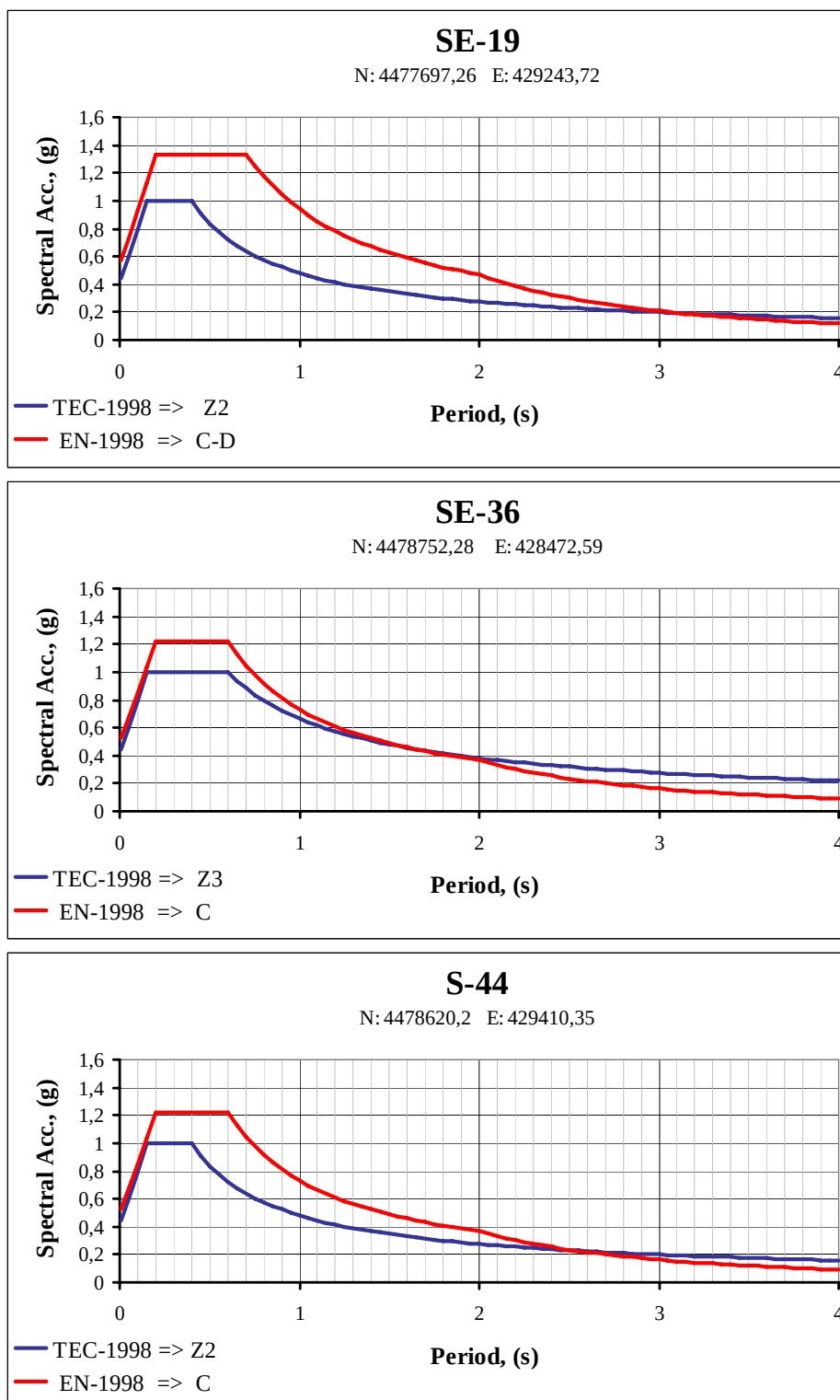


Figure D.13: Elastic response spectra for SE-19, SE-36 and SE-44

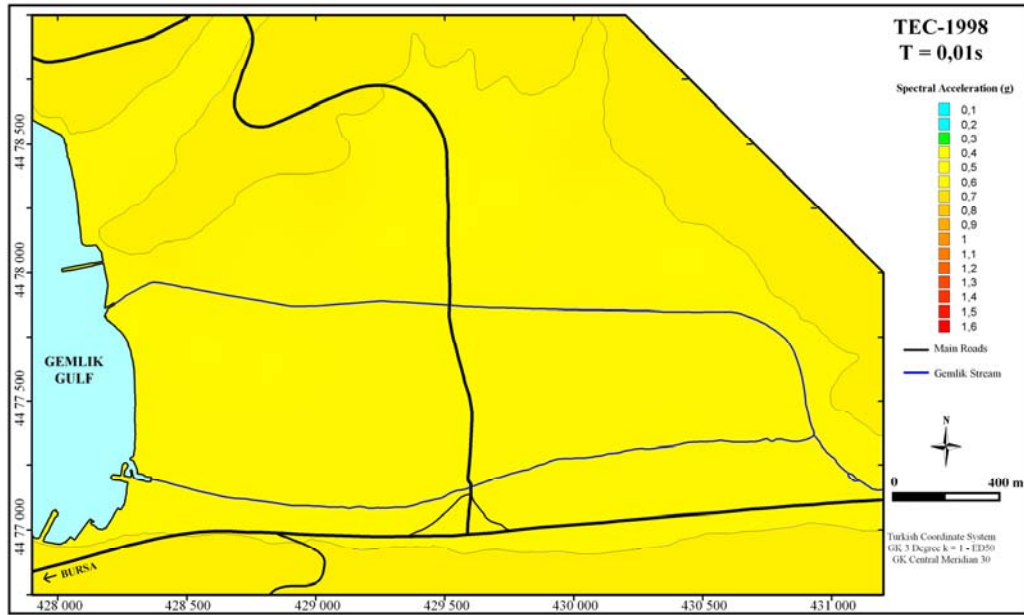


Figure E.1: Map of spectral acceleration at 0,01s for TEC-1998

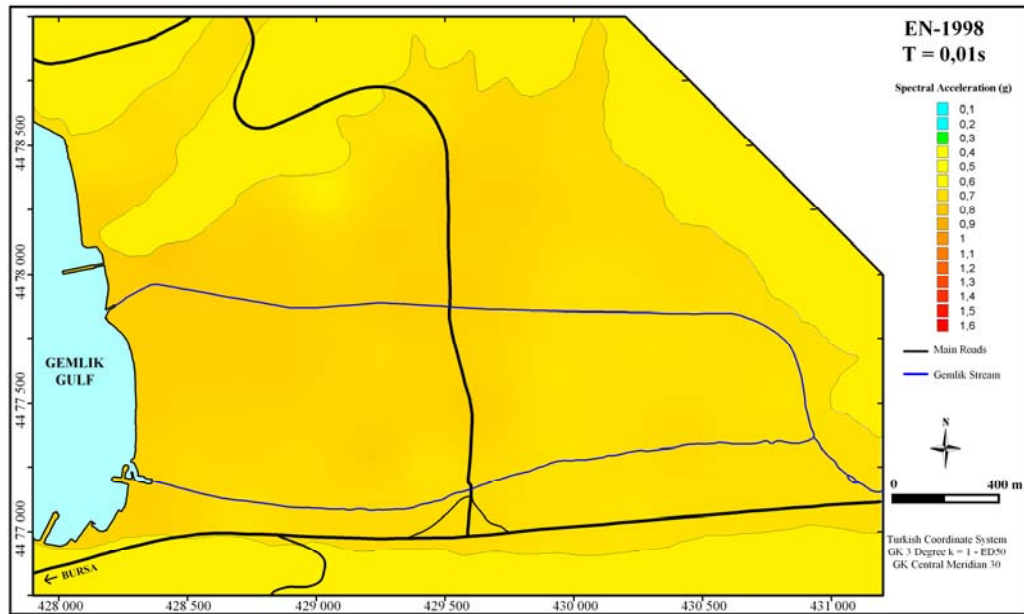


Figure E.2: Map of spectral acceleration at 0,01s for EN-1998

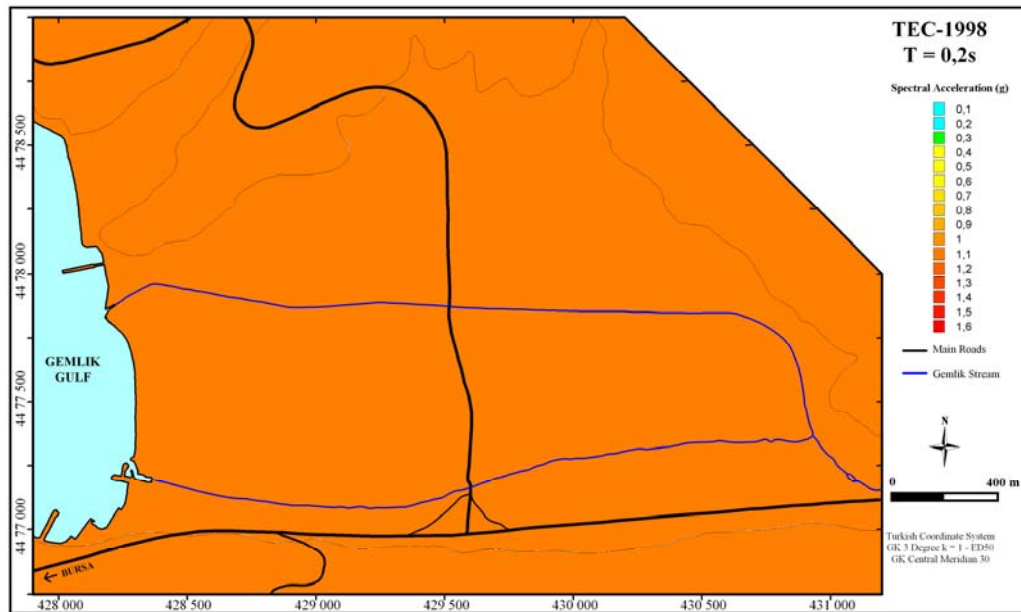


Figure E.3: Map of spectral acceleration at 0,2s for TEC-1998

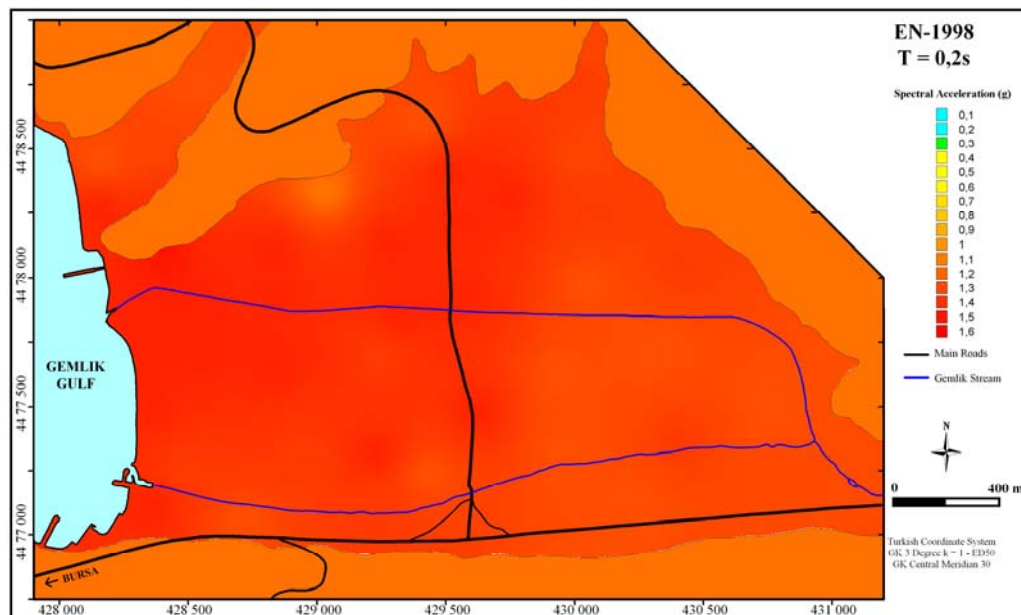


Figure E.4: Map of spectral acceleration at 0,2s for EN-1998

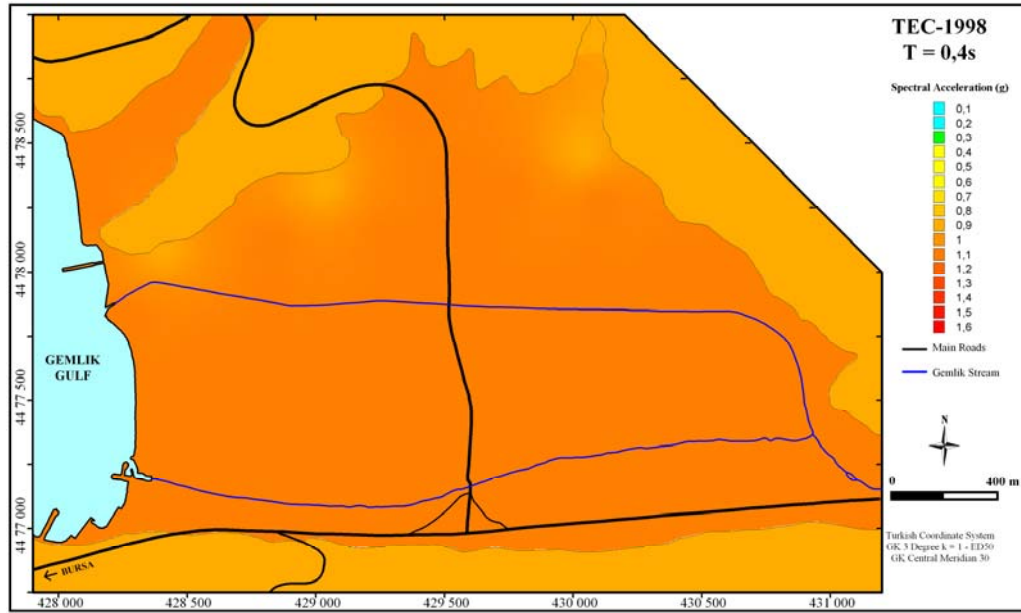


Figure E.5: Map of spectral acceleration at 0,4s for TEC-1998

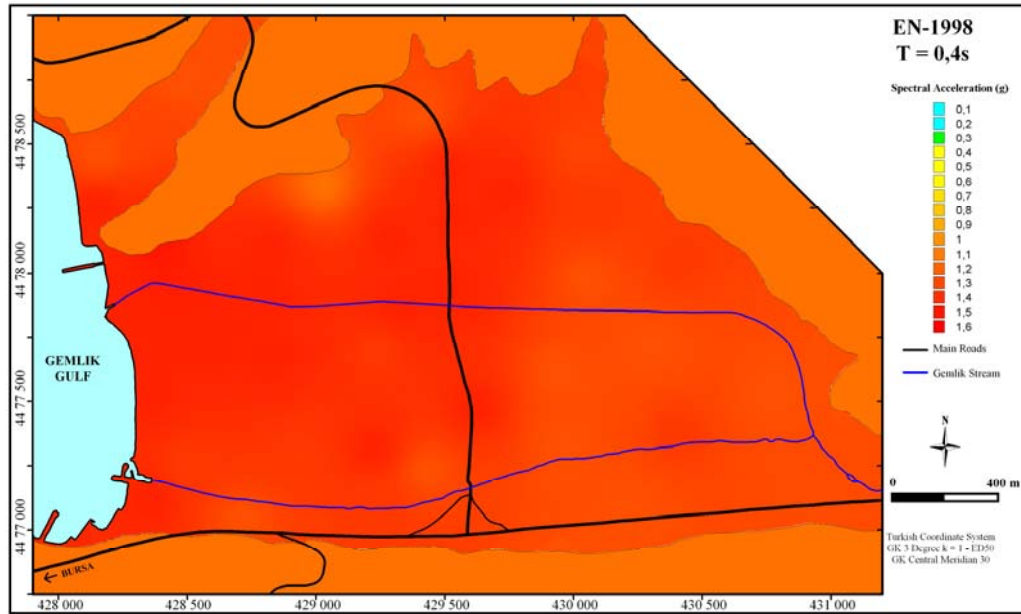


Figure E.6: Map of spectral acceleration at 0,4s for EN-1998

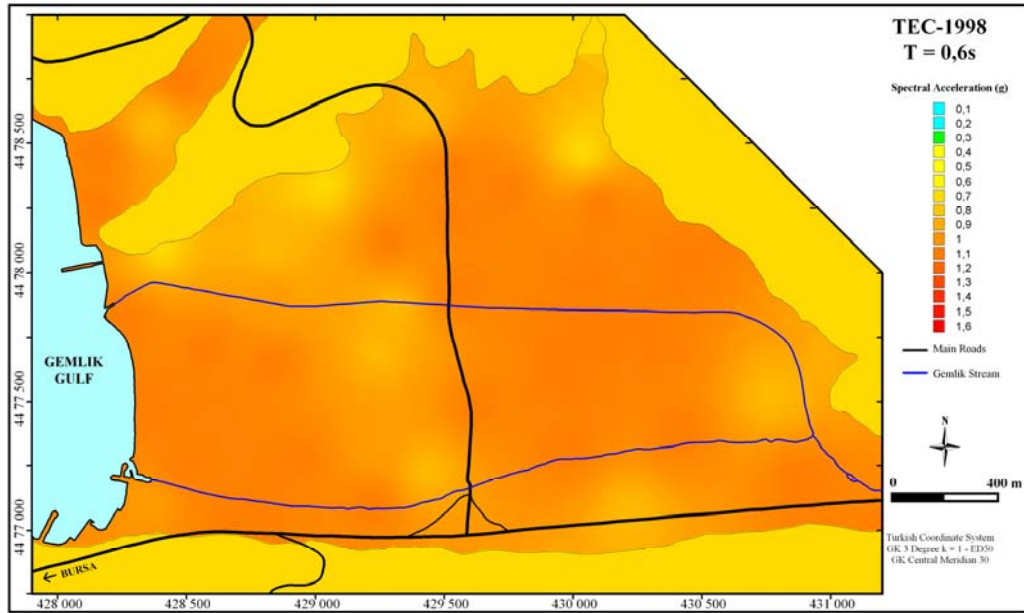


Figure E.7: Map of spectral acceleration at 0,6s for TEC-1998

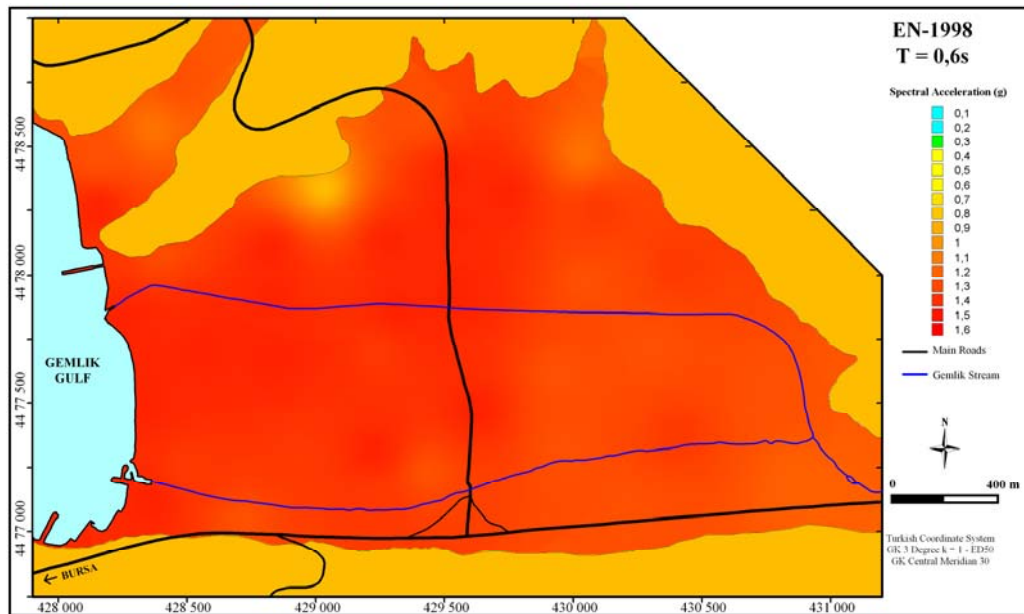


Figure E.8: Map of spectral acceleration at 0,6s for EN-1998

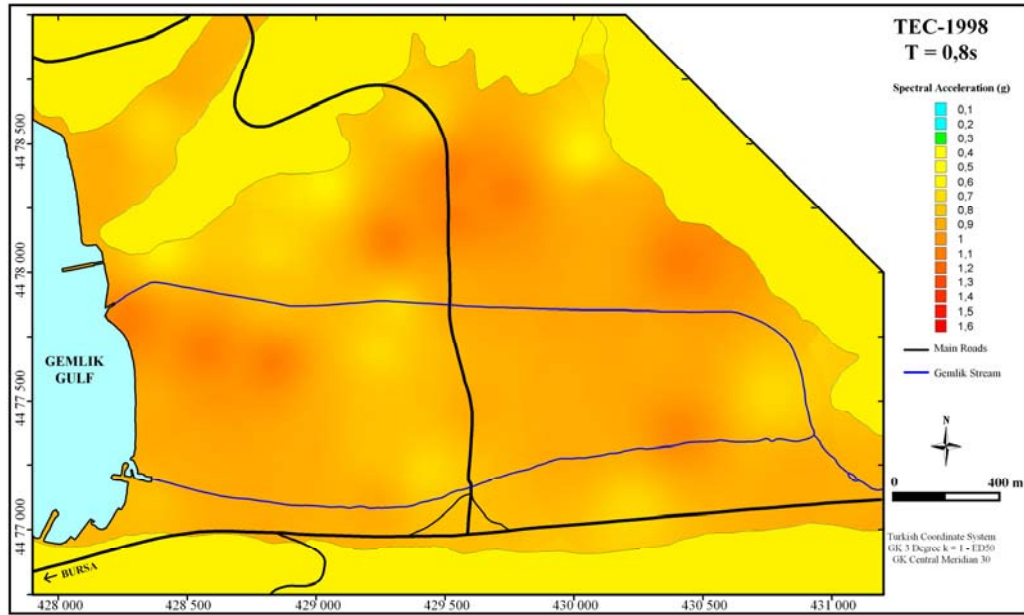


Figure E.9: Map of spectral acceleration at 0,8s for TEC-1998

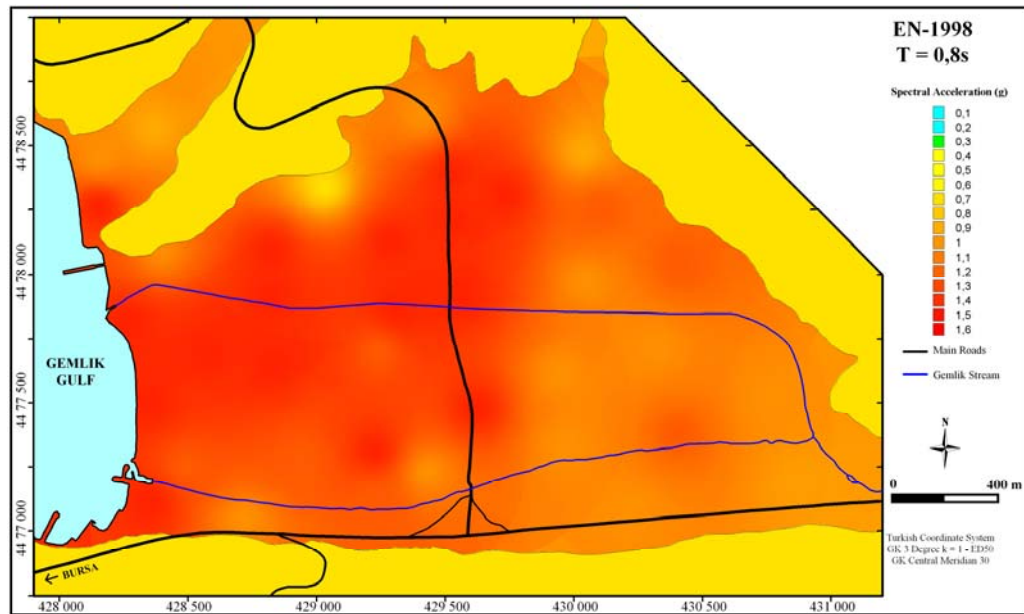


Figure E.10: Map of spectral acceleration at 0,8s for EN-1998

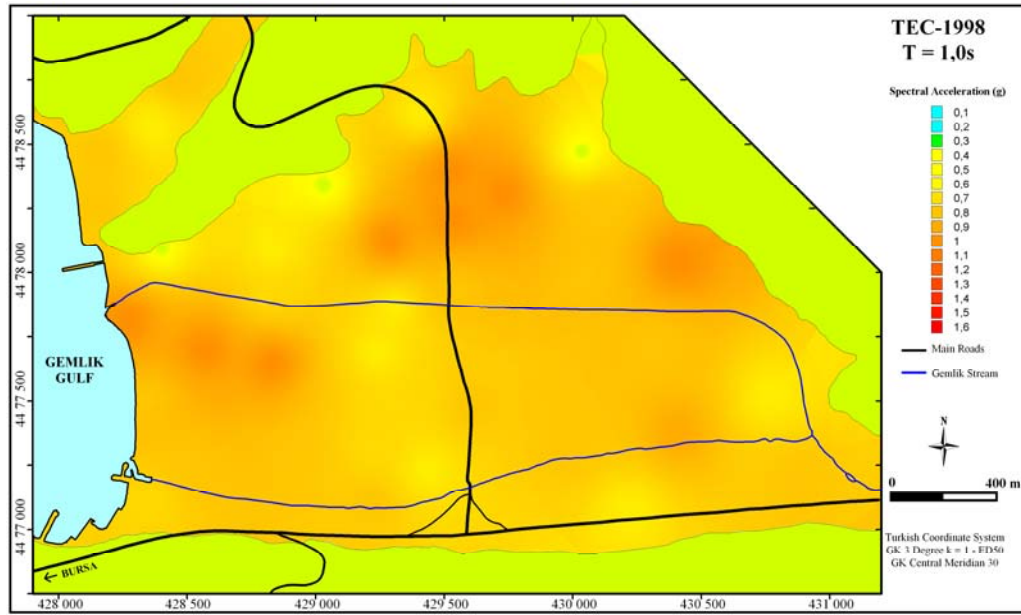


Figure E.11: Map of spectral acceleration at 1,0s for TEC-1998

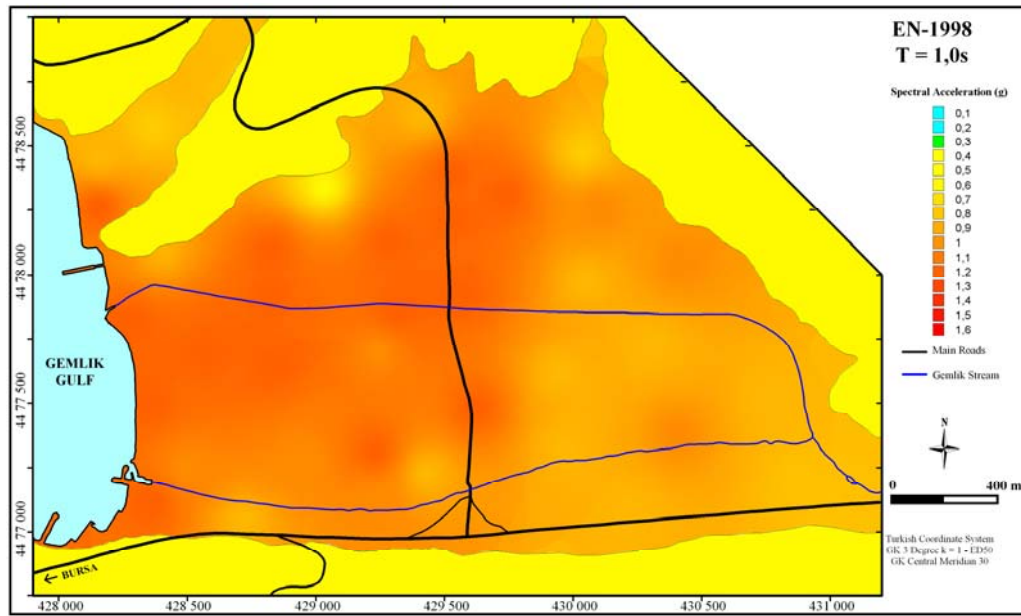


Figure E.12: Map of spectral acceleration at 1,0s for EN-1998

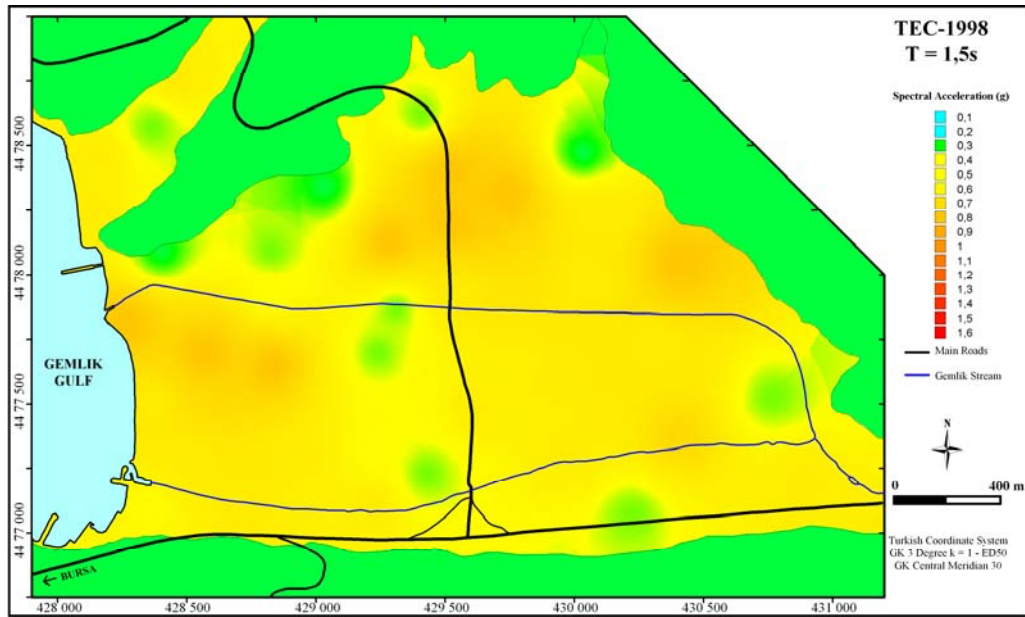


Figure E.13: Map of spectral acceleration at 1,5s for TEC-1998

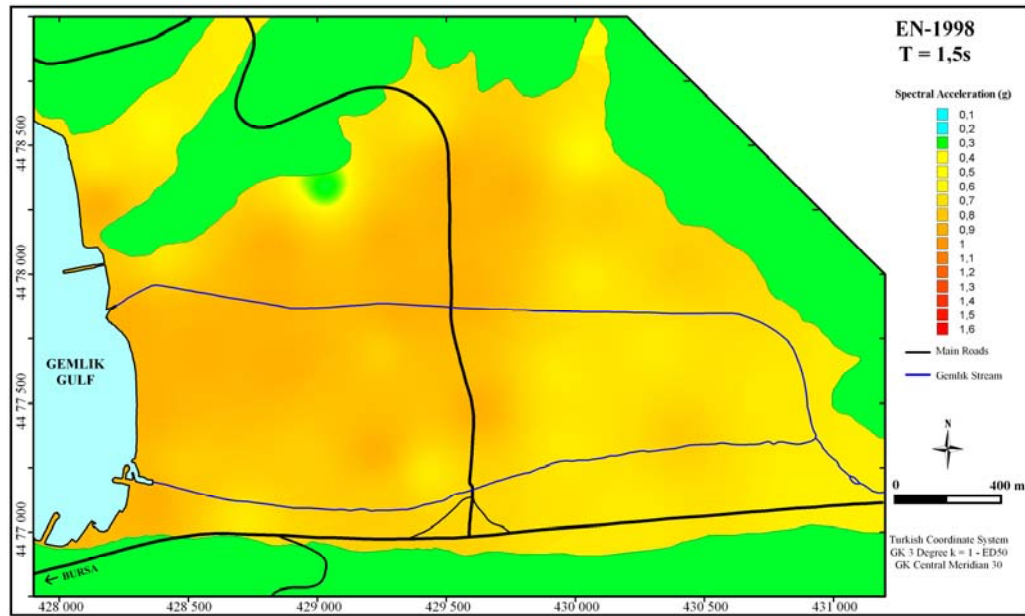


Figure E.14: Map of spectral acceleration at 1,5s for EN-1998

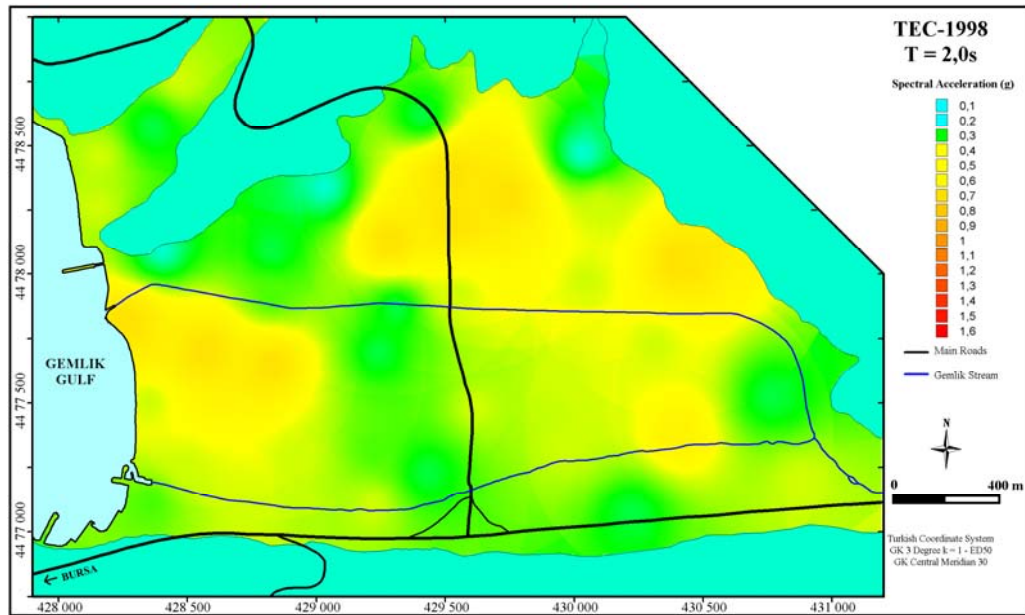


Figure E.15: Map of spectral acceleration at 2,0s for TEC-1998

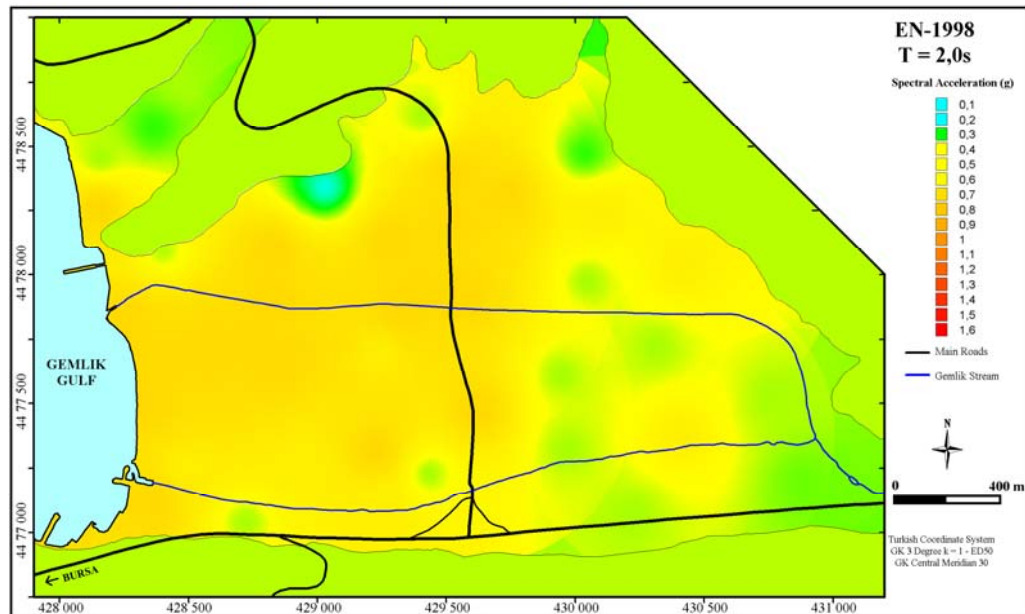


Figure E.16: Map of spectral acceleration at 2,0s for EN-1998

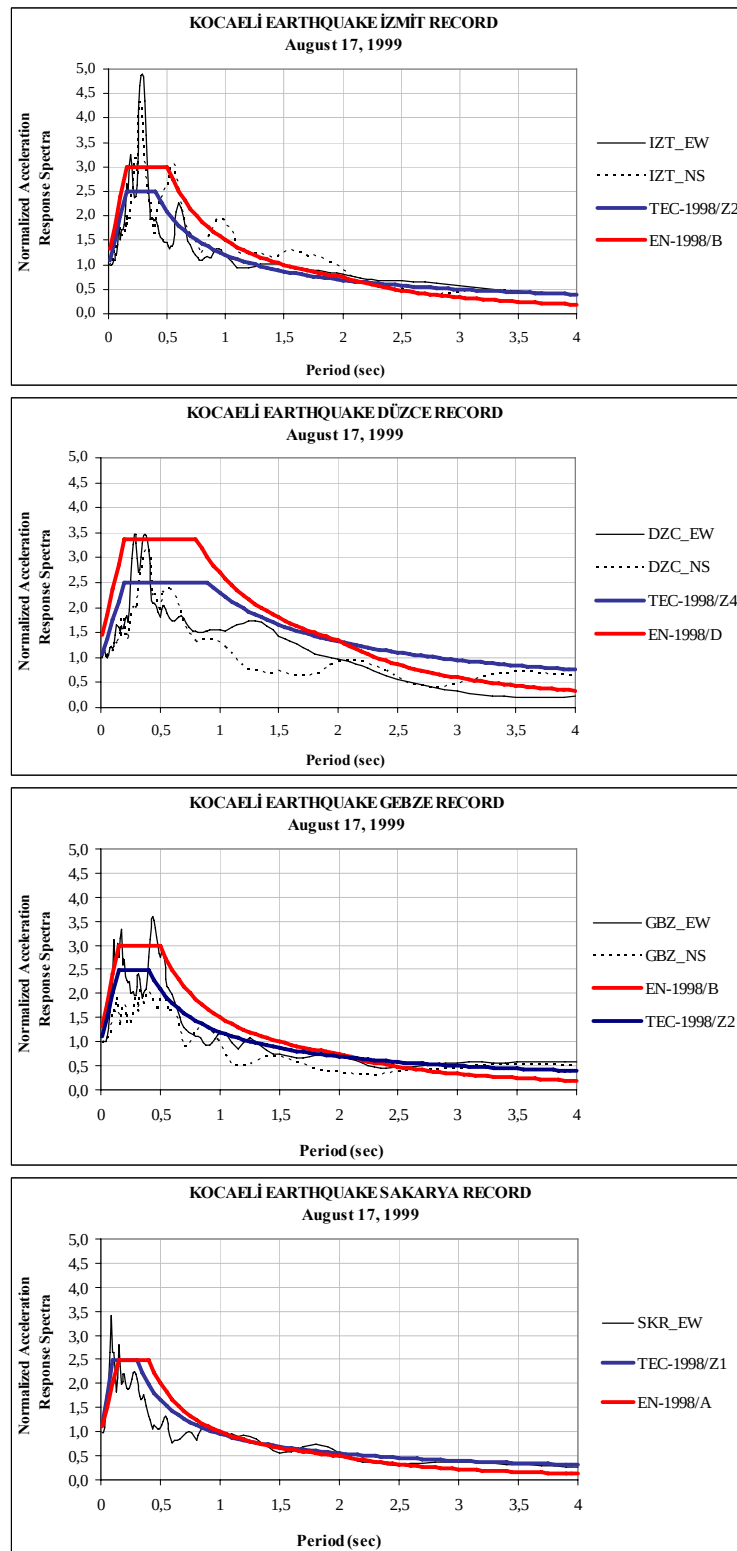


Figure F.1: Plot of normalized acceleration response spectra for Kocaeli Earthquake of August 17, 1999.

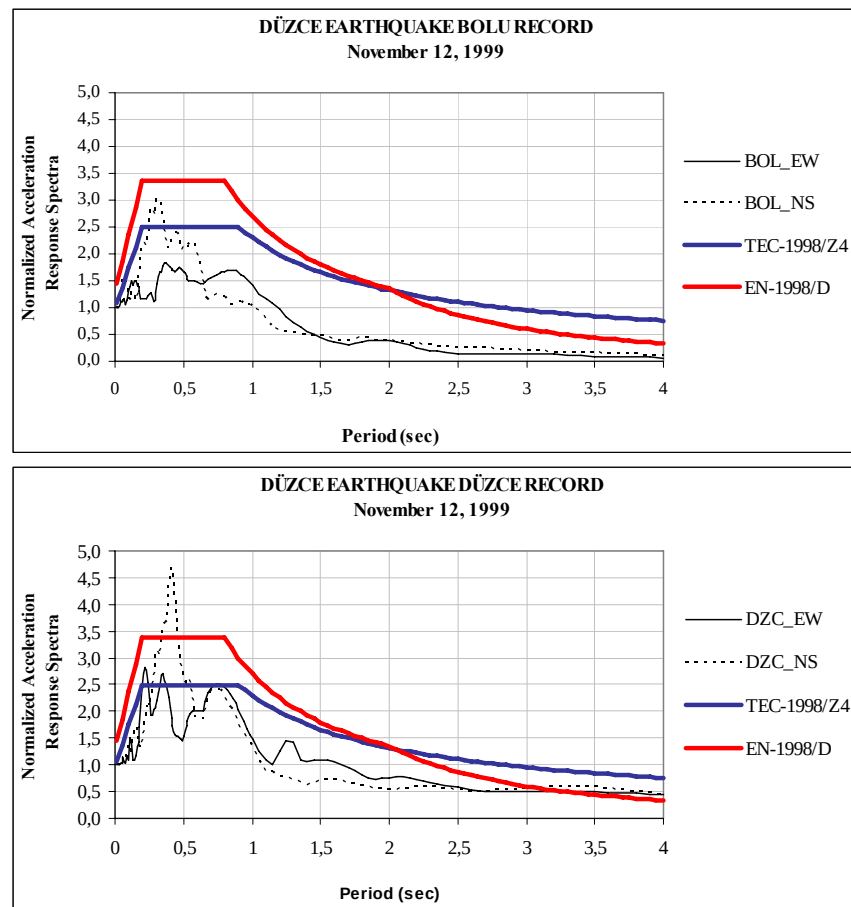


Figure F.2: Plot of normalized acceleration response spectra for Düzce-Bolu Earthquake of November 12, 1999.

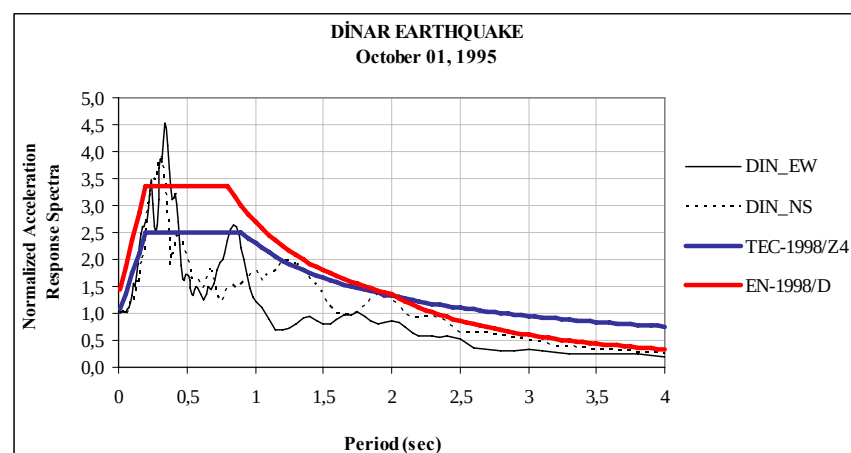


Figure F.3: Plot of normalized acceleration response spectra for Dinar Earthquake of October 01, 1995.

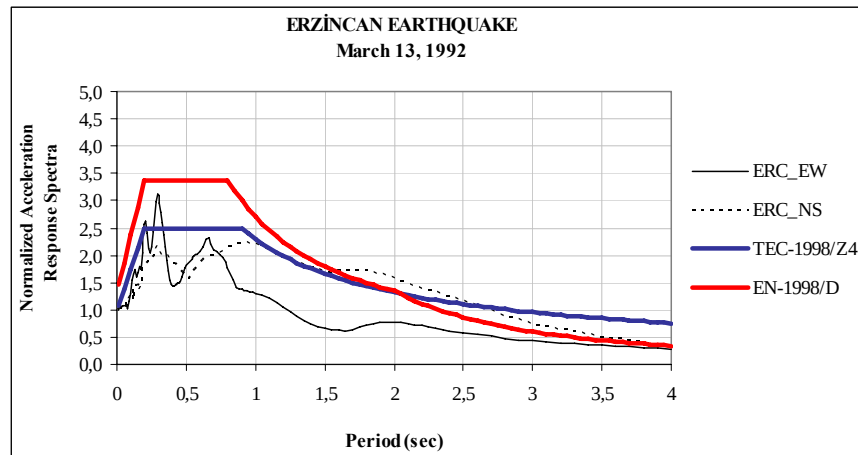


Figure F.4: Plot of normalized acceleration response spectra for Erzincan Earthquake of March 13, 1992.

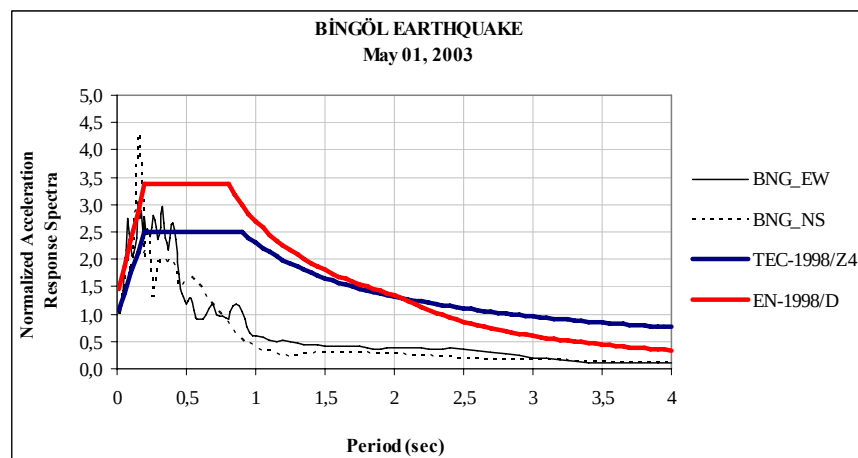


Figure F.5: Plot of normalized acceleration response spectra for Bingöl Earthquake of May 01, 2003.

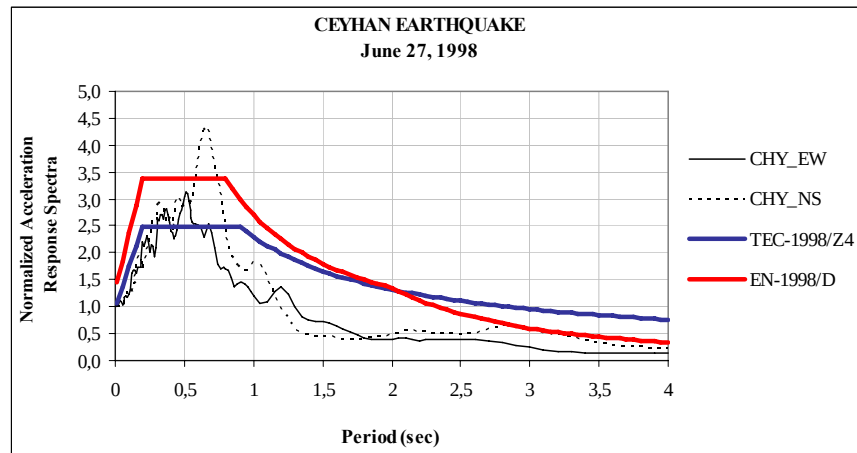


Figure F.6: Plot of normalized acceleration response spectra for Adana-Ceyhan Earthquake of June 27, 1998.