ASSESSMENT OF BURIED PIPELINE PERFORMANCE DURING THE 1999 DUZCE EARTHQUAKE

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ABSTRACT

ASSESSMENT OF BURIED PIPELINE PERFORMANCE DURING THE 1999 DÜZCE EARTHQUAKE

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The goal of this study is to develop probabilistically based empirical correlations for seismic performance assessment of buried pipelines. Within the scope of these research efforts, pipeline performance case histories have been compiled from Duzce city after Duzce earthquake. The characteristics of Duzce water supply and distribution system with the earthquake damage on the system were studied. Correlations of the damage patterns with the water distribution system, earthquake and geotechnical characteristics have been developed. Moreover spatial distributions of the earthquake effects have

been transferred into Geographic Information System (GIS) format. As a result of these studies, it was intended to define the seismic, geotechnical and structural parameters which may explain the spatial variability of the observed seismic pipeline hazard.

For the development of such correlations, a maximum likelihood framework for the probabilistic assessment of seismically induced buried pipeline performance is described. A database, consisting of post-earthquake field observations of buried pipeline performance after Duzce earthquake in conjunction with in-situ “index” test results, is used for the development of probabilistically based seismic pipeline performance correlations. As a result of careful processing of available data, the variables of the problem are selected as: liquefaction susceptibility of soil, thickness of soft soil layer if it exists, peak ground acceleration and estimated ground deformations. A limit state function is defined in terms of these variables. Repairs on the pipeline system due to earthquake are compiled with the surrounding soil and earthquake parameters and the correlations of pipeline performances with the mentioned variables are determined. Different sets of fragility curves are developed for seismic pipeline performance problem, representing various sources of uncertainty that are intrinsic to the problem. Such information is believed to be useful to utility system operators in planning a seismic retrofit or upgrade program for existing pipeline systems.

Keywords: Buried pipelines, pipes, seismic performance, maximum likelihood, liquefaction, liquefaction hazard, lifelines, reliability.

ÖZ

1999 DÜZCE DEPREMİNDE GÖMÜLÜ BORU HATLARININ PERFORMANSLARININ DEĞERLENDİRMESİ

Yargıcı, Volkan

Yüksek Lisans, İnşaat Mühendisliği Bölümü

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Temmuz 2003, 76 sayfa

Bu çalışmanın amacı gömülü boru hatlarının sismik performanslarının değerlendirmesi için, istatistiksel bağıntılar elde etmektir. Bu amaçla, Düzce depremi sonrasında Düzce'de boru hatlarının performansına ilişkin veriler toplanmıştır. Düzce su kaynakları ve su dağıtım şebekesi özellikleri ve Düzce depremi nedeni ile boru hatlarında meydana gelen hasarların tamir verileri incelenmiştir. Hasar dağılımının, su dağıtım şebekesi, deprem ve geoteknik özelliklerle korelasyonu araştırılmıştır. Ek olarak toplanan veriler coğrafi bilgi sistemleri formatına taşınmıştır. Bu çalışmaların sonucunda, gözlenen

sismik hasarların dağılımını açıklayabilecek sismik, geoteknik ve yapısal parametreler tanımlanmıştır.

Düzce depremi sonrası gömülü boru hatları performans saha gözlemleri maksimum olabilirlik yöntemi kullanılarak değerlendirilmiştir. Düzce depremi sonrası gömülü boru hatları performanslarının saha gözlemlerinden oluşan bir veri tabanı, istatistiksel tabanlı sismik boru performans korelasyonlarının geliştirilmesinde kullanılmıştır. Toplanan verilerin incelenmesi sonucunda, hasarı etkileyen değişkenler; zeminin sıvılaşma eğilimi, olası yumuşak toprak katmanlarının kalınlığı, maksimum yer ivmesi ve hesaplanan zemin deformasyonları olarak seçilmiştir. Seçilen geoteknik ve sismik değişkenler kullanılarak, boru hatlarının performansını ortaya koyan bir limit durum fonksiyonu önerilmiştir. Gömülü boru hatlarının sismik performanslarına ilişkin kırılganlık eğrileri sunulmuştur. Bu çalışmanın kamu hizmeti kuruluşlarının var olan gömülü boru hatlarının yeniden değerlendirilmesi ve yenilenmesi çalışmalarında faydalı olacağı düşünülmektedir.

Anahtar Kelimeler: Gömülü boru hatları, borular, sismik performans, maksimum olabilirlik, sıvılaşma, güvenirlik.

To my family

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Thanks and acknowledgements are given to all my friends for their friendship, fellowship and encouraging support.

For once again in my life, but I believe not for the last time, I want to thank my parents, my brother and sister. I cannot possibly begin to describe how much their love means to me.

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LIST OF SYMBOLS

AC	:	Asbestos cement
C	:	The propagation velocity of the wave
CI	:	Cast iron
CONC	:	Concrete
CSR	:	Cyclic stress ratio
DI	:	Ductile iron
DR	:	Damage rate per km
FC	:	Fines content
GIS	:	Geographic information systems
M_w	:	Moment magnitude of the earthquake
MMI	:	Modified Mercalli Intensity
NAF	:	North Anatolian Fault
PE	:	Polyethylene
PGA	:	Peak ground acceleration
PGD	:	Permanent ground deformation
PGV	:	Peak ground velocity
PL	:	Probability of liquefaction
PVC	:	Polyvinyl chloride
RR	:	Repair rate
SGMR	:	Strong ground motion record

S	:	Liquefaction induced ground settlements
SI	:	Spectrum intensity
SPT	:	Standard penetration test
SPT-N	:	Standard penetration test blow counts
V_{max}	:	The peak horizontal particle velocity
WSGWJ	:	Welded steel gas-welded joints
WSCJ	:	Welded steel caulked joints
WSAWJ (X)	:	Welded steel arc-welded joints (X grade)
WSAWJ (A,B)	:	Welded steel arc-welded joints (Grade A, B)
TFR	:	Total failure rate
ε	:	Model correction term
φ	:	Normal probability density function
ϕ	:	Pipe diameter
σ	:	Standard deviation
ν	:	Damage rate
θ	:	Model parameters

CHAPTER 1

INTRODUCTION

In 1999 two strong earthquakes; August 17, Kocaeli Earthquake (M_w=7.4) and November 12, Duzce Earthquake (M_w=7.2) shook Turkey's urban areas, resulting in widespread economical and life losses, as well as lifeline damage. This study will focus on understanding the performance of water delivering pipelines subjected to earthquake.

In the event of an earthquake, a water delivery system may sustain various kinds of damage that may result in considerable reduction in water flow and water pressure in the water delivery system. The failure of the water delivery system not only impairs fire-fighting capacity, but also disrupts residential, commercial, and industrial activities resulting in huge economic losses. Since water delivery systems are one of the critical lifeline systems in an urban area, it is important to assess the seismic performance of these systems.

Loss estimation predictions for future earthquakes are needed for various reasons, including emergency response, risk management, and hazard mitigation. These estimations can be used by municipalities, governmental officials for planning and allocating efforts and resources to reduce hazards from earthquakes and for emergency response and recovery preparations.

1.1 Research Statement

Within the scope of these research efforts, pipeline performance case histories have been compiled from Duzce city after Duzce earthquake. A comprehensive study on Duzce water supply and distribution system has been carried out and pipeline repairs due to Duzce earthquake have been investigated. The characteristics of Duzce water supply and distribution system with the earthquake damage on the system were studied. Correlations of the damage patterns with the system, earthquake and geotechnical characteristics have been developed. Moreover spatial distributions of the earthquake effects have been transferred into Geographic Information System (GIS) format. As a result of these studies, it was intended to define the seismic, geotechnical and structural parameters which may explain the spatial variability of the observed seismic pipeline hazard.

The objectives of this study are listed as follows:

1. Evaluation of November 12, 1999 Duzce earthquake (Mw=7.2) effects on Duzce water supply systems.
2. Investigation of the predictions of the available pipeline performance models and their applicability to the Duzce water pipeline system.
3. Development of a probabilistic model for seismic performance assessment of buried pipelines: characterization of areal damage intensity from the point source repair data and identifying the correlation of lifeline damage with seismic, geotechnical and pipeline properties.

1.2 Problem Significance and Limitations of Previous Studies

Although there exist several pipe damage predictive models available in the literature, most of them have severe limitations. Some researchers tried to correlate the observed damage with only one parameter such as peak ground acceleration (PGA) (Chen et al.. 2002, Katayama et al. 1975, Patelunas et al. 1977, Erel et al. 1977, O'Rourke and Ayala 1991), or Modified Mercalli Intensity (MMI) (Eguchi 1991), or peak ground velocity (PGV) (O'Rourke and Ayala 1993, Chen et al. 2002) or spectrum intensity (SI) (Chen et al. 2002). Some others incorporated pipeline material properties (Eidinger et al. 1995) or pipe geometry (Honegger 1995) into their correlations.

However, in addition to the lack of a robust model addressing significant parameters of the problem, main limitation of previous studies is that they are based on pipe performance databases primarily lacking asbestos cement (AC) pipe seismic performances due to their rare use in water distribution systems contrary to their wide use in Turkey.

1.3 Scope

Within the scope of this research work, a maximum likelihood framework for the probabilistic assessment of seismically induced buried pipeline performance is described. A database, consisting of post-earthquake field observations of buried pipeline performance after Duzce earthquake in conjunction with in-situ "index" test results, is used for the development of probabilistically based seismic pipeline performance correlations. As a result of careful processing of available data, the variables of the problem are selected as: liquefaction susceptibility of soil, thickness of soft soil layer if one exists, peak ground acceleration and estimated ground deformations. A limit state

function is defined in terms of these variables. Repairs on the pipeline system due to earthquake are compiled with the surrounding soil and earthquake parameters.

This thesis is divided into five chapters, the first of which presents the research statement and introductory comments. Chapter 2 contains a discussion of available pipeline performance correlations with different seismic parameters.

Chapter 3 presents the compiled database, briefly. This database is composed of seismic data from the Duzce Earthquake, geological and geotechnical information about Duzce City, and the water distribution network information. Visualization of the city network, and the spatially distributed damage it sustained during Duzce Earthquake is presented using Geographical Information System (GIS). Liquefaction potential of the city with estimated liquefaction induced permanent ground settlements is described in this chapter as well.

In Chapter 4, the probabilistic models for seismic performance assessment of buried pipelines are developed.

In the final chapter, research findings of this work are summarized, and the conclusions are presented.

Finally in Appendix A and in Appendix B, the database of the collected and resultant data of this research can be found.

CHAPTER 2

AN OVERVIEW OF AVAILABLE METHODS FOR THE ASSESSMENT OF THE SEISMIC VULNERABILITY OF PIPELINES

Seismic performance of buried pipelines has been a topic of considerable interest for various researchers. Researchers approach to this problem from different paths; some used empirical relationships while others presented analytical models. Analytical approaches help us to understand the failure mechanisms, whereas empirical solutions lead to useful and simple damage correlations with seismic parameters. These valuable researches are discussed and their applicability to Duzce water pipeline network is investigated.

Katayama, et al. (1975) compiled earthquake and pipeline damage information associated with the 1923 Tokyo, 1948 Fukui, 1964 Niigata, 1968 Tokachi-Oki, 1972 Managua, and 1971 San Fernando earthquakes. They reported that they had difficulties in assessing pipeline damage data as well as strong motion correctly. Because of lack of data they had to make major assumptions regarding the seismic ground motion characteristics of 1923 Tokyo, 1948 Fukui and 1972 Managua earthquakes. Katayama et al. (1975) developed one of the first correlations between damage rate and peak ground acceleration

(PGA). As shown in Figure 2.1 pipeline performance was expressed as number of failures per kilometer as a function of maximum acceleration.

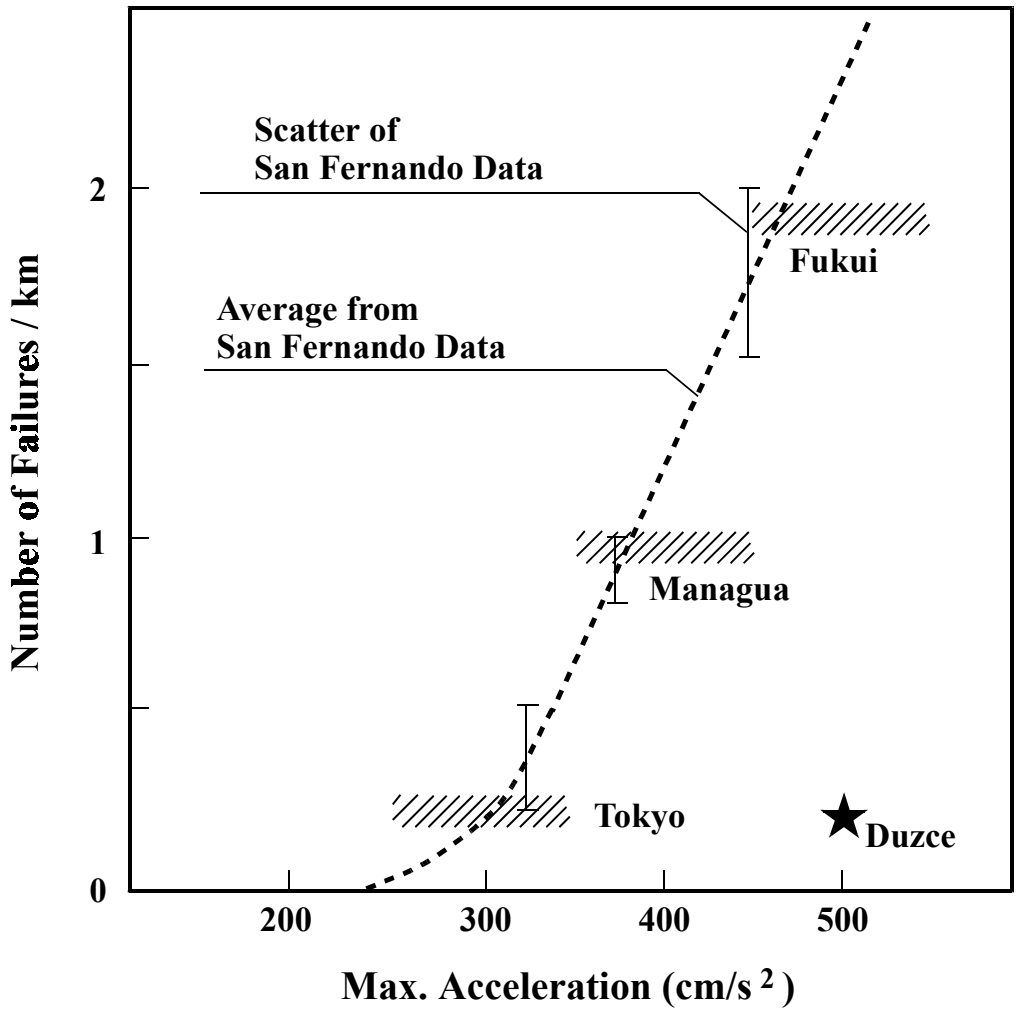

Figure 2.1 Pipe damage versus peak ground acceleration (After Katayama et al., 1975)

Reported number of failures in Duzce, after the Duzce earthquake is 32 repairs per 160 km of the pipeline corresponding to a repair rate of 0.2 repairs/km. Peak ground acceleration at a soil site was recorded as 0.513 g at Duzce strong ground motion station. By using this information, failure rate and acceleration data pair is also shown in Figure 2.1. This plot clearly shows that pipeline damage after Duzce earthquake in the city of Duzce is less than what is anticipated by Katayama method (2.25 failures/km)

After Katayama, Patenulas, et al. (1977) and Erel, et al. (1977) reanalyzed the database that was compiled by Katayama, et al. and prepared the plot in Figure 2.2. This plot has more explicit information about data points and is widely used by other researchers (O'Rourke and Ayala, 1993, Toprak, 1998). As shown in Figure 2.2 the damage rate increases by a factor of 100 if peak ground acceleration is doubled. Duzce data is also shown on this plot for comparison purposes.

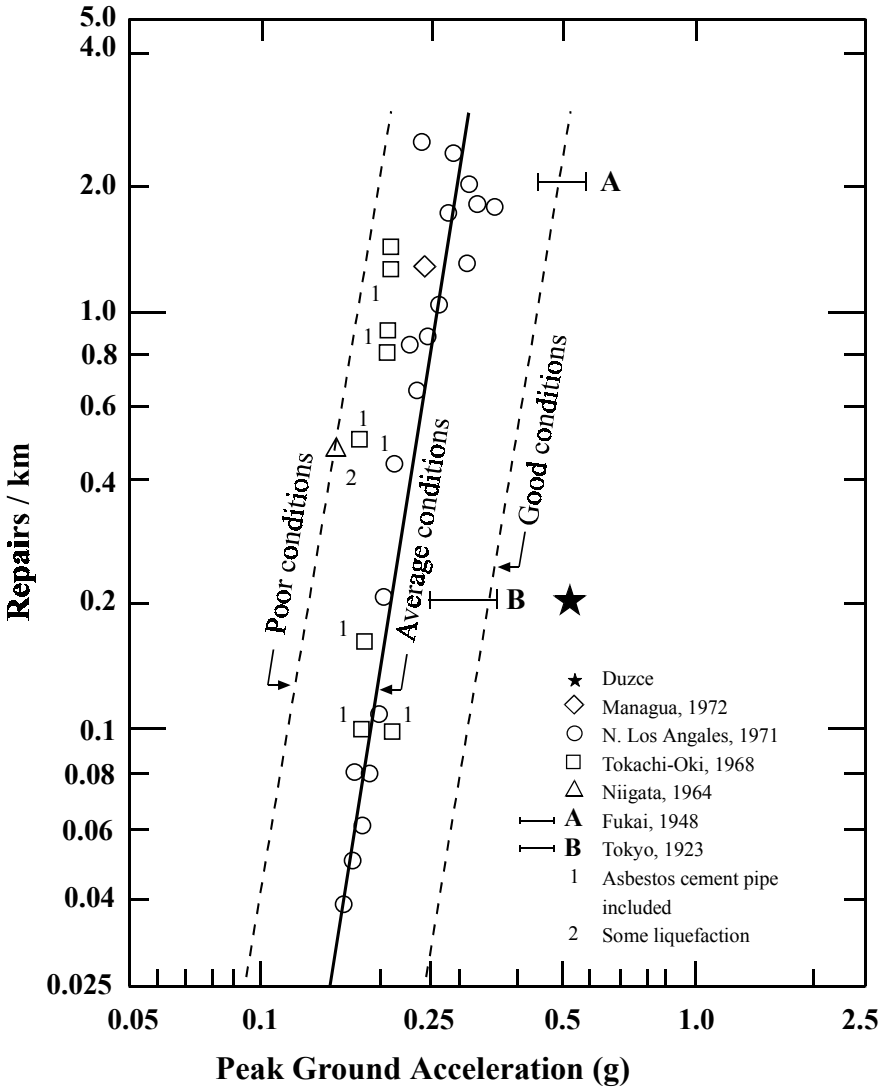

Figure 2.2 Pipe damage versus peak ground acceleration (After Katayama et al., 1975, Patenulas et al. 1977, Erel et al., 1977)

Eguchi (1983) summarized pipe failure rate versus Modified Mercalli Intensity (MMI) for several earthquakes in the United States, and developed fragility relations for six different pipeline materials subject to the wave propagation hazard. His 1991 plot is shown in Figure 2.3, where the following notation is used: AC = Asbestos Cement, CONC = Concrete, CI = Cast Iron, PVC = Polyvinyl Chloride, WSCJ = Welded Steel Caulked Joints, WSGWJ = Welded Steel Gas-Welded Joints, WSAWJ (A, B) = Welded Steel Arc-Welded Joints (Grade A, B), WSAWJ (X) = Welded Steel Arc-Welded Joints (X Grade), DI = Ductile Iron, PE = Polyethylene. Note for MMI < 8, the damage rate increases by a factor of 10 for a unit increase in MMI. A unit increase in MMI results in roughly doubling of the damage ratio for MMI > 8. Also note that for any given ground motion intensity the damage ratio for asbestos cement pipelines is roughly 2.5 times that of cast iron pipelines. However, it should also be noted that cast iron pipes are vulnerable to corrosion related damage. For example, peak horizontal accelerations are reported as between 0.23 and 0.4g in El Centro after 1979 Imperial Valley earthquake (Porter, 1983), and the corresponding damage rate for cast iron pipelines was 1.03 repair/km. Eguchi, 1982 related this high damage rate to corrosion-prone characteristics of cast iron pipes.

O'Rourke et al. (1985) emphasized that although it is acceptable to assume soil motions of all points at the foundation level to be identical for regular structures, this assumption may not be valid for long structures such as buried pipelines. Because as seismic waves propagate away from the epicentral region, the soil motions at two points of a buried pipeline would be out of phase leading to relative displacements over the length of pipeline and axial strains.

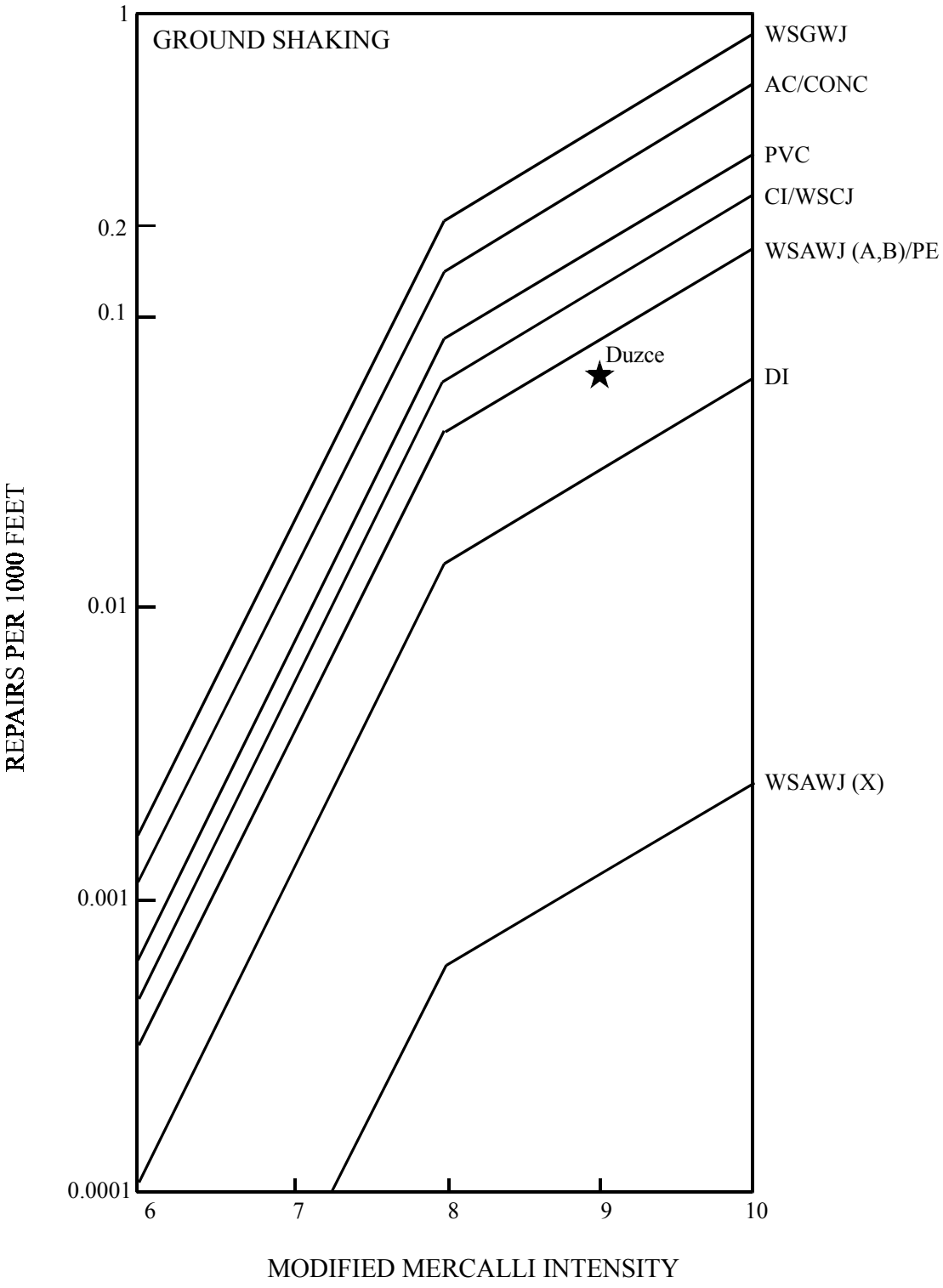

Figure 2.3 Pipe damage versus Modified Mercalli Intensity (After Eguchi, 1983)

Many researchers approach the pipeline response to seismic waves problem analytically. Pipelines are long structures and unlike most above ground structures their response is affected by differential movements along their length. Since buried pipelines are totally surrounded by soil, soil pipe interaction is an important factor in determining the pipeline response to seismic wave propagation. For longitudinal or axial motion of the pipeline, soil-pipe interaction is generally modeled by discrete spring sliders distributed along the pipeline (Colton et al. 1981, O'Leary and Datta 1985, O'Rourke and Wang 1978). Hahn (1993) proposed an analytical expression that can be used to find associated bending moment and stresses in the pipeline for different supporting conditions.

Wong et al. (1986) developed a model to analyze the effects of seismic shaking on a buried pipe including the full interaction of the pipe with the surrounding soil. He examined the three dimensional nonaxisymmetric response of a pipeline caused by plane body and surface waves moving at arbitrary angles to the axis of pipeline buried in a semi-infinite medium, taking full dynamic interaction between the pipe and surrounding ground into account. He developed a mathematical model for three-dimensional motion of a long continuous pipe embedded in a semi-infinite homogeneous isotropic elastic medium. The result of this investigation reveals that dynamic amplification is significantly dependent on the properties of the surrounding ground, the frequency, the angle of incidence, and the depth of embedment.

Based on data from three U.S. earthquakes namely San Fernando, 1971, Santa Rosa, 1969, Puget Sound, Seatle, 1965, Barenberg (1988) correlated the pipeline damage rate as repairs or breaks per kilometre with the two forms of ground motion, namely velocity induced ground strain and permanent ground displacement. In

his technical note, velocity induced ground strain ($\varepsilon_{max}=V_{max}/C$, ε_{max}=peak ground strain; V_{max}= the peak horizontal particle velocity; C= the propagation velocity of the wave) is assumed to govern pipeline damage at large distances from the actual fault where transient ground waves dominate the ground motion. Significant levels of permanent ground displacement occur in regions near the fault and attenuate rapidly. The main uncertainties included in the research are coming from the uncertainties in peak particle velocity and the "C" value. In the research "C" is taken as constant through out all the area and equal to 2.1 km/s as O'Rourke and Castro (1981) have stated as the average apparent propagation velocity in their study of San Fernando Earthquake in 1971. It is concluded that it is reasonable to characterize pipeline damage with a transient ground motion parameter in a region of low intensity shaking and permanent ground displacement in regions of high intensity shaking.

In addition to the four data points of Barenberg, O'Rourke and Ayala (1993) include seven new data points from two Mexican and one U.S. earthquakes. In Figure 2.4 all eleven data points and the proposed correlations are plotted. They also prepared a plot of wave propagation damage rate versus peak ground velocity including cast-iron pipe, concrete pipe, pre-stressed concrete pipe and asbestos cement pipe where damage predictions are somewhat higher than Barenberg's. They assigned the increase in the damage rates of some sites in their database to the special soil conditions such that for points well above the best line (Point E) the low resistivity surrounding soil lead to pipe corrosion and variable sub-surface conditions. For points well below the best line (point F) they noted that relatively uniform soil conditions decreased the damage rate. Damage ratio of Duzce city is marked on this plot, and it is obvious that damage rate in Duzce city is quite away from their estimation.

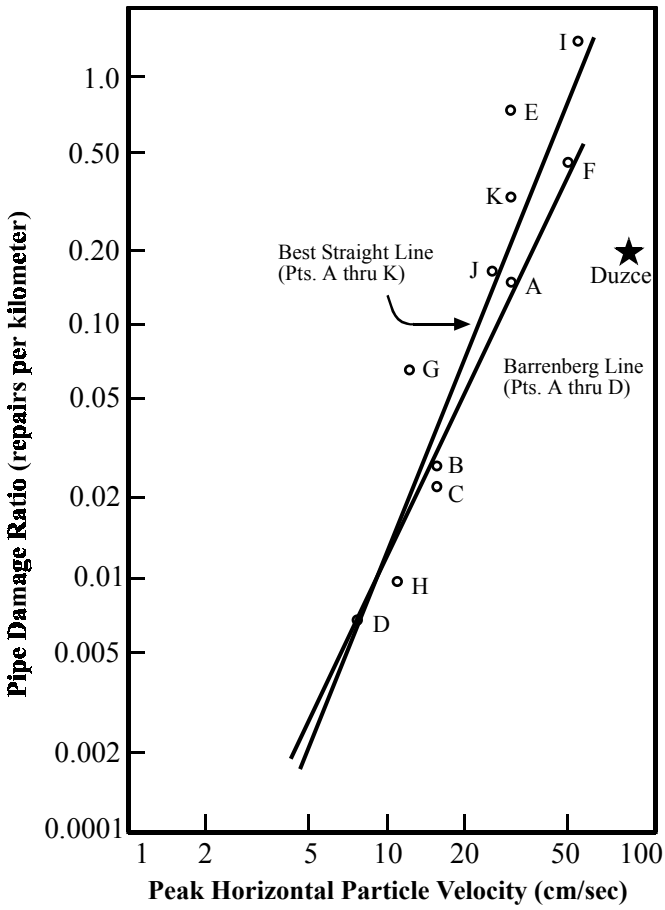

Figure 2.4 Wave propagation damage to pipe system versus peak horizontal particle velocity (After Baranberg, 1988, O'Rourke and Ayala, 1993)

Various researchers have subsequently developed empirical wave propagation damage relations for different pipe materials (e.g. : Eidinger et al., 1995) or for different diameter ranges (Honegger, 1995). O'Rourke and Ayala relation is currently being used to estimate wave propagation damage to brittle type materials in HAZUS, the FEMA/NIBS earthquake loss estimation program.

Heubach (1995) derived damage rate equations for liquefaction induced permanent ground deformation (PGD) for various types of pipes with either rigid or flexible joints. According to Heubach, the pipe damage rate, ν, for cast iron pipes with rigid joints is:

$$\nu = 100 \{1- \exp[-(1.12*PGD)^{1.69}]\} \quad (2.1)$$

and the pipe damage rate for ductile iron pipes with flexible joints is:

$$\nu = 100 \{1- \exp[-(0.283*PGD)^{1.33}]\} \quad (2.2)$$

In these equations, PGD = permanent ground deformation in meters.

Following the Northridge, California Earthquake, Trifunac and Todorovska (1996) developed empirical scaling equations, which relate the average number of pipe breaks per km^2 with peak strains in soil or intensity of the shaking at the site.

O'Rourke et al. (1997) investigated liquefaction sites in San Francisco affected by 1906 and 1989 earthquakes with combining subsurface mapping and evaluation of liquefaction damage. They defined 3 characteristic dimensions related to liquefaction listed as:

a) **submerged thickness:** the interested thickness of soil below ground water table,

b) **maximum liquefiable thickness:** where the submerged deposit is interlayered by clay and silt with low liquefaction susceptibility, the maximum liquefiable thickness is evaluated by subtracting the cumulative thickness of clay and plastic silt layers from the submerged deposit thickness

c) **liquefiable thickness:** In addition to the maximum liquefiable thickness it also involves an assessment of which granular soils are susceptible to liquefaction for a given intensity. Investigation of liquefaction effects showed that the thickness of liquefiable layer is an indicator for both permanent ground deformation and locally amplified strong ground motion. They concluded that liquefiable thickness can be correlated with settlement associated with post liquefaction consolidation,

horizontal surface movement resulting from lateral spread and intensity of buried pipeline damage. Wave propagation damage to ductile pipe materials is taken as a third of the brittle pipe value.

Hwang et al. (1998), evaluated seismic vulnerability of buried pipelines using pipe damage rate versus ground motion parameters such that ground shaking and soil liquefaction. Based on the data from 1995 Kobe earthquake and the results from previous studies they proposed a refined pipe damage correlation. They stated that for strong ground motions, O'Rourke's (1991) PGA versus damage rate correlations are overestimating the damage because they include data not only from ground shaking but also from liquefaction induced pipeline damage cases. They also provided some modification factors for pipe diameter or pipe material. Figure 2.5 shows their summary of previous studies, their proposal and Duzce city.

More recently O'Rourke and Jeo (1999) developed a fragility relation for cast-iron pipe in the 1994 Northridge event damaged primarily by wave propagation effects. The slope of the Northridge repair rate versus PGV curve is substantially smaller than that estimated by O'Rourke and Ayala relation. O'Rourke (2000) correlated pipeline repair rate (RR) with PGV (cm/s) according to pipeline material (AC, DI, CI) as follows:

For CI pipes: log (RR) = 1.21*log(PGV)-6.78 (2.3)

For DI pipes: log (RR) = 1.83*log(PGV)-9.39 (2.4)

For AC pipes: log (RR) = 2.26*log(PGV)-11.02 (2.5)

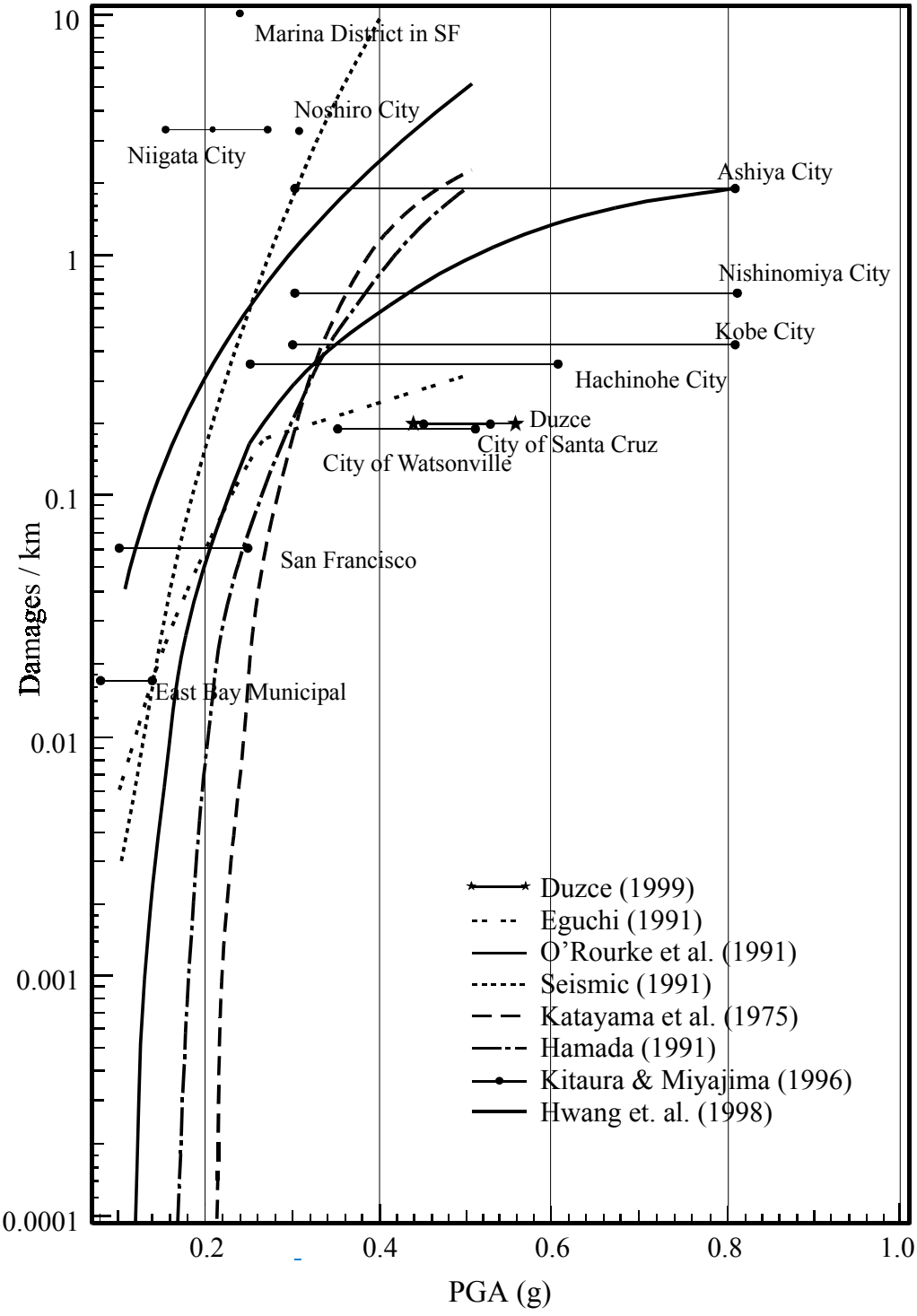

Figure 2.5 Seismic damage models for cast iron pipes (Hwang et al., 1998)

This approach differs from Eguchi's correlations by its different slopes for pipeline materials. Also note that these regressions are only applicable to PGV≤ 75 cm/s. For the zones where PGV exceeding this value which is the case in Duzce also, instead of PGV, PGD from liquefaction or land sliding is assumed to be the cause of the damage.

Toprak (1999), worked with a more precise data, such that he used only recorded motion data for his PGV correlation plot, and excluded the strong motion data from attenuation relationships. He presented pipeline damage rate and PGA and PGV correlations also (Figure 2.6 and Figure 2.7). His selection criterion for a reliable database is so high that he omitted all the data points except three earthquakes, Loma Prieta 1989, Whittier Narrows 1987 and San Fernando 1971 and he added a data point for Imperial Valley, 1979. Because of the data from Imperial Valley is mainly from asbestos cement pipes, this data point is important for this study. Resulting PGA correlation curve of Toprak (1999), is well below of all the previous studies. Note that unlike the previous estimations, this curve underestimates the observed damage in Duzce.

In Figure 2.7 PGV correlated damage rate is shown, Duzce data is more in harmony with the Imperial Valley data, which is composed of mainly AC pipes, too.

As mentioned before, Toprak, 1999 included CI and AC pipes in his research and stated that damage statistics for CI pipe can be used as a conservative estimate for damage to AC pipe. Both materials are brittle and relatively vulnerable. Cast iron pipe is subject to metallic corrosion, whereas AC is not. In long term, cast iron pipe would be expected to increase in vulnerability, when buried in corrosive grounds.

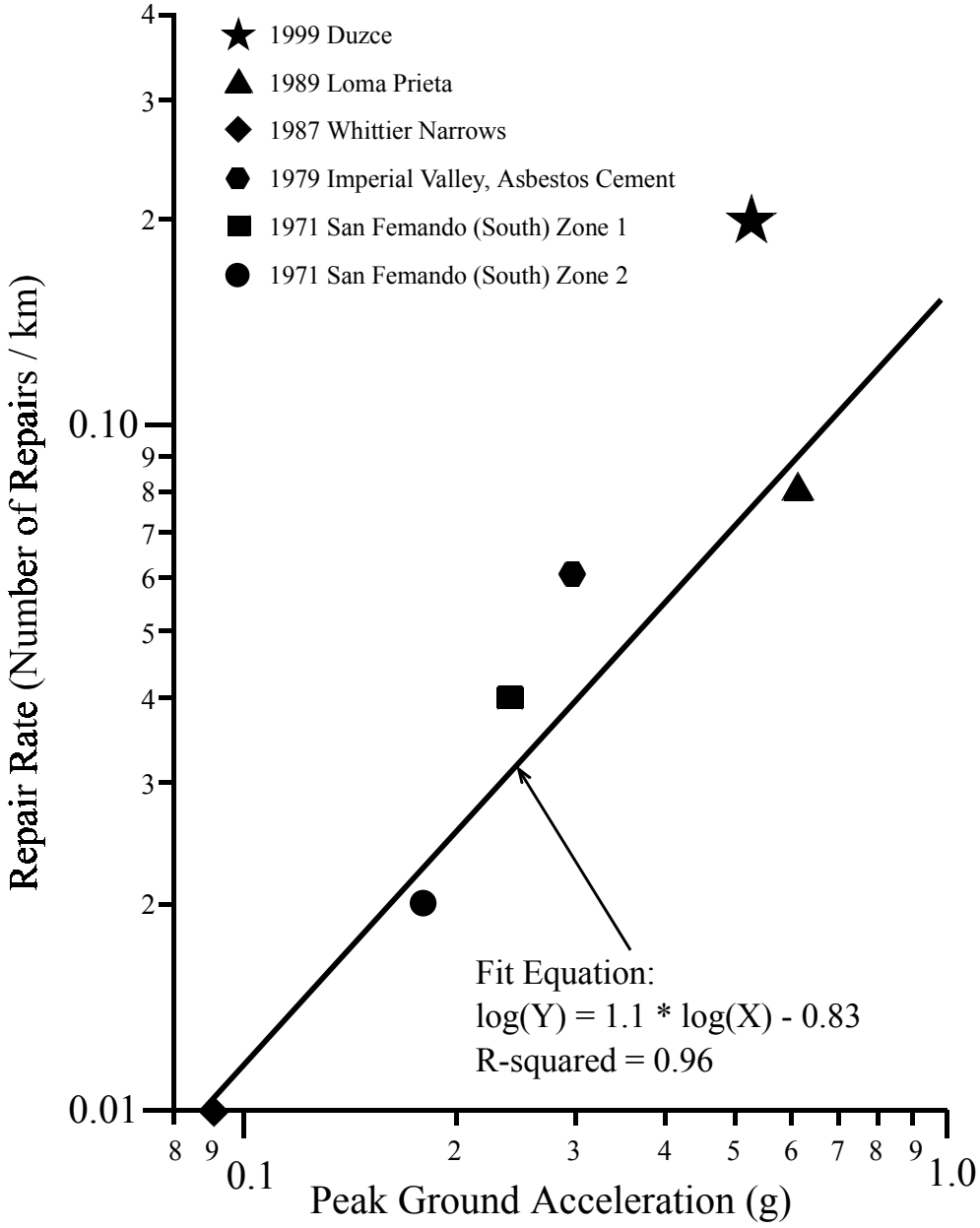

Figure 2.6 PGA seismic damage models for cast iron pipes (Toprak, 1999)

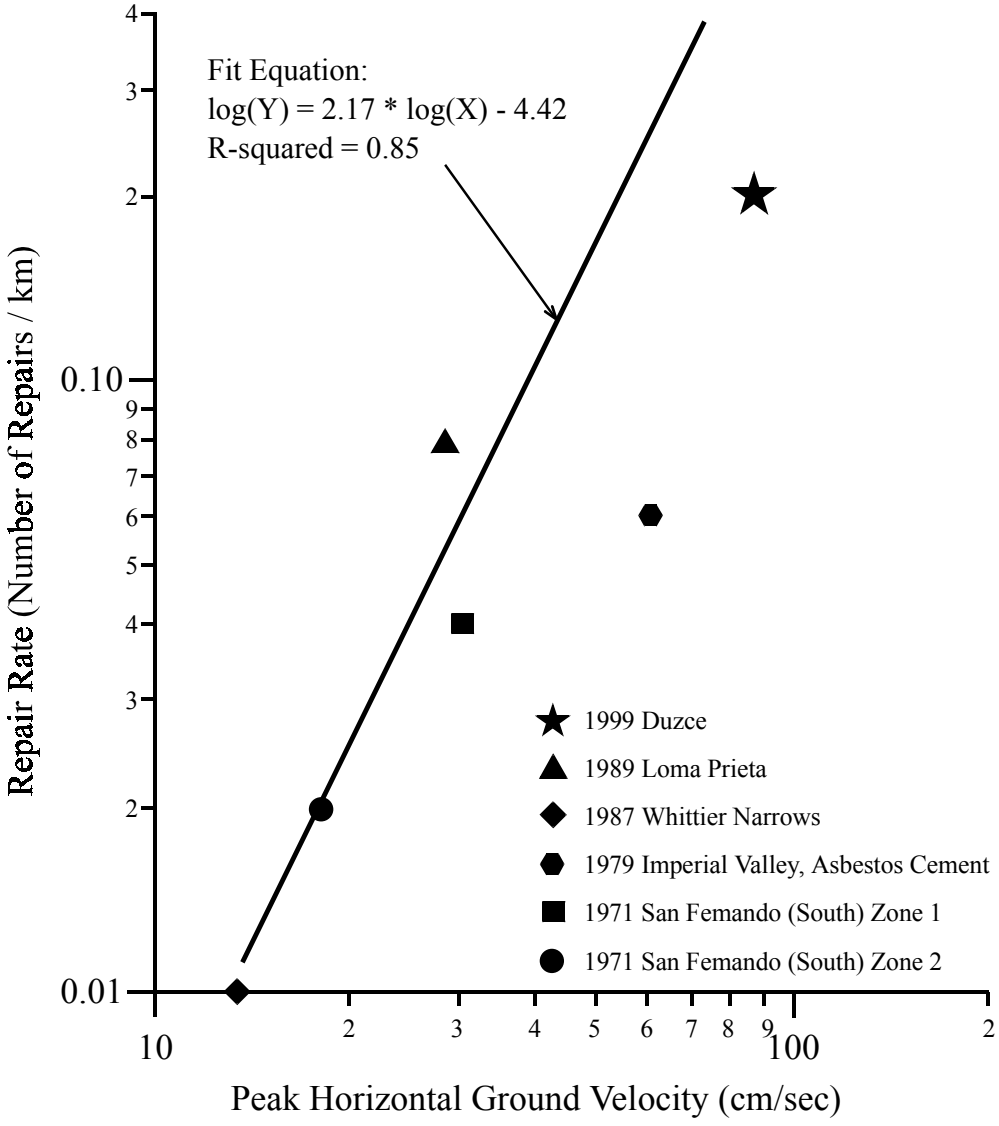

Figure 2.7 PGV seismic damage models for cast iron pipes (Toprak, 1999)

More recently after analyzing the damage patterns of water and gas pipelines in the Ji-Ji earthquake as damage rates correlated with PGA, PGV and spectrum intensity, Chen et al. (2002) concluded that the PGA has the best correlation with pipeline damage compared to PGV and Spectrum Intensity (SI). In his research, it is stated that the worst indicator in the study is PGV. The correlations for the damage rate estimations (DR) for pipe diameters (ϕ) between 65 mm and 600 mm, and PGA in terms of g, PGV in terms of cm/s, are as follows:

$$DR = 3.97 * PGA^{4.54} \quad (2.6)$$

$$DR = 2.26 * 10^{-13} * PGV^{6.34} \quad (2.7)$$

Different than intensity or ground shaking, another important parameter leading to pipeline damages is permanent ground deformation (PGD). There are variety of patterns of PGD depending on local soil conditions and seismic faulting. One type is localized abrupt relative displacement such as at the surface expression of a fault, or at the margins of a landslide.

The second type of PGD is spatially distributed permanent displacement, which could result, for example, from liquefaction-induced lateral spreads, or ground settlement due to soil consolidation or post-liquefaction volumetric compression. For spatially distributed PGD, Porter et al (1991) developed an empirical relation for bell and spigot cast iron water pipe with lead and oakum joints as shown in the Figure 2.8. The damage rate is a function of permanent ground displacement. A bilinear curve is fitted to the data from the 1906 San Francisco and 1989 Loma Prieta earthquakes. As shown in Figure 2.8, the normalized pipe break rate is a non-linear function of PGD. Relatively small ground displacement produces initial pipe breakage. At larger ground displacements, failure rates increase, but at a smaller rate. To explain this non-linearity, Porter et al. (1991) postulate that damage initiates at low magnitudes of PGD, breaking the original pipe network into shorter segments that are relatively free to move with the surrounding soil. Relatively larger displacements are then required to cause further breaks in the remaining intact segments.

Porter et al.'s relation for cast iron pipe forms the basis for the PGD damage relationship in HAZUS.

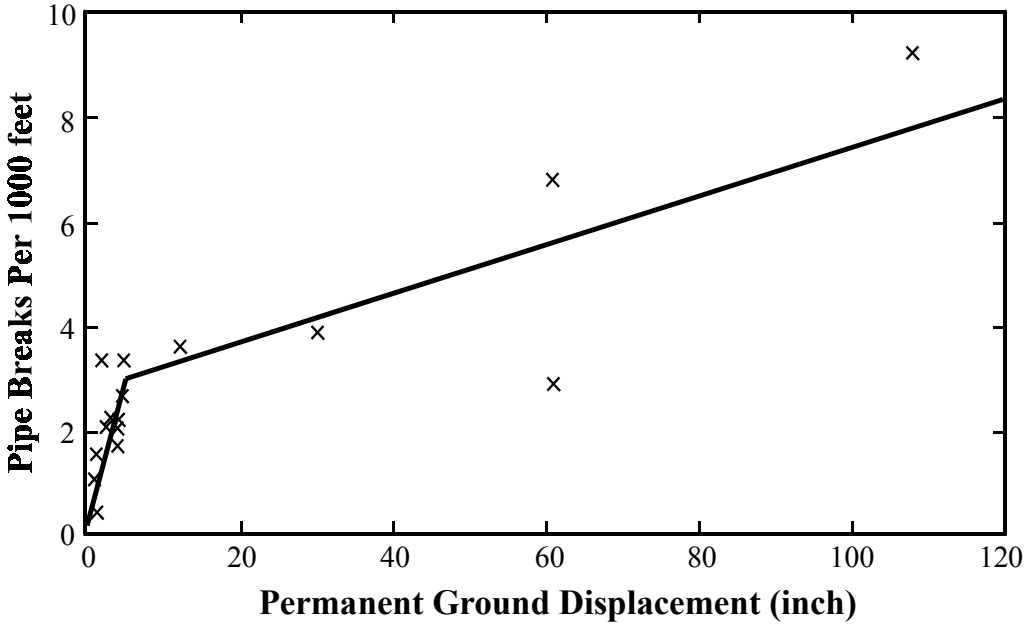

Figure 2.8 PGD seismic damage models for cast iron pipes (Porter et al., 1991)

As it can be concluded after reviewing the results of previous studies that estimations vary significantly. For the pipe damage rate in Duzce city due to Duzce earthquake is estimated from 0.08 breaks/km (PGA vs damage rate correlation, Toprak 1999) to more than 5 breaks/km (O'Rourke et al., 1991). However, damage rate of Duzce water network system in Duzce Earthquake is generally below the damage rate estimations in the literature as discussed.

Case histories compiled after 1999 Turkey earthquakes cover a wide range of pipeline damage including pipeline damage due to i) liquefaction-induced ground deformations (both lateral spreading and settlement), ii) wave propagation and iii) fault offsets. In the light of the previous researches, this research will focus on combined damages of wave propagation effects and liquefaction induced ground deformation effects. New models will be developed considering the previous studies.

CHAPTER 3

AN OVERVIEW OF DATA COMPILATION AND PROCESSING EFFORTS

3.1 Introduction

After the 1999 Duzce earthquake, a database of water pipeline performance case histories was compiled within a two-year period. This database is composed of three main data components:

1. Seismic Data:
    i. Duzce earthquake characteristics: Moment magnitude (Mw) of the earthquake, location and the properties of the fault, location of the epicenter, focal depth, etc.
    ii. Strong ground motion: Duzce ground motion record, spectral accelerations, Peak Ground Acceleration (PGA), Peak Ground Velocity (PGV), etc.
2. Geological and Geotechnical Data: General geological and geotechnical information about the city, including borelog information, soil classification test results such as sieve analysis and Atterberg limit test results, shear wave velocity estimations, standard penetration test blow counts, etc.

3. Pipeline Data: Information about water sources, water distribution facilities of Duzce, water pipeline materials, dimensions and their spatial distribution.

After collecting and compiling all the data, a careful analysis is carried out and second order parameters, like liquefaction susceptibility, spatially distributed ground deformations are obtained, moreover the differential settlements are estimated. Compilation and processing each data component will be discussed next.

3.2 Seismic Data

3.2.1 Duzce Earthquake Characteristics

On November 12, 1999 the M_w = 7.2 Duzce earthquake, affecting Duzce city the most, triggered on the North Anatolian fault with epicenteral coordinates at 40.76° N and 31.15° E, and the focal depth at 12 km. North Anatolian Fault (NAF) is predominantly a single right-lateral strike-slip fault with a differential slip rate of 10–20 mm/yr. The faulting on this mega tectonic entity has a segmental character with a characteristic earthquake in the M_w = 7+ range (Durukal, 2002).

The Duzce earthquake is associated with the so-called Duzce fault, which forms a morphological boundary at the south of the Duzce Plain and extends for 70 km between Akyazi and Kaynasli. At Adapazari and Bolu, the Duzce fault joins the North Anatolian Fault System.

Duzce earthquake produced a surface fault rupture of approximately 40-km on the Duzce fault between the Eften Lake and Bolu Tunnels at Elmalik. The maximum right-lateral offsets were measured as high as 4 m (Durukal, 2002).

3.2.2 Strong Ground Motion Records

The Duzce earthquake produced a very valuable strong ground motion data set for understanding the near field seismicity. The strong motion stations operated by the General Directorate of Disaster Affairs, Kandilli Observatory and Earthquake Research Institute of Bogazici University and Istanbul Technical University have produced 32 strong motion records after Duzce earthquake. These records were obtained at fault distances between 0.01 and 31 km with peak horizontal accelerations varying between 0.9 and 0.03 g. The closest of these strong motion stations to the fault rupture are the ones at Duzce (8.2 km) and Bolu (20.4 km), as shown in Figure 3.1. Three components of the peak horizontal accelerations, recorded at Duzce and Bolu stations after the Duzce earthquake are presented in Table 3.1 and 3.2, respectively.

Table 3.1 Characteristics of SGMR recorded at Duzce Station. (Closest distance to fault rupture, d =8.23 km, Site Classification=Soil)

Component	PGA (g)	PGV (cm/s)	PGD (cm)
E-W	0.513	86.05	170.12
N-S	0.410	65.76	88.04
Vertical	0.340	28.0	69.0

Table 3.2 Characteristics of SGMR recorded at Bolu Station. (Closest distance to fault rupture, d =20.41 km, Site Classification=Soil)

Component	PGA (g)	PGV (cm/s)	PGD (cm)
E-W	0.821	66.92	21.27
N-S	0.754	58.25	40.29
Vertical	0.20	24.5	22.1

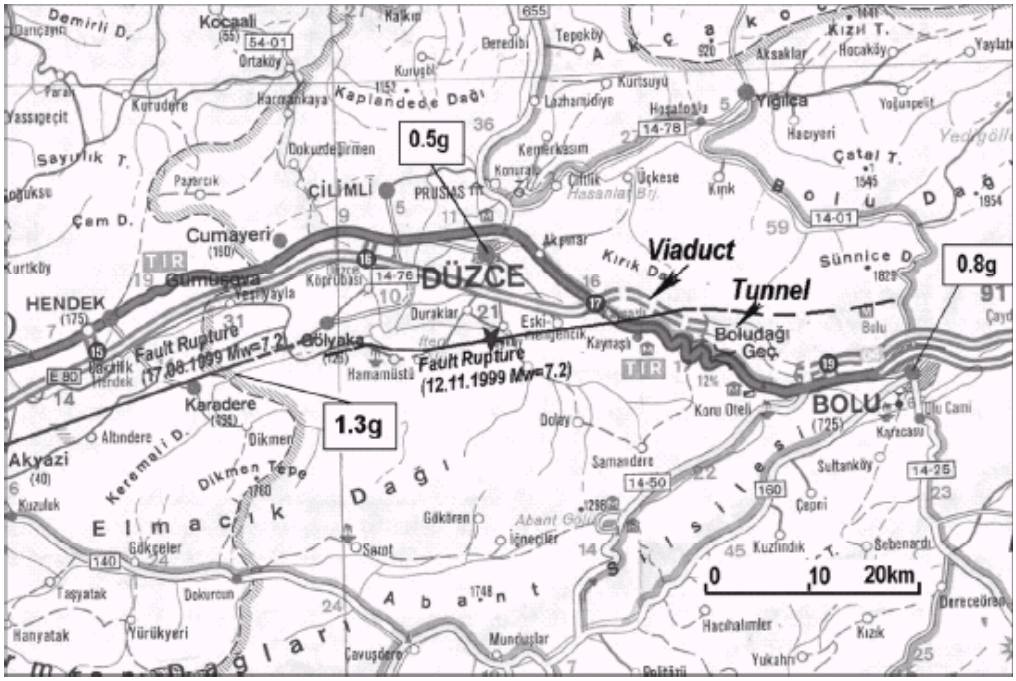

Figure 3.1 Peak horizontal accelerations recorded in the Duzce earthquake

No official intensity map has been developed for the city of Duzce. To be able to model the variation of the intensity of shaking within the city of Duzce, available attenuation relationships were compared and calibrated with the Duzce record. Figure 3.2 presents peak ground acceleration predictions by Joyner and Boore (1988), Campbell (1997) and Sadigh et al. (1997) attenuation relationships. For the former, site condition is selected as soil, for Campbell as alluvium and for the latter deep soil is selected as the site condition. In all relations M_w = 7.2 and faulting mechanism is chosen as strike-slip. Additionally, recorded peak ground accelerations (PGA) at various fault distances were also shown on the same plot for comparison purposes. As can be clearly seen that the selected attenuation relationships can match recorded PGA's reasonably well. Thus, these attenuation models can further be used to understand and predict the variability of shaking within the city of Duzce.

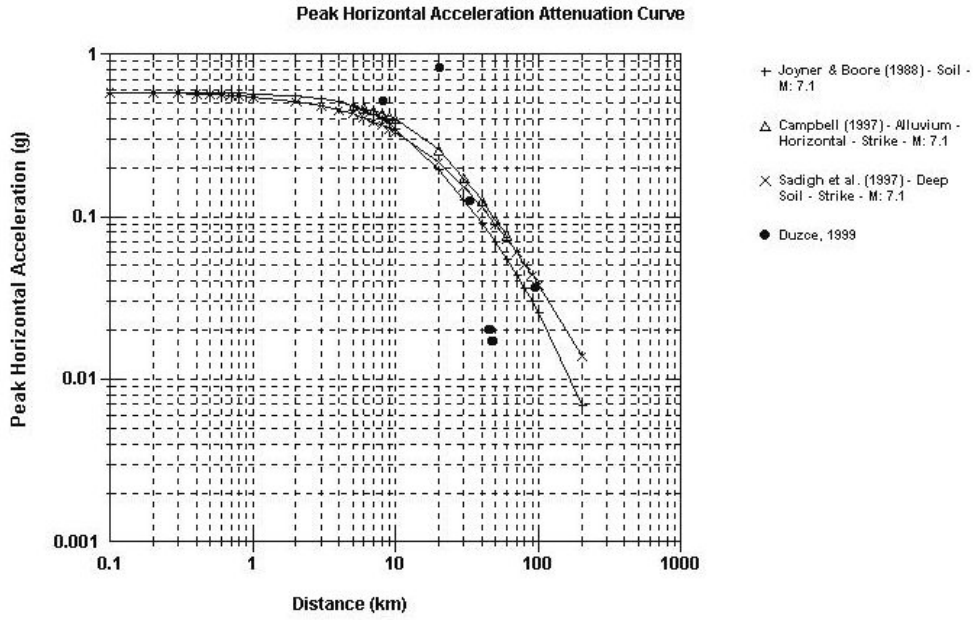

Figure 3.2 Peak horizontal acceleration curves and Duzce earthquake records

For similar purposes, peak ground velocity predictions proposed by Joyner and Boore (1988), Campbell (1997) are also presented in Figure 3.3. Duzce earthquake characteristics as mentioned before, are used in the development of Figure 3.3. Recorded PGV value at Duzce and Bolu stations are also shown in the same figure for comparison purposes.

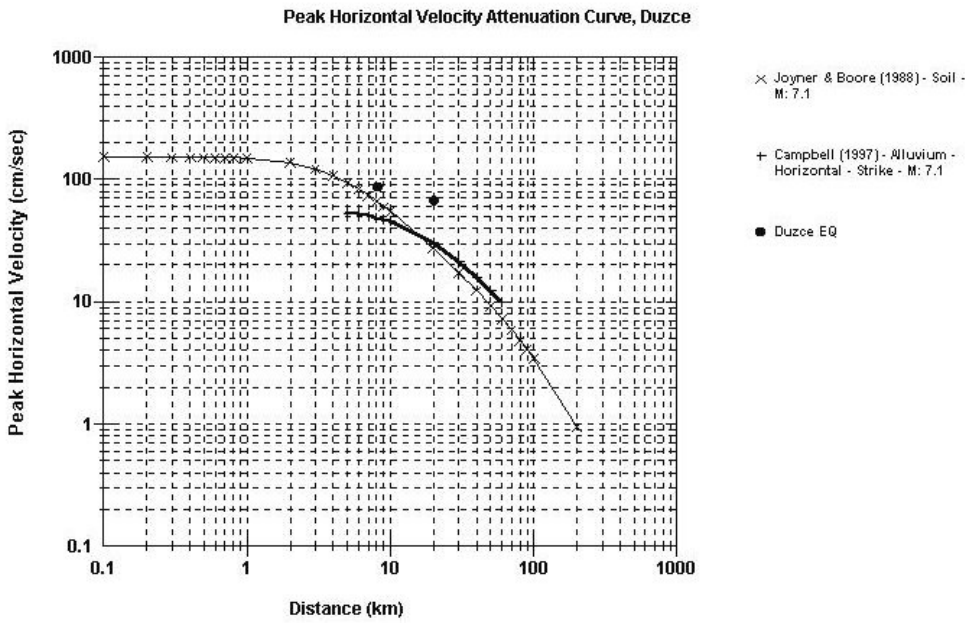

Figure 3.3 Peak horizontal velocity curves and Duzce earthquake records

Since, the discussed attenuation models after calibration are well capable of modeling the intensity of shaking at various fault distances, it was intended to use these calibrated models to predict the variability in shaking intensity within the city of Duzce. For this purpose as shown in Figure 3.4, a bigger scale Duzce city map was generated showing i) strong ground motion station, ii) district boundaries, iii) North Anatolian Fault. By the help of this map, for each district center or grid, fault distances can be estimated, which could be further used with calibrated attenuation relationships to estimate PGA or PGV values representing the level of shaking for that particular district.

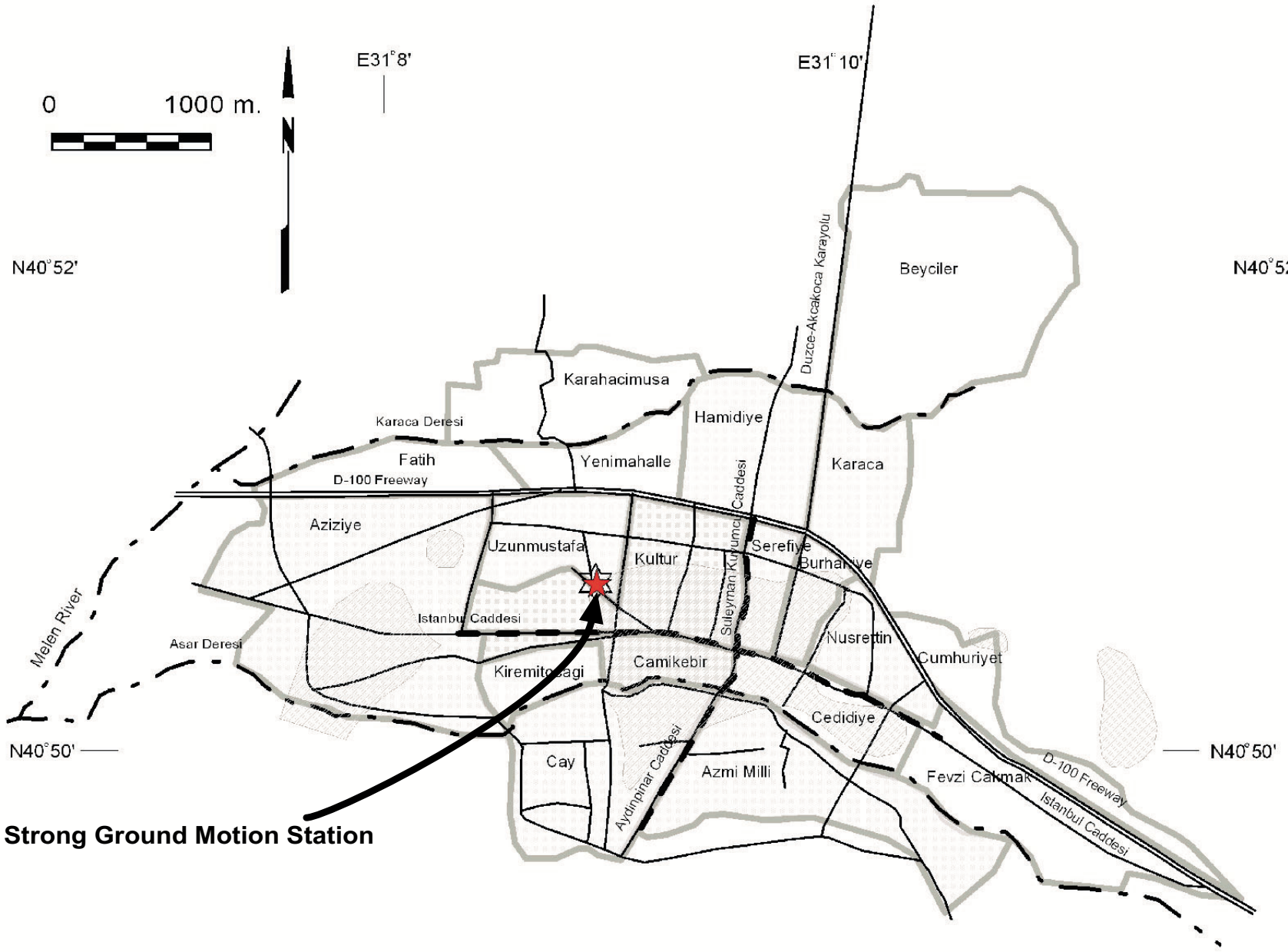

Figure 3.4 Duzce district boundaries, location of the strong ground motion station and the fault rupture

3.3 Geological and Geotechnical Data:

3.3.1 Geological Setting of Duzce City

The name “Duzce” indicates that the city is located on a plateau with very mild slopes ranging from 0.5º to 3º inclination to southwest. The provincial center is located on a pull-apart basin, of deep alluvial deposits. On its southern border, the Asarsu flows on unconsolidated gravel and sand layers. The subgrade for the town includes layers of clay, silt, sand, and gravel extending to depths of at least 200 m.

Water table depths within the city vary from 2 to 4 m and has been observed to be shallower in the north relative to southern districts of the city.

3.3.2 Geotechnical Conditions

3.3.2.1 Database of Geotechnical Investigations

In this section of the thesis, geotechnical factors affecting the response of buried pipelines will be investigated together with seismic factors. For this purpose a database composed of i) over 255 borelogs usually extending to 20 m depth with ii) standard penetration test results obtained at applicable depths, iii) “disturbed” and “undisturbed” sampling at various soil layers as well as iv) seismic p-wave and s-wave velocity measurements obtained at 115 locations, has been compiled. To be able to sort, correlate and access relevant information in a timely and orderly manner, it was decided to transfer all geotechnical data to geographic information systems framework. The tool for this was selected as Map-info software package.

Figure 3.5 shows the locations of borehole data available after screening for quality standards. Any borehole data without proper

definition of instruments and standards were disregarded from further consideration. The rectangles in the Figure 3.5 are the Duzce municipalities water network boundaries. As it can be seen from the figure the municipality's water network is serving to the near villages also.

Figure 3.6 and 3.7 present two typical borelogs available for the city of Duzce. From these borelog data directly and after processing the geotechnical data with seismic data, important soil parameters were selected as:

i. depth to water table
ii. depth to liquefiable (critical) layer
iii. thickness of liquefiable layer(s)
iv. average standard penetration blow counts in the critical layer
v. vertical effective stress at the mid-height of the critical layer
vi. thickness of the layer with SPT blow counts less than 10 in the upper 10m.
vii. settlement estimations
viii. lateral displacement estimations

Figure 3.5 Borelog locations and the city water network boundaries

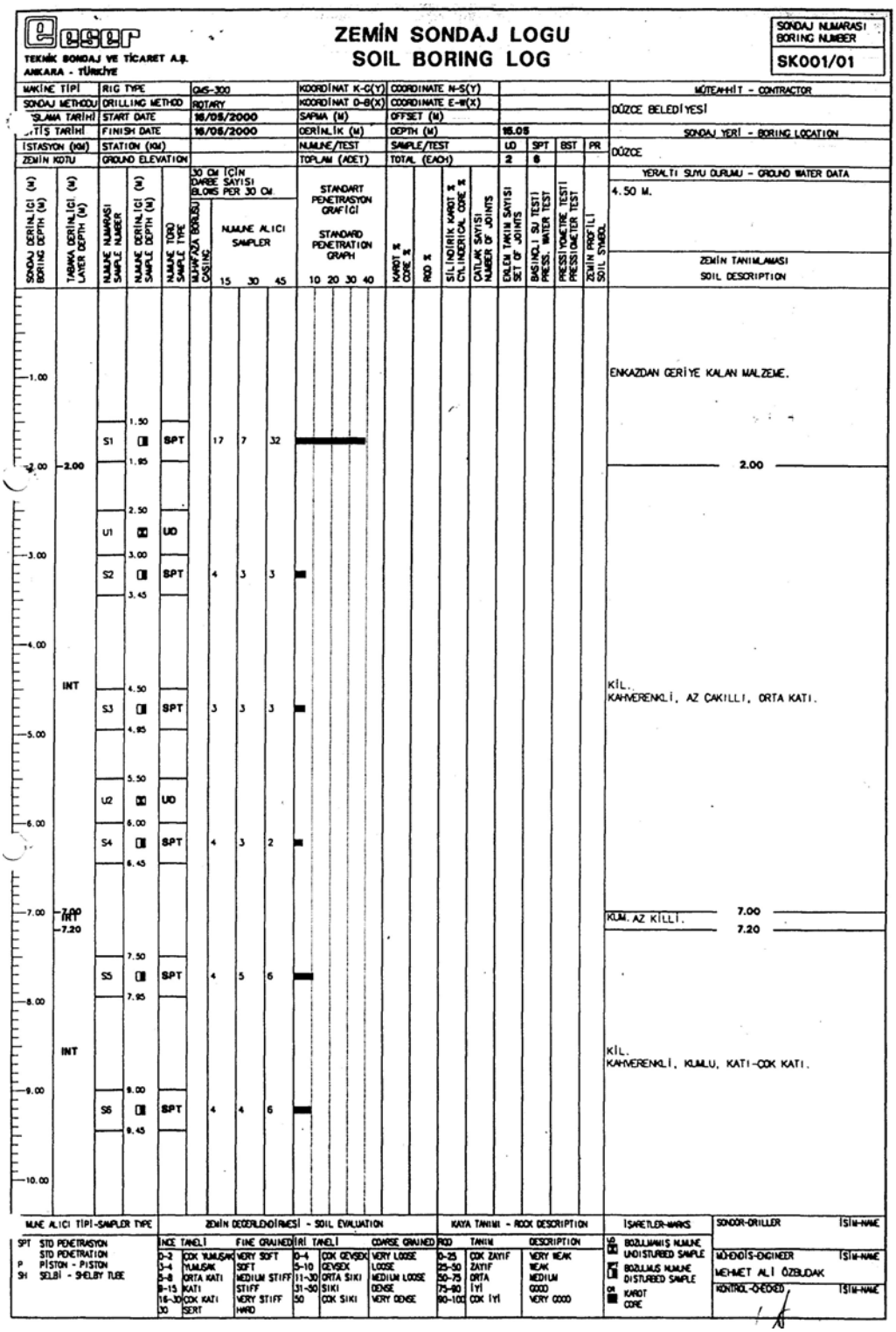

Figure 3.6 An example of borelog data from Duzce (Bayındırlık, 2000)

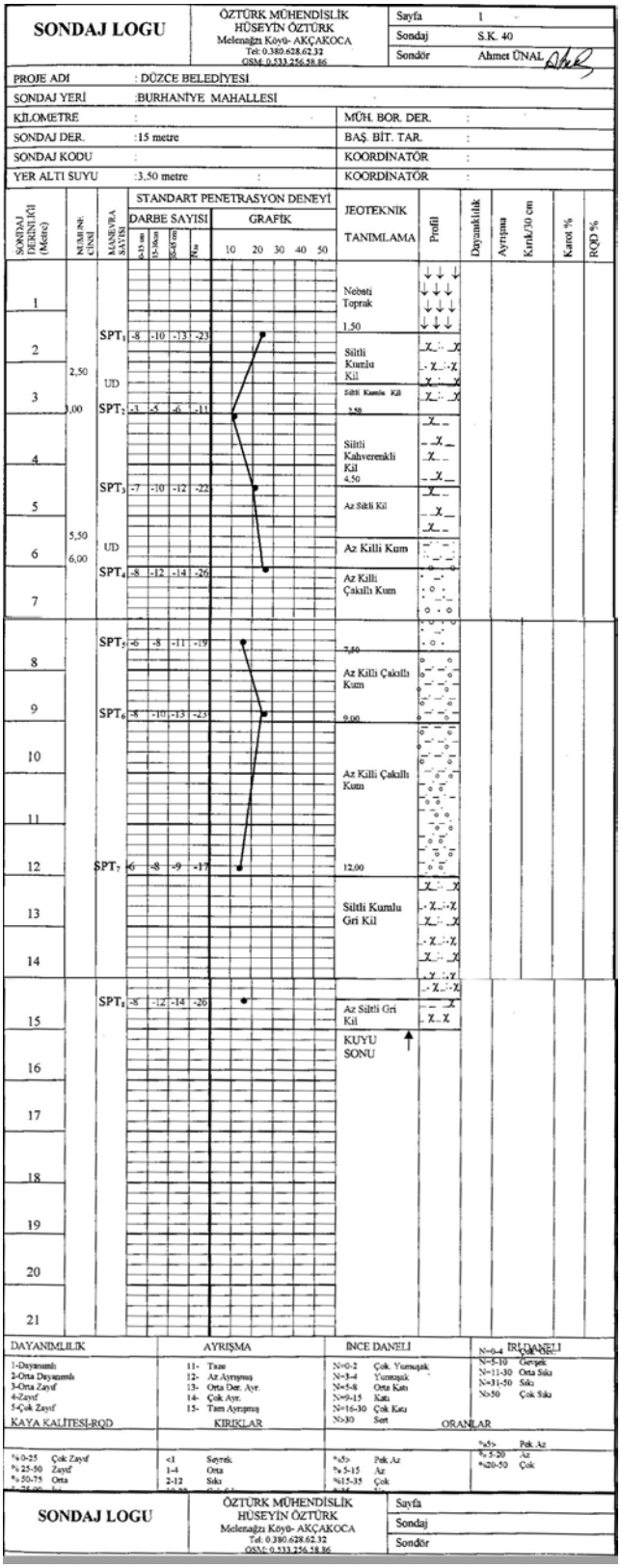

Figure 3.7 An example of borelog data from Duzce (Ankara University, 2001)

As a part of these efforts, i) generalized soil profiles, ii) dynamic soil response properties, as well as iii) liquefaction vulnerability of the underlying soils were studied. Soil conditions were found to be consist principally of silts and clays, with interbeds of sands and gravels (Bayindirlik, 2000). The thickness of these sediments is reported to be approximately 175-225 m. Relatively low seismic velocities were found in the districts Aziziye, Uzunmustafa, Kultur, Kiremitocagi and Camikebir (located between the D-100 highway and the Asar river). Higher velocities were found in districts north of the D-100 highway, although the soil composition is similar. It is noted that the Duzce strong motion station is located on the relatively soft materials south of the D-100 highway (Figure 3.4 and Figure 3.5).

3.3.2.2 Generalized soil profiles

As discussed in previous sections, over 255 borehole data as well as 115 shear wave velocity profiles were carefully processed. For the sake of simplicity and convenience six representative soil profiles, as shown in Figure 3.8, were generated to represent possible soil profiles for Duzce city. In the same figure, in addition to the classification based on soil types, standard penetration test blowcounts (N) were also presented.

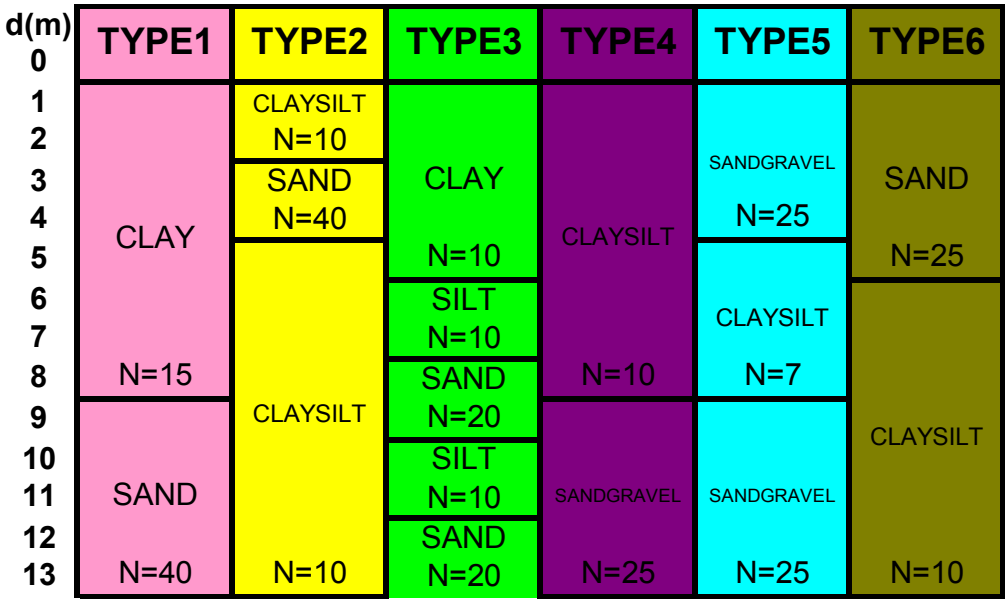

Figure 3.8 Generalized soil profiles for the city of Duzce

Figure 3.9 shows the spatial distribution of these six soil profiles throughout Duzce as well as the locations of the fault trace and the strong ground motion station.

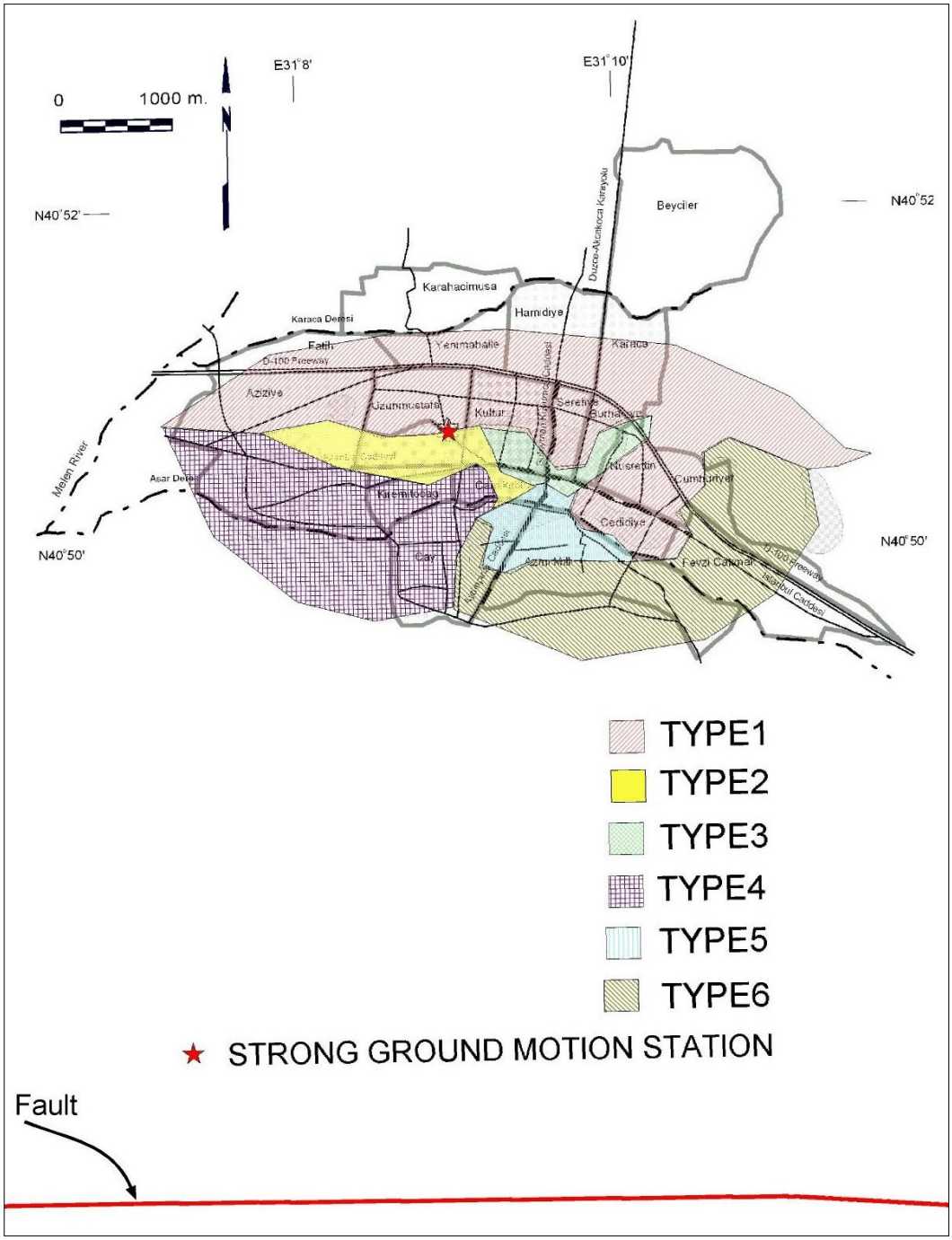

Figure 3.9 Site Classification of Duzce City

3.3.2.3 Seismic Response Analysis

After clearly identifying the six representative soil profiles in Duzce, the responses of these soil profiles to Duzce earthquake were studied by using 1-D equivalent linear site response analysis program Shake 91. For the purpose of addressing the variations in peak ground acceleration estimations as a result of variations in distances to the fault rupture, the calibrated attenuation relationships as discussed in previous sections were used after scaling it to the value obtained at Duzce strong ground motion station (i.e. a local attenuation relationship was developed specific to Duzce for 1999 Duzce earthquake). Next, series of site response analysis were performed by deconvolving Duzce soil strong ground motion record and assigning it as a within motion to the bottom of 6 different soil profiles. The results of these extensive studies were summarized in Figure 3.10 as a peak ground acceleration contour map developed for the city of Duzce after Duzce earthquake. These site response analyses are the subject of another study and will not be discussed in detail here. It should be noted that peak soil ground acceleration values are predicted to vary between 0.44 to 0.62 within the city of Duzce during Duzce earthquake.

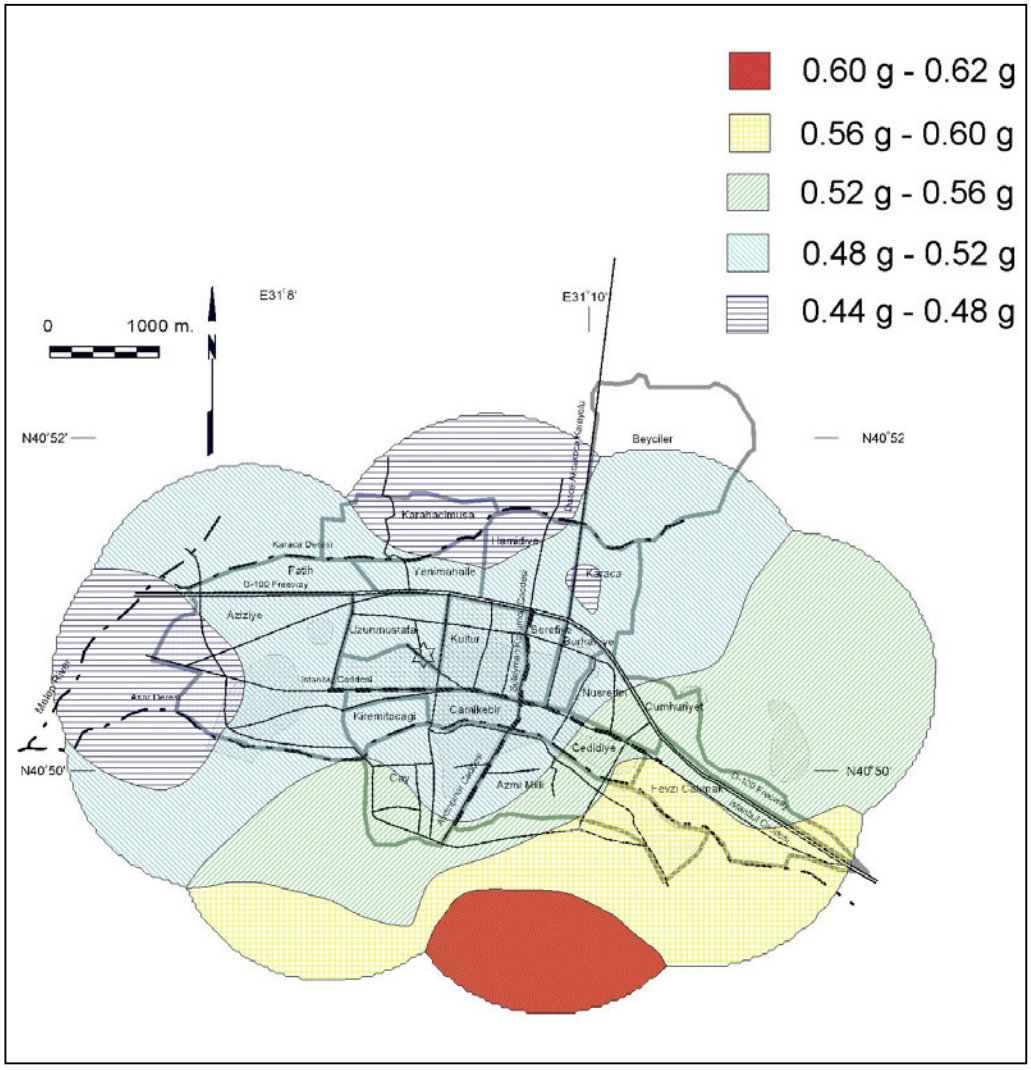

Figure 3.10 Site Response of Duzce City, PGA contours

3.3.2.4 Liquefaction Assessment

In literature, various researchers stated that damage ratios of the pipelines buried in liquefied soils are relatively higher (Trifunac and Todorovska, 1996, Datta, 1999, Hwang, 1998, Chen et al., 2002). The effects of the liquefaction of surrounding or underlying soils on the performance of buried pipelines after 1999 Duzce earthquake was studied by first identifying liquefaction vulnerability of Duzce soils. Liquefaction triggering methodology proposed by Cetin (2000) and Seed, et al. (2001) was implemented, and liquefaction vulnerability of Duzce soils was expressed as probability of liquefaction. Although this

methodology gives very precise estimations of liquefaction susceptibility of a single soil layer, for estimating the liquefaction potential of a soil profile, it is necessary to define a single parameter which addresses the liquefaction vulnerability of each soil layer within a profile. Following methodologies are implemented for this purpose.

a. Liquefaction susceptibility of each soil layer in a profile is estimated, then the maximum of the liquefaction probabilities of soil layers is assigned as the representative values of the soil profile. This method assumes the site is liquefied if one or more layers of the site are liquefied. The corresponding liquefaction potentials are shown in Figure 3.11.

b. Weighted average of the liquefaction probabilities of all layers is assigned to the soil profile. The weighted average is calculated such as; liquefaction probability of each soil layer in the site is estimated by using Cetin et al. (2000) then this probability of liquefaction is multiplied with layer thickness as a weight factor. The probability of liquefaction of the profile is then assigned as the arithmetic mean of the weighted probabilities. (Figure 3.12)

Liquefaction susceptibility of Duzce city according to these two methods is shown with the pipeline failure points in the Figures 3.11 and 3.12. One should note that high probabilities of liquefaction might not necessarily mean that liquefaction has occurred. However, high probability of liquefaction values can be indicated as the presence of soft soil deposits.

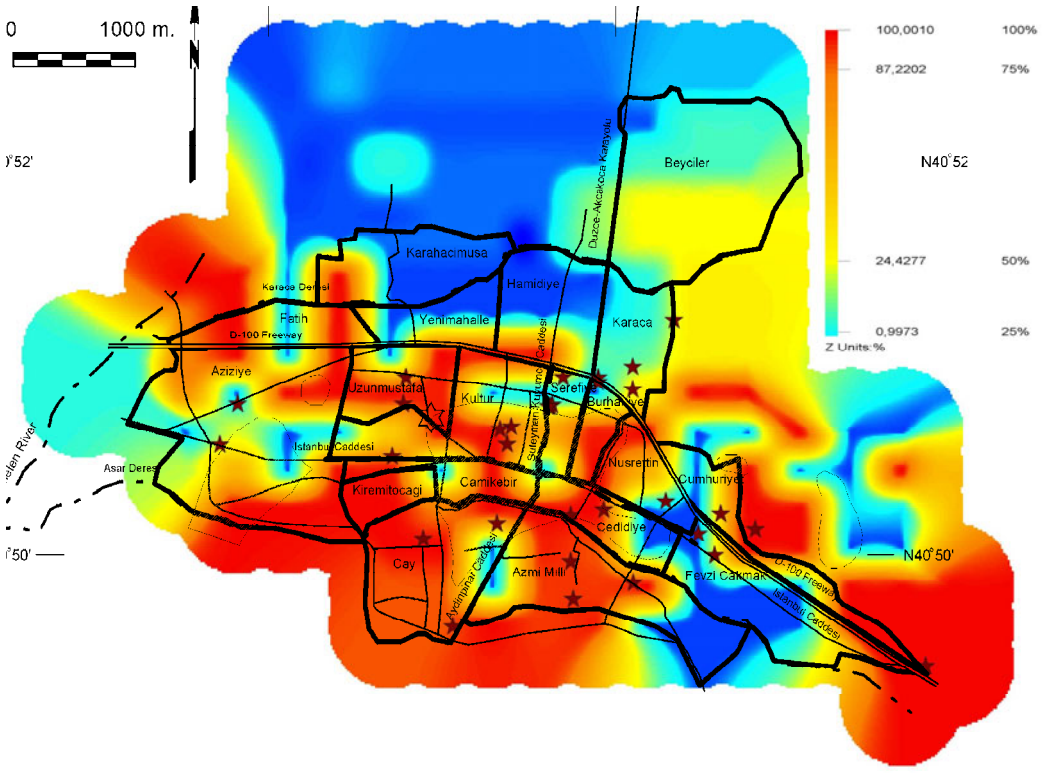

Figure 3.11 Liquefaction susceptibility and pipe failure locations of Duzce, based on maximum probability of liquefaction

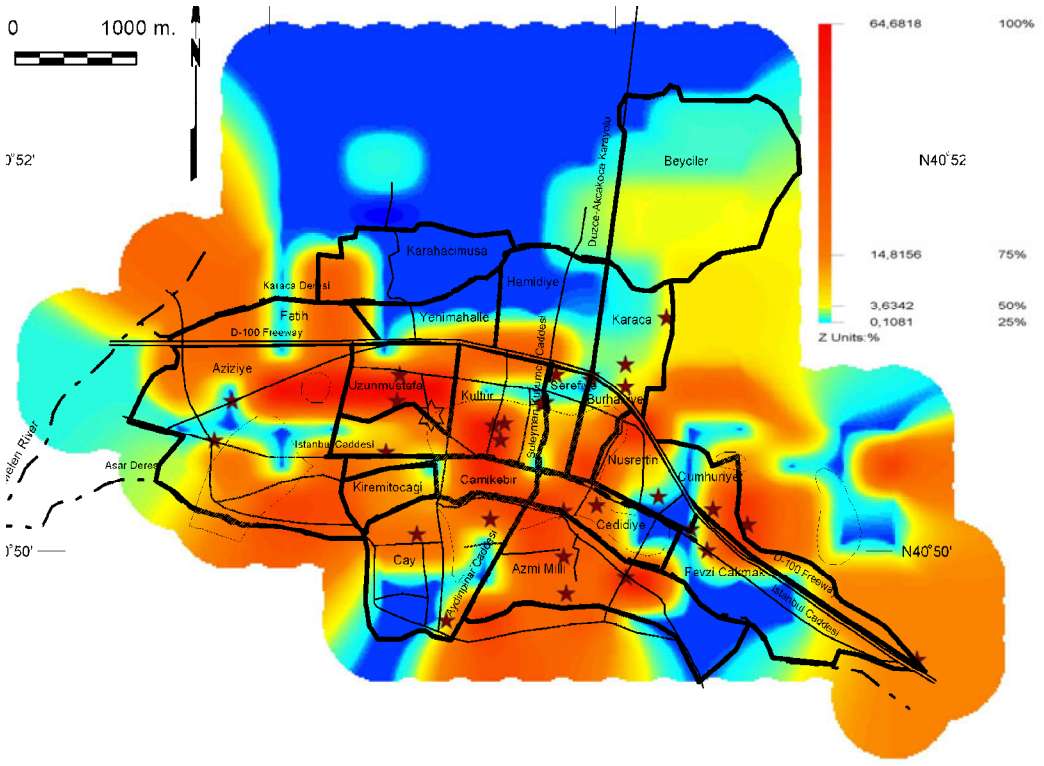

Figure 3.12 Liquefaction susceptibility and pipe failure locations of Duzce, based on weighted average probability of liquefaction

3.3.2.5 Ground Deformations

Post liquefaction settlement and lateral displacement estimations of Duzce city soil profiles are performed by following the methodologies proposed by Unutmaz (2003) and Cetin (2000).

After studying the well-known relations of SPT-N values with the cyclic stress ratios for shear strains 3%, 10% and 20% (Seed, 1976, Tokimatsu, 1987, and Ishihara 1979), Unutmaz proposed a closed form estimation of post liquefaction settlement and lateral displacements as summarized in Equations 3.1 and 3.2. The main advantage of Unutmaz method, in addition to closed form expression, is that it gives an unbiased estimate of Seed's (1983), Tokimatsu's (1987) and Ishihara's (1980) predictions.

$$\gamma = \frac{-N_{1,60}\cdot(1+0.001\cdot FC)+29.2231\cdot\ln M_w+3.6604\cdot\ln\sigma_v'-0.05\cdot FC+13.3247\cdot\ln CSR-40.1031}{0.0508\cdot N_{1,60}+0.1853} \quad (3.1)$$

$$\varepsilon_V = \frac{-N_{1,60}\cdot(1+FC)+152.0203\cdot\ln M_w+467.0402\cdot\ln\sigma_v'-0.05\cdot FC+847.4096\cdot\ln CSR+16.3942}{104.2823\cdot N_{1,60}+464.1991} \quad (3.2)$$

where γ is shear strain, ε is the volumetric strain, $N_{1,60}$ is the corrected SPT-N value, corrected for overburden effects, for "short" rod length, for non-standardized sampler configuration, for borehole diameter and for hammer energy efficiency (for details of these corrections refer to Seed and Cetin et al, 2000), FC is the fines content, M_w is the moment magnitude of the earthquake, CSR is the cyclic stress ratio and can be defined as the ratio of the shear stress to the vertical stress and is evaluated by using the following equation:

$$CSR = 0.65\cdot\frac{PGA}{g}\cdot\gamma_{soil}\cdot\frac{h}{\sigma_v'}\cdot r_d \quad (3.3)$$

where PGA is peak ground acceleration, g is the gravitational acceleration, γ_{soil} is the soil density, σ_v' is vertical effective stress and r_d is the stress reduction factor

As it can be seen easily from the above expressions (Equations 3.1 and 3.2) settlement and lateral spread estimations are strongly correlated. Due to this strong correlation lateral spread estimation is excluded from further consideration. In Figure 3.13 settlement estimations for Duzce are presented with the pipeline failure points. Note that in Figure 3.13 most of the failures are on the contours where settlement is expected. Moreover another attracting result can be seen form the figure is that most the failures are at the edges of settlement contours. This result directs the attention to differential settlement problem. To examine this problem, the rate of change of settlement at neighboring grids is computed and shown in Figure 3.14, representing the differential settlement estimations. However due to the grid intervals of 300 m, this differential settlement estimations can only be used for visualization purposes, numerical values may not be representative.

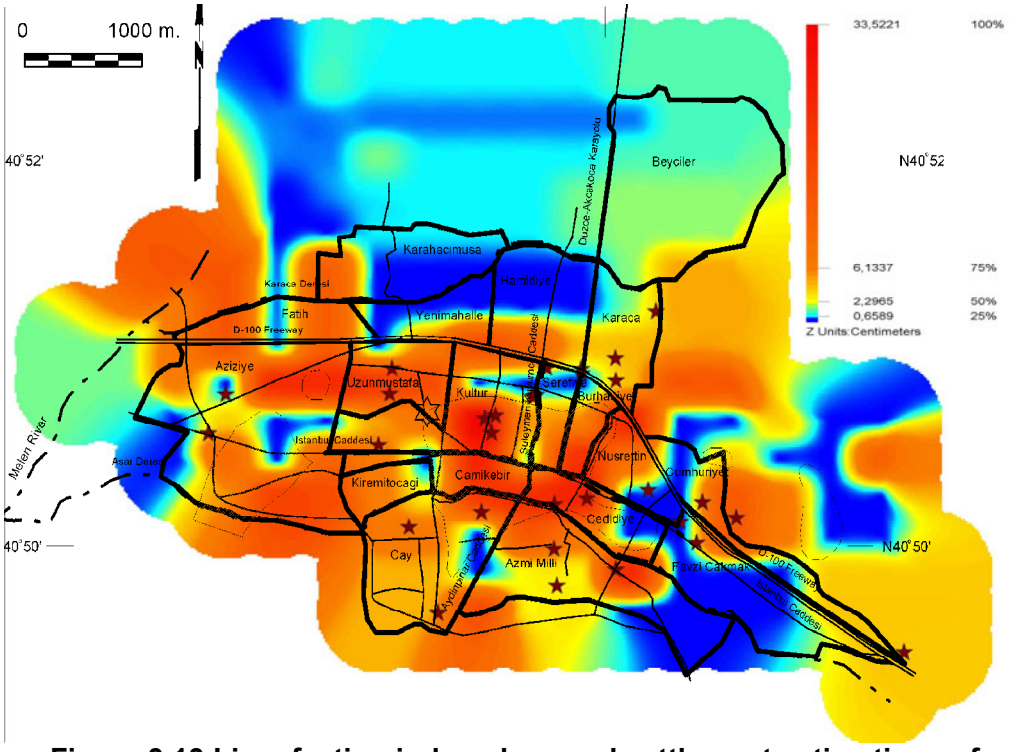

Figure 3.13 Liquefaction induced ground settlement estimations of Duzce city with failure locations

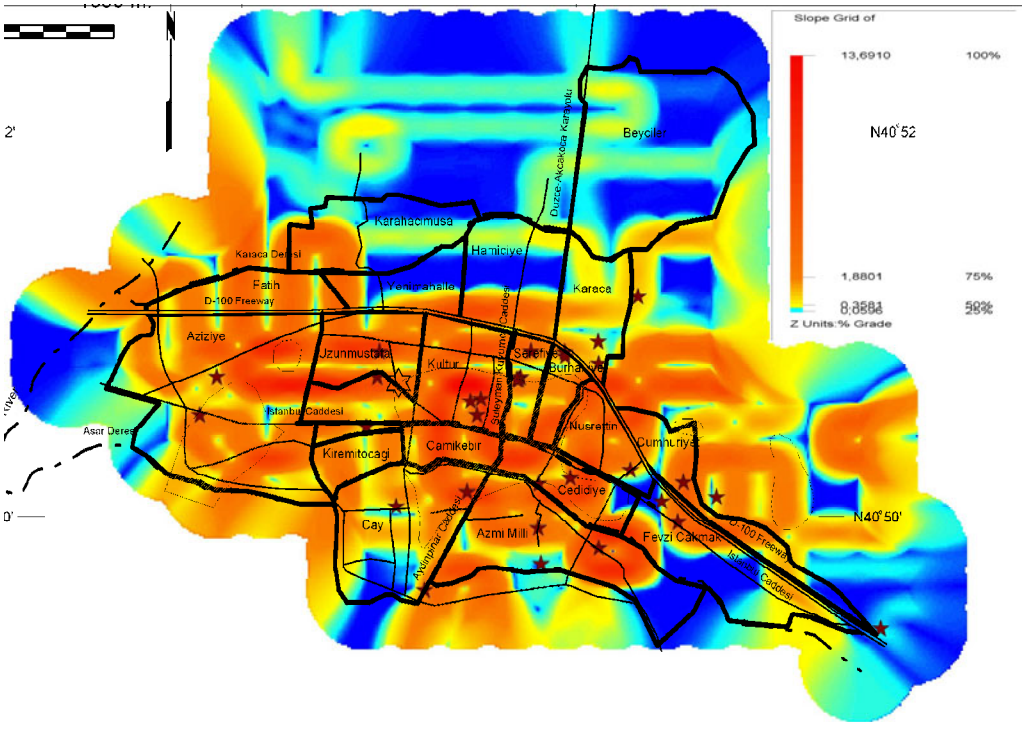

Figure 3.14 Differential settlement estimations of Duzce city with failure locations

3.4 Pipeline Characteristics

3.4.1 Water Sources and Production Facilities

Duzce city water network, operated by Duzce Municipality is serving to a population of 76,038 residents. The water is taken from two water sources. The main source is the mountain creek, Ugur Suyu, approximately 7.5 km south of the treatment plant in a valley by a river intake near Ugur Village (34,500 m^3/day). A subsidiary water source is the two wells located on the right banks of the river Kucuk Melen near Tokuslar Village (total of 2,000 m^3/day). Total daily production rate in the water supply system is approximately 36500 m^3/day.

From Ugur Suyu river intake the unprocessed water gravitates in an asbestos cement pipe with a diameter of 600 mm to the treatment plant over a distance of 7.5 km. This pipe was broken during the earthquake. As a result of this pipe failure significant amount of water was released causing a landslide and recursively the landslide washed away a number of single pipe sections.

From the treatment plant a 1000 mm steel pipe transports the water to the city at a distance of approximately 5 km. There was no breaks or leakage reported by the municipality on this connection due the earthquake.

3.4.2 Water Distribution System

There are two water distribution systems, the old and the new one, serving the city. For some streets it is possible to find the pipes of the two systems parallel to each other. The old water supply system of Duzce dates back to year 1940. This old system is composed of mainly cast iron pipes, however there are no maps or any documented

information available for the old system. Because of the lack of data, the old system is excluded from the analysis.

Starting from 1985 a new water distribution system was installed. This new water distribution system is generally composed of PVC pipes for small diameters (φ<150 mm), AC for medium sized pipes (100mm<φ<450mm) and steel for greater size pipes. After the earthquake a total of 30 km long PVC pipes were sent to city by the Provincial Bank of Turkey.

According to the city network system map 1997, the city distribution lines are approximately 160 km long, excluding the transmission pipes (ϕ>600mm) to the city and the connection pipes to the houses ($\phi \leq$100mm). Approximately 70% of the city distribution pipes have diameters equal or smaller than 150 mm, and only a 5% of the pipes have diameters greater than 300 mm as shown in Figure 3.15.

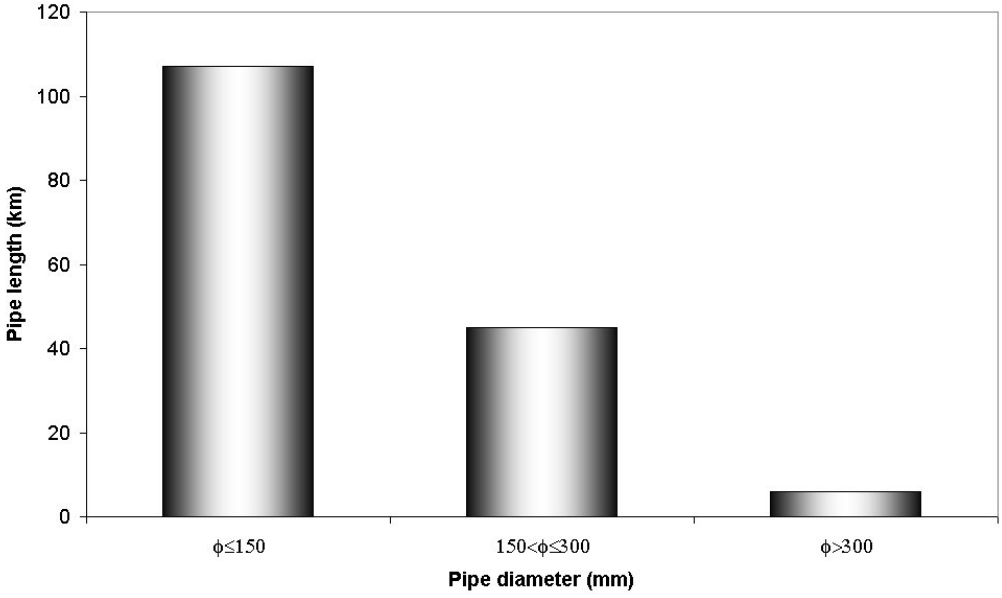

Figure 3.15 Pipe distribution according to pipe size

The boundary shown in Figure 3.16 is the boundary of the pipeline intensity where pipeline intensity is greater than 1 km/km^2,

according to city network system map 1997 and will be used for further considerations.

After earthquake repairs were investigated, all reported repair cases were examined in detail and the ones that fulfill data quality requirements were added to the database. Because all the repairs after the earthquake were recorded in a ledger in the municipality, a great amount of work was spent to select the relevant data and eliminate the old system repairs.

3.5 Summary

Result of these intensive data compilation efforts is a high quality database summarizing important variables of the problem as:

i. peak ground acceleration (PGA)

ii. estimated liquefaction-induced ground settlements (S)

iii. liquefaction susceptibility expressed as in Section 3.2.2.4 (a)

iv. depth to the most liquefaction susceptible layer (d_{layer})

v. total thickness of liquefiable layer(s) (t_{liq})

vi. total thickness of soft layer(s) (t_{soft}) expressed as in Section 3.3.2.1

Due to strong correlation between settlement and thickness of liquefiable layer (t_{liq}), t_{liq} is excluded from further consideration.

In order to compile all the data from seismic, geotechnical and pipeline sources of the city together, Duzce City is divided into 400m by 300m grids (Figure 3.16). At the center of each grid all the relevant data

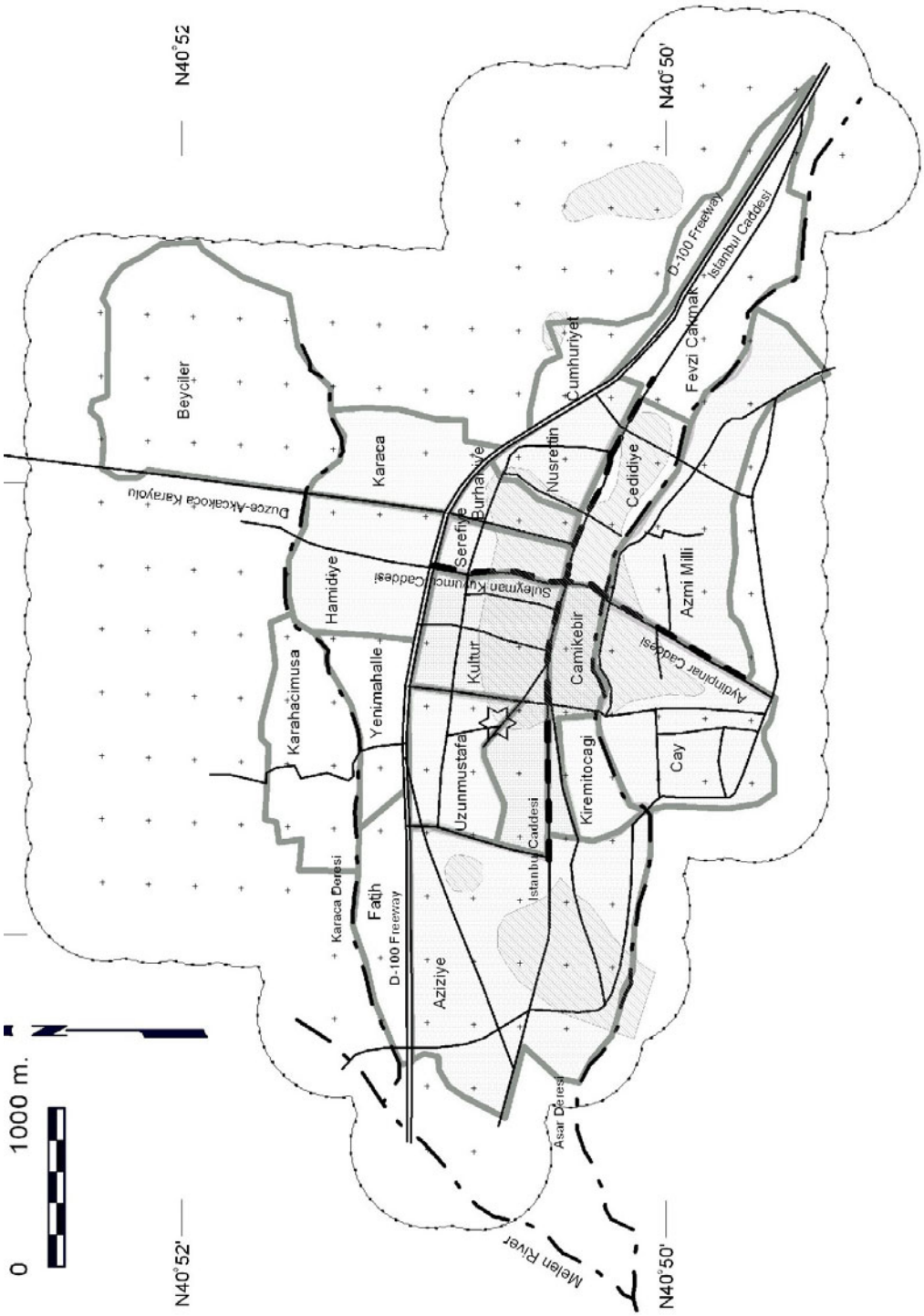

Figure 3.16 Grids of the city

is concentrated and then assigned to the corresponding grid (Figure 3.17). A small example of grid database is presented in Figure (3.18). In some grids more than one borelog is available, for such cases after a very careful study, representative borelog data are assigned to the grid. Whereas for some grids no borelog data is available in the grid, for these grids, the neighboring grids are studied, and if there is not a sharp change in these neighboring grids' geotechnical characteristics, the data from the neighboring grids are assigned to the grid. The grids without available borelog data and having sharp changes in the soil profiles of the neighboring grids are excluded from further consideration.

A detailed presentation of relevant data components for every grid point in Duzce is available in Appendix A and in Appendix B.

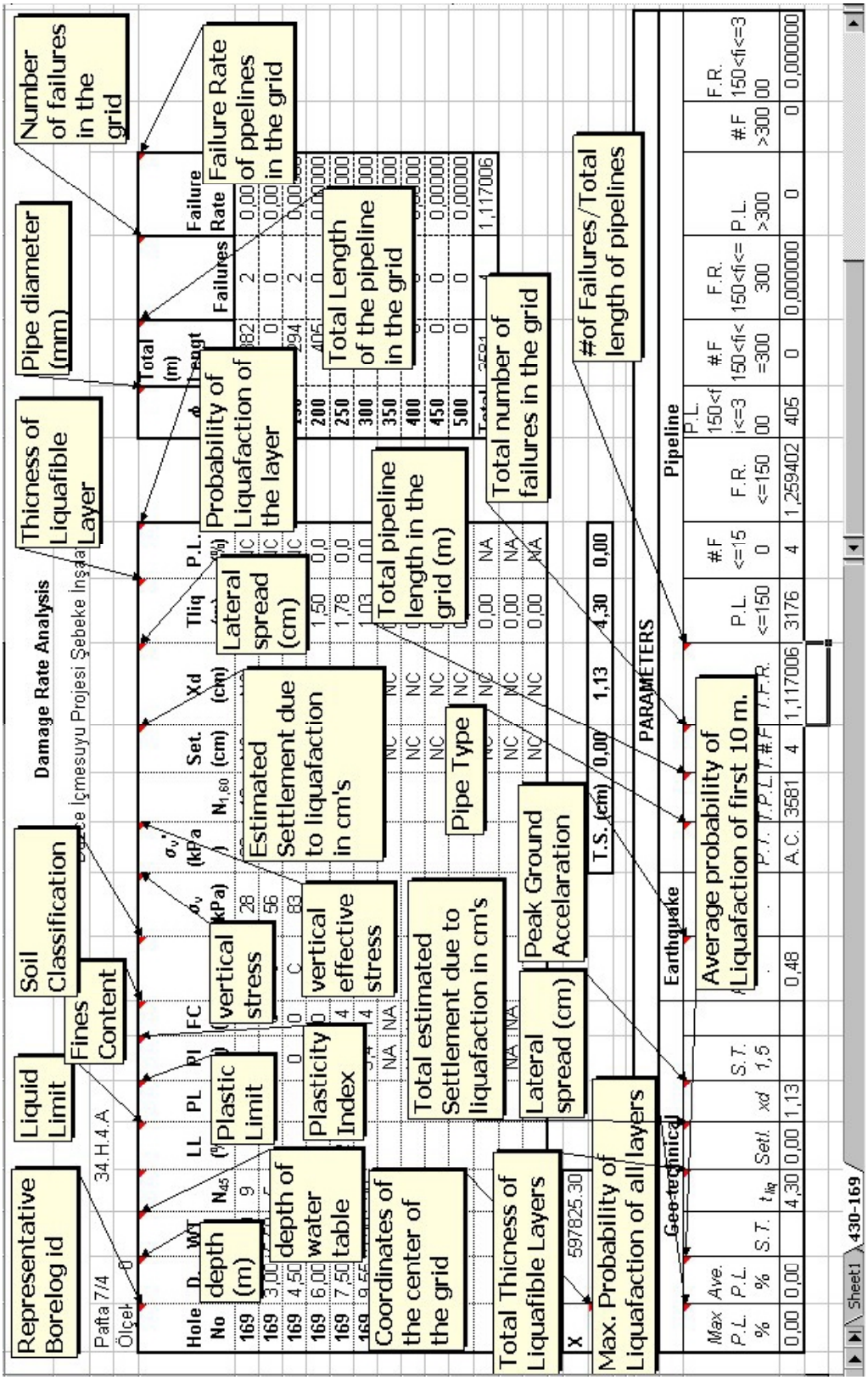

Figure 3.17 Input and computed data of each grid

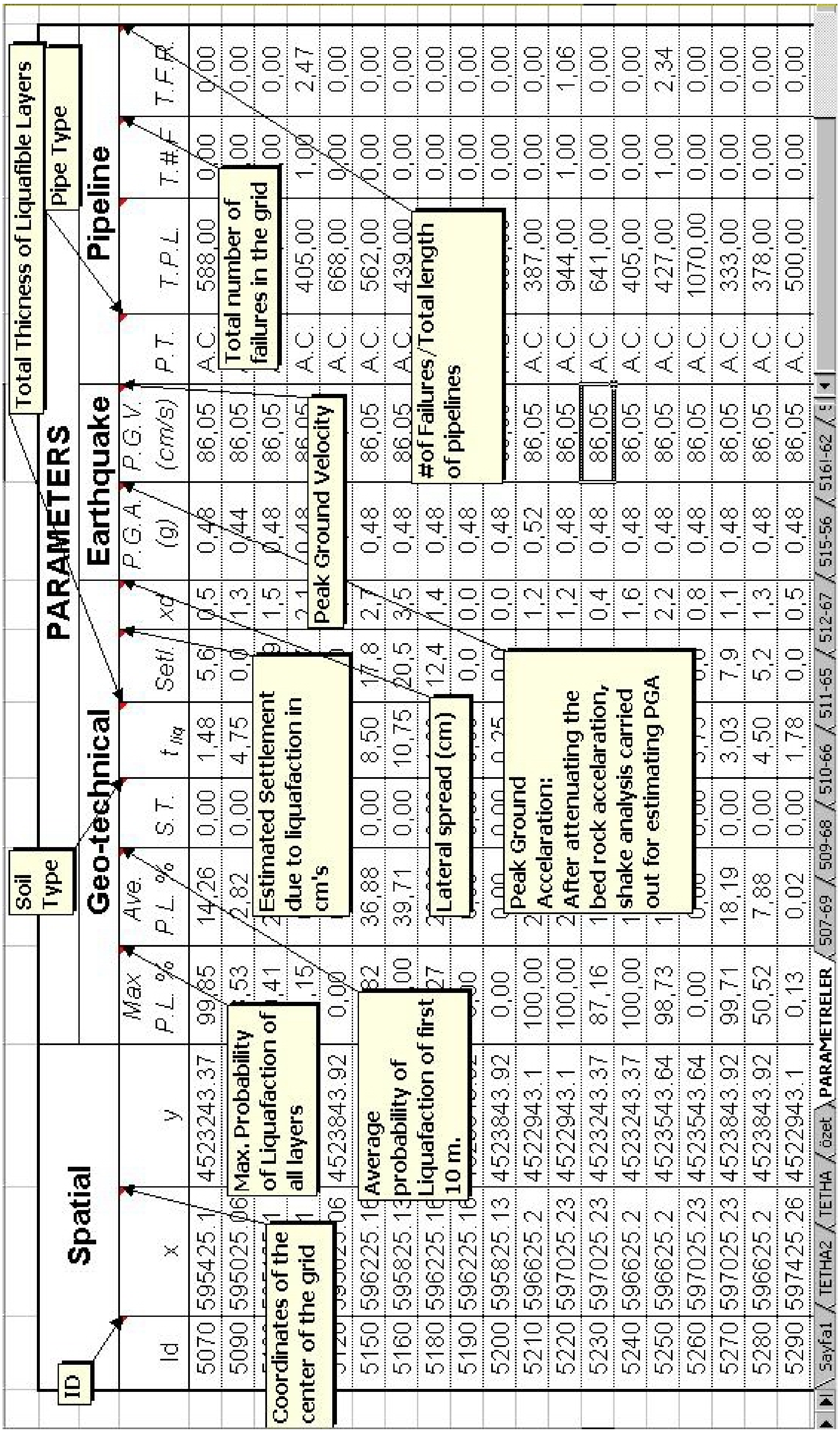

Figure 3.18 Database for all grids

CHAPTER 4

DEVELOPMENT OF PROBABILISTIC MODELS FOR THE ESTIMATION OF PIPE DAMAGE RATE

4.1 Introduction

In order to develop a model for the assessment of seismic performance of buried pipelines, first a series of sensitivity analysis are performed. Then, a limit state function is defined according to the results of the sensitivity analysis and considering the prior research efforts. A maximum likelihood framework for the probabilistic assessment of seismically induced buried pipeline performance is described and the fragility curves are constructed with the proposed model.

4.2 Sensitivity Studies

For the purpose of defining important parameters relevant to the problem addressed as well as the possible mathematical form of the relationship among pipe failure rate and selected descriptive parameters, a series of sensitivity studies were performed. As shown in Table 4.1, some of the potential descriptive variables are intercorrelated. Accordingly, in order to minimize the correlations, the descriptive variables are selected as; liquefaction induced ground settlements (S) in

centimeters, peak ground acceleration (PGA) in g, soft layer thickness, t_{soft} (defined as thickness of the layer in meters with SPT blow counts less than 10 in the upper 10 m) and two liquefaction susceptibility variables obtained as described in Section 3.3.2.4 (a) (PL_{max}) and Section 3.3.2.4 (b) (PL_{ave}). For each variable a cumulative damage rate versus descriptive variable plots are prepared and the tendency of the change in the damage rate with respect to the variable is investigated.

Table 4.1. Correlation matrix

	t_{liq}	t_{stiff}	PL_{max}	PL_{ave}	S	PGA	t_{soft}	d_{liq}	T.F.R.
tliq	1.000								
tstiff	0.620	1.000							
Max P.L. %	0.092	-0.322	1.000						
Ave. P.L. %	0.180	-0.339	0.808	1.000					
Setl.	0.198	-0.343	0.752	0.918	1.000				
P.G.A.	-0.520	-0.329	0.340	0.215	0.126	1.000			
tsoft	-0.522	-0.513	0.219	0.245	0.332	0.470	1.000		
dliq	-0.107	0.334	-0.956	-0.823	-0.759	-0.327	-0.174	1.000	
T.F.R.	0.086	-0.137	0.309	0.331	0.421	0.191	0.256	-0.279	1.000

In Table 4.1 t_{liq} is the thickness of the potentially liquefiable layer in meters, t_{stiff} is the thickness of the layer with SPT blow counts more than 30 in the upper 10m, t_{soft} is the thickness of the layer with SPT blow counts less than 10 in the upper 10m, d_{liq} is the depth in meters where liquefaction is expected and finally T.F.R. is the total failure rate in the grid.

Figure 4.1 shows the change in cumulative number of failures with respect to change in liquefaction induced ground settlements. As it can be seen from this figure, cumulative failures linearly increase with the increase in post liquefaction settlements.

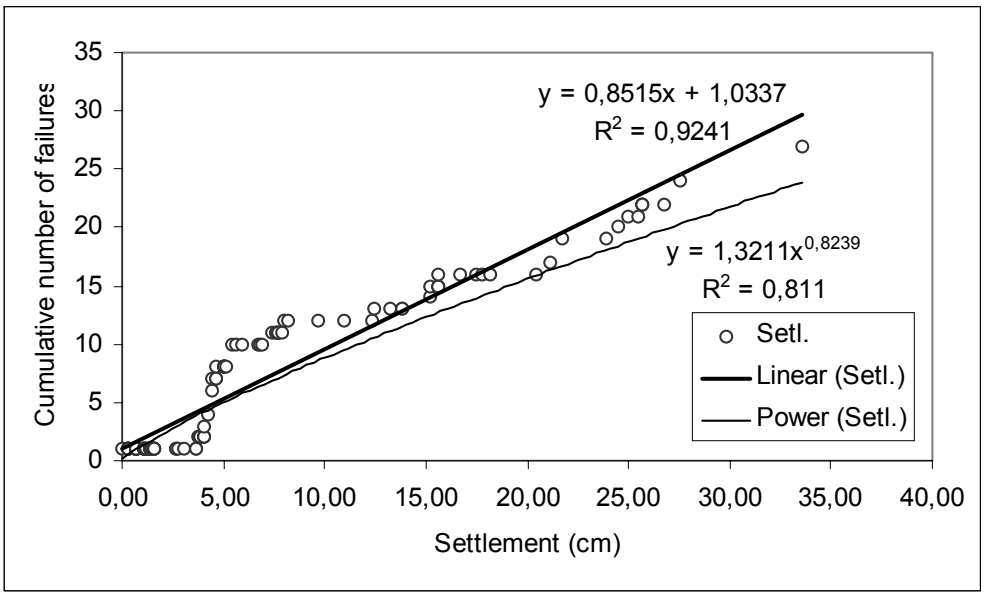

Figure 4.1 Distribution of the number of failures with settlement

Similarly, Figure 4.2 shows the effect of PGA on damage distribution. As the PGA increases the damage rate is increasing rapidly. This relation exhibits an exponential type relationship.

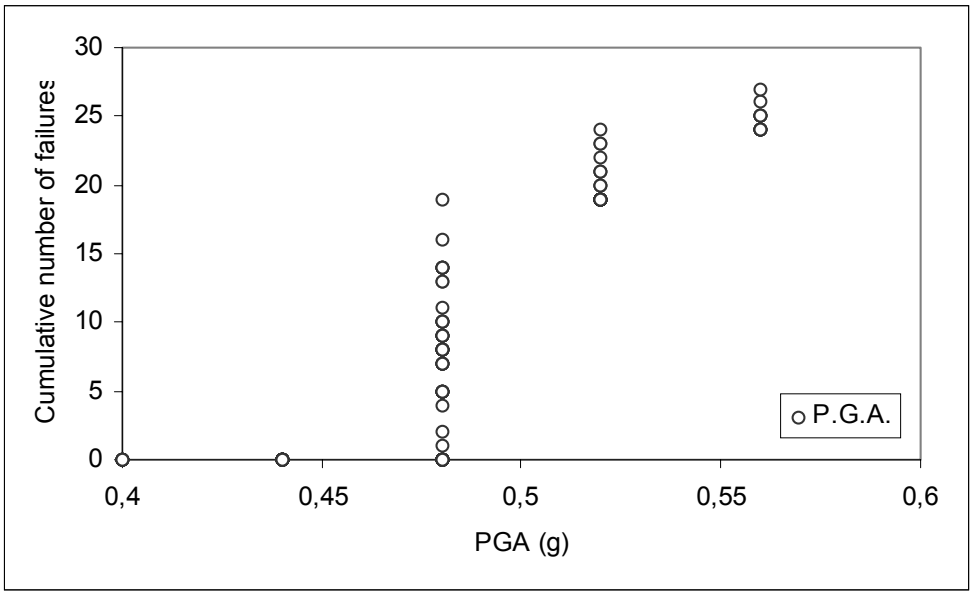

Figure 4.2 Distribution of the number of failures with PGA

Figures 4.3 and 4.4 show the effects of liquefaction susceptibility on damage distribution. In Figure 4.3, liquefaction susceptibility is expressed as the average probability of liquefaction of the soil profile whereas in Figure 4.4, as the maximum probability of liquefaction of the most susceptible layer within the soil profile. In Figure 4.3, linear increase in cumulative damage with respect to increase in probability of liquefaction is clear. However, once maximum probability of liquefaction is used as an indicator of failure rate then the relationship becomes more exponential like as shown in Figure 4.4.

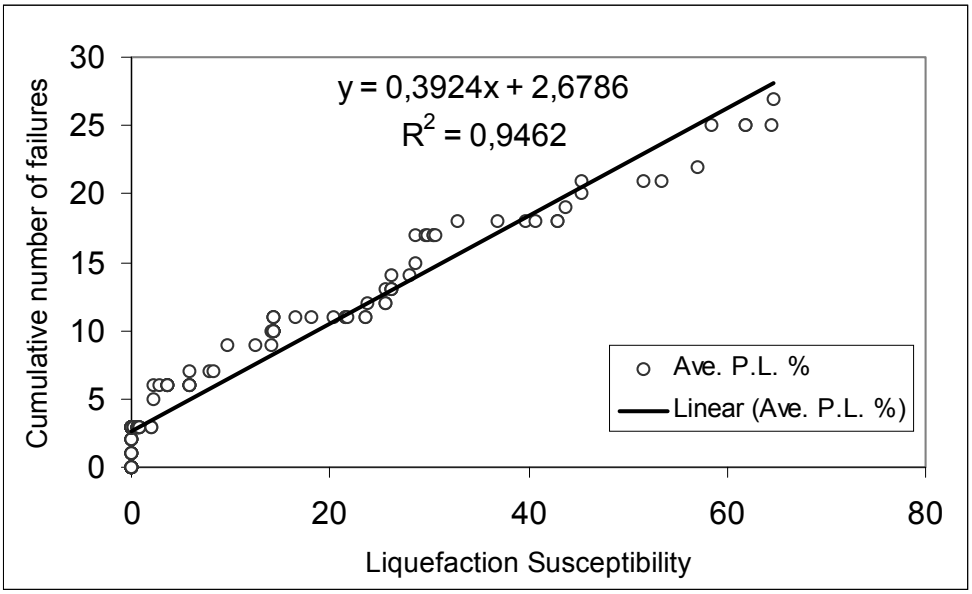

Figure 4.3 Distribution of the number of failures with average liquefaction susceptibility

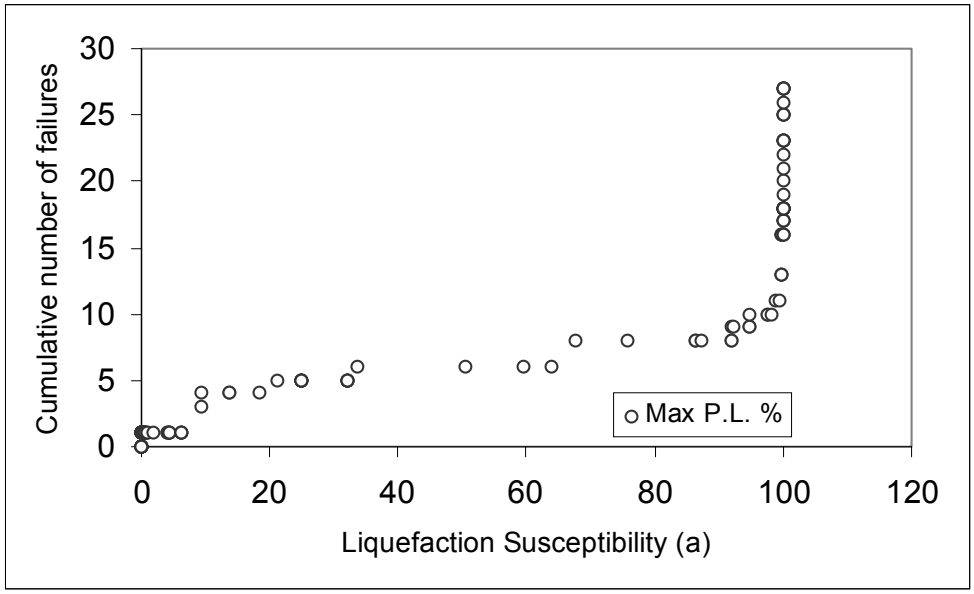

Figure 4.4 Distribution of the number of failures with maximum liquefaction susceptibility

Last but not least, Figure 4.5 shows the effect of existing soft layers on cumulative failure rates. Although this term seems to be highly correlated with liquefaction, it differs from the liquefaction term as it includes the thicknesses of soft layer of non-liquefiable nature as well. As it can be seen on Figure 4.5, the relationship is linear.

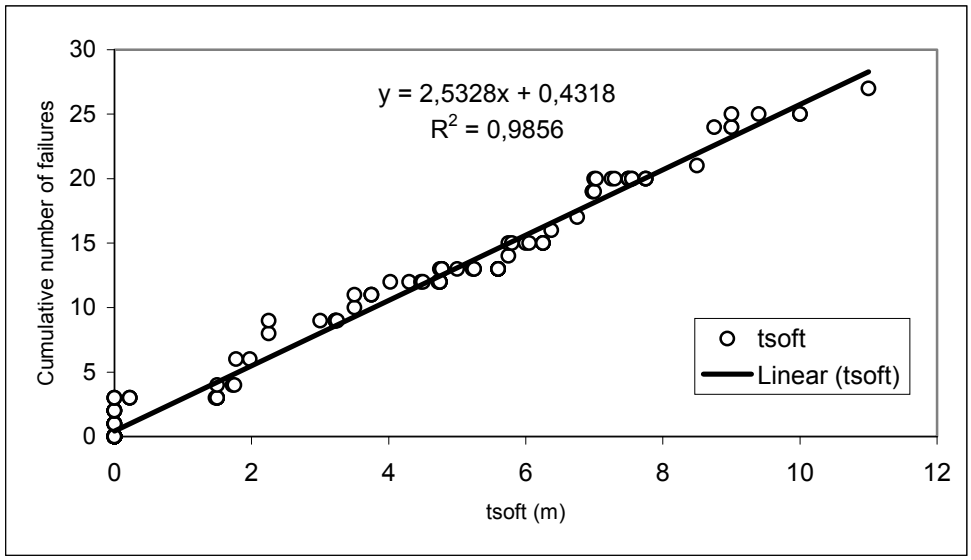

Figure 4.5 Distribution of the number of failures with soft layer

4.3 Construction of the Limit State Function

Maximum likelihood approach for developing a model for the assessment of seismic performance of buried pipelines requires the selection of a mathematical model. The model for the correlation has the general form $\hat{g} = g(\mathbf{x}, \boldsymbol{\Theta})$, where $\mathbf{x}$ is a set of descriptive variables and $\boldsymbol{\Theta}$ is the set of unknown model parameters. The limit-state surface $g(\mathbf{x}, \boldsymbol{\Theta}) = 0$ denotes the pipe failure rates per kilometer of the pipeline. Motivated by the results of discussed sensitivity studies as well as prior research efforts (e.g.: Hwang et. al. (1998), Toprak (1999), Chen et. al. 2002), we adopt the following improved model for the limit state function:

$$\hat{g}(\mathrm{DR}, \mathrm{PGA}, \mathrm{S}, \Theta) = DR - \grave{e}_1 \cdot \mathrm{PGA} - \grave{e}_2 \cdot S - \grave{e}_3 \qquad (4.1)$$

$$\hat{g}(\mathrm{DR}, \mathrm{PGA}, \mathrm{S}, \Theta) = DR - (\grave{e}_1 + \mathrm{S})^{\theta_2} \cdot \mathrm{PGA}^{\theta_3} \cdot (\grave{e}_4 + \mathrm{t}_{\mathrm{soft}})^{\grave{e}_5} + \grave{e}_6 \qquad (4.2)$$

where;

DR is the damage rate expressed as the number of failures per km of pipeline

S is the estimated liquefaction-induced ground settlements (S) in centimeters as described in section 3.3.2.5

PGA is peak ground acceleration in meter per square second

t_{soft} is thickness of the layer in meters with SPT blow counts less than 10 in the upper 10 m

$\Theta = (\theta_1, \ldots, \theta_5)$ is the set of model parameters

The limit state functions in equations 4.1 and 4.2 assume that pipe failure rates can be completely estimated by the three descriptive variables S, PGA, t_{soft}. Obviously other variables exist which may influence pipe failures. Even if the selected descriptive variables were to fully explain the liquefaction phenomenon, the adopted mathematical expression may not have the ideal form. Hence, equations 4.1 and 4.2 are imperfect models of the limit-state function. We have signified this by use of a superposed hat on g. To account for the influences of the missing variables and the possible incorrect model form, we introduce a random model correction term, ε, and write the corrected limit state function as

$$g(\mathrm{DR}, \mathrm{PGA}, \mathrm{S}, \Theta) = DR - \grave{e}_1 \cdot \mathrm{PGA} - \grave{e}_2 \cdot S - \grave{e}_3 + \boldsymbol{\varepsilon} \tag{4.3}$$

$$g(\mathrm{DR}, \mathrm{PGA}, \mathrm{S}, t_{soft}, \Theta) = DR - (\grave{e}_1 + \mathrm{S})^{\boldsymbol{\theta}_2} \cdot \mathrm{PGA}^{\boldsymbol{\theta}_3} \cdot (\grave{e}_4 + t_{soft})^{\grave{e}_5} + \grave{e}_6 + \boldsymbol{\varepsilon} \tag{4.4}$$

It is reasonable and also convenient to assume that ε has a normal distribution. With the aim of producing an unbiased model (i.e., one that, in the average, makes the correct prediction), we set the mean of ε to zero. The standard deviation of ε, denoted by σ_ε, however is unknown and must be estimated. The set of unknown parameters of the model, therefore, is $\boldsymbol{\Theta} = (\boldsymbol{\theta}, \sigma_\varepsilon)$.

4.4 Formulation of the Likelihood Function:

For assessing the pipe damage rate model, we make use of field case histories at sites where pipe damage has or has not occurred after

Duzce earthquake. Let DR_i, S_i, PGA_i, $tsoft_i$ be the values of damage rate, post liquefaction settlement, peak ground acceleration and thickness of the soft layer at the i^{th} grid, respectively, and let ε_i be the corresponding realization of the model correction term. Assuming the observations compiled from different grids to be statistically independent, we can write the likelihood function as the product of the probabilities of the observations, i.e.,

$$L(\grave{\mathbf{e}}, \boldsymbol{\sigma}_{\boldsymbol{\varepsilon}}) = \prod_{\text{grid no}=1}^{167} P\left[g(DR_i, S_i, PGA_i, tsoft_i, \boldsymbol{\varepsilon}_i, \grave{\mathbf{e}}) = 0\right] \tag{4.5}$$

Suppose the measured or estimated values DR_i, S_i, PGA_i, $tsoft_i$ at each grid are exact, i.e., no measurement or estimation error is present. Then, noting that

$$g(DR_i, S_i, PGA_i, tsoft_i, \varepsilon_i, \boldsymbol{\theta}) = \hat{g}(DR_i, S_i, PGA_i, tsoft_i, \boldsymbol{\theta}) + \varepsilon_i \tag{4.6}$$

has the normal distribution with mean $\hat{g}(DR_i, S_i, PGA_i, tsoft_i, \boldsymbol{\theta})$ and standard deviation σ_ε, the likelihood function (Eq. 4.5) can be written as

$$L(\grave{\mathbf{e}}, \boldsymbol{\sigma}_{\boldsymbol{\varepsilon}}) = \prod_{\text{grid no}=1}^{161} \boldsymbol{\varphi}\left[\frac{g(DR_i, S_i, PGA_i, tsoft_i, \boldsymbol{\varepsilon}_i, \grave{\mathbf{e}})}{\boldsymbol{\sigma}_{\boldsymbol{\varepsilon}}}\right] \tag{4.7}$$

where $\varphi[\cdot]$ is the normal probability function. Note that the above is a function of the unknown parameters $\boldsymbol{\theta}$ and σ_ε.

Model parameters' θ's and σ_ε were estimated as the values that will maximize the likelihood functions as shown in Table 4.2.

Table 4.2 Maximum Likelihood Estimates of Model Parameters

Eqn.	θ_1	θ_2	θ_3	θ_4	θ_5	θ_6	σ_ε	Ln(Max. Likelihood Value)
4.3	0.038	2.6	-1.2				0.64	-155.8
4.4	7.62	2.39	12	3.46	0.05	0.04	0.56	-133.7

As it can be seen from Table 4.2, since maximum likelihood value of the limit state model given in equation 4.4 is higher, exponential model is concluded to be better.

4.5 Damage Rate Estimations

As discussed previously, two models were developed for the performance assessment of buried pipelines subjected to liquefaction-induced ground deformations. In both models, probability of liquefaction (PL) term was not explicitly represented, however liquefaction induced settlement was highly correlated with PL. (Table 4.1)

Figure 4.6 shows the damage rate estimation of AC pipes versus PGA corresponding to different liquefaction induced settlements estimated by using the linear model. As it can be seen from this figure as settlement values increase failure rates increase.

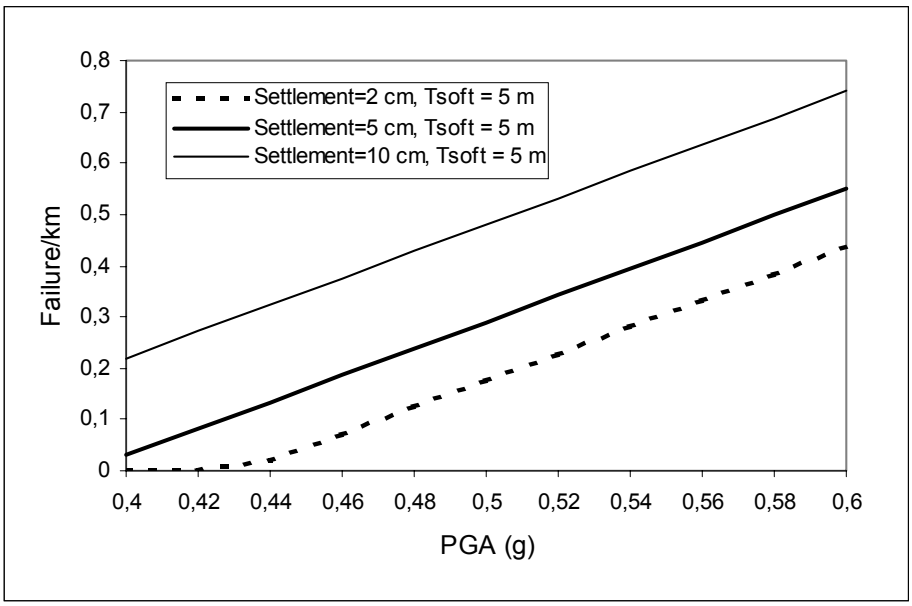

Figure 4.6 Damage rate versus PGA for different liquefaction induced settlement values (linear model)

Figure 4.7 shows the damage rate estimation of AC pipes vs PGA corresponding to different liquefaction induced settlements estimated by using the exponential model. As it can be seen from the figure as settlement values increase failure rates increase. Keeping in mind that this model has a higher likelihood value and thus can be concluded to be more realistic.

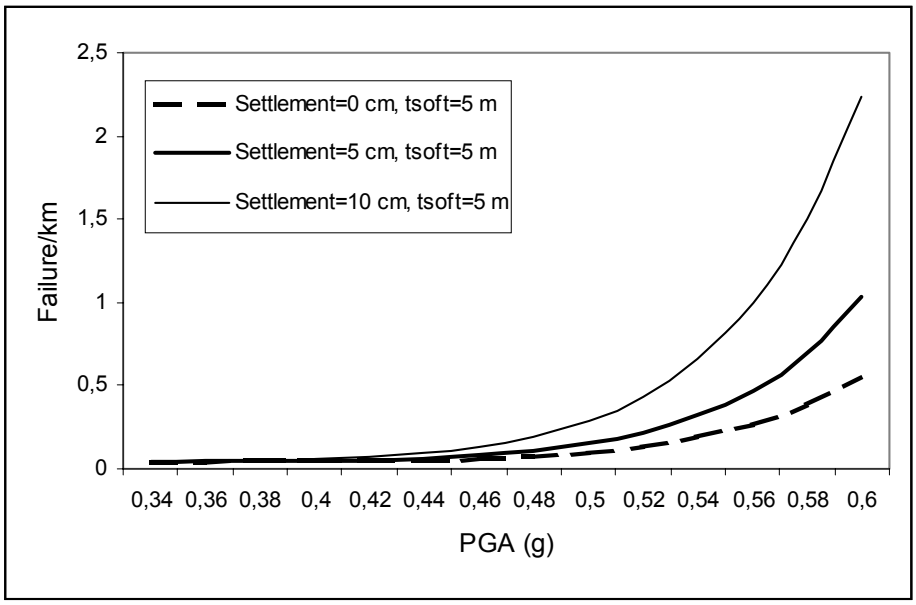

Figure 4.7 Damage rate versus PGA for different liquefaction induced settlement values (exponential model)

Figure 4.8 shows the influence of soft layers on the failure rates. As it can be seen from the figure influence of soft layer thickness is not significant as opposed to the importance of PGA and settlement.

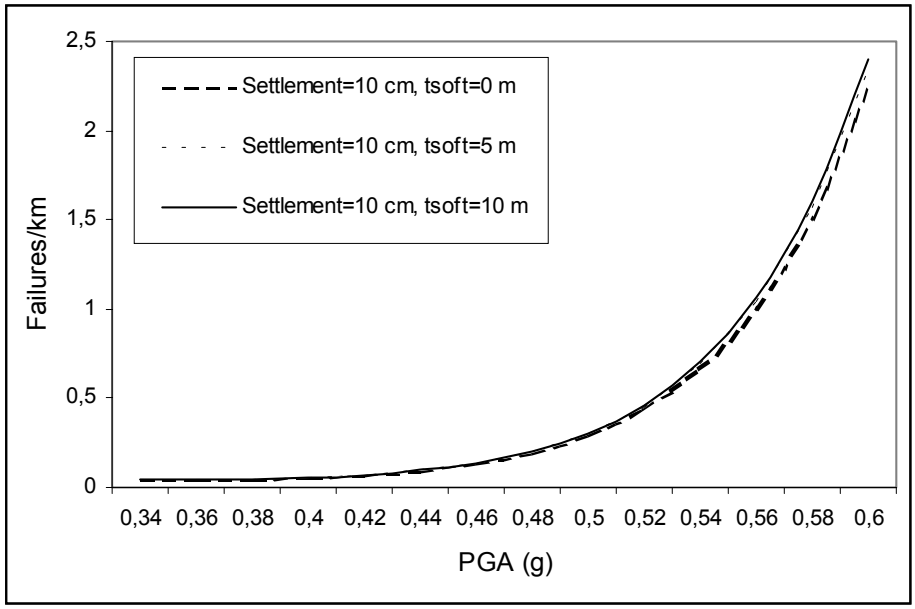

Figure 4.8 Influence of soft layer thickness on damage rates

Figure 4.9 presents the effect of settlement on failure rates of buried pipelines of Duzce city according to the linear model. As it can be seen from the figure as settlement values increase failure rates increases.

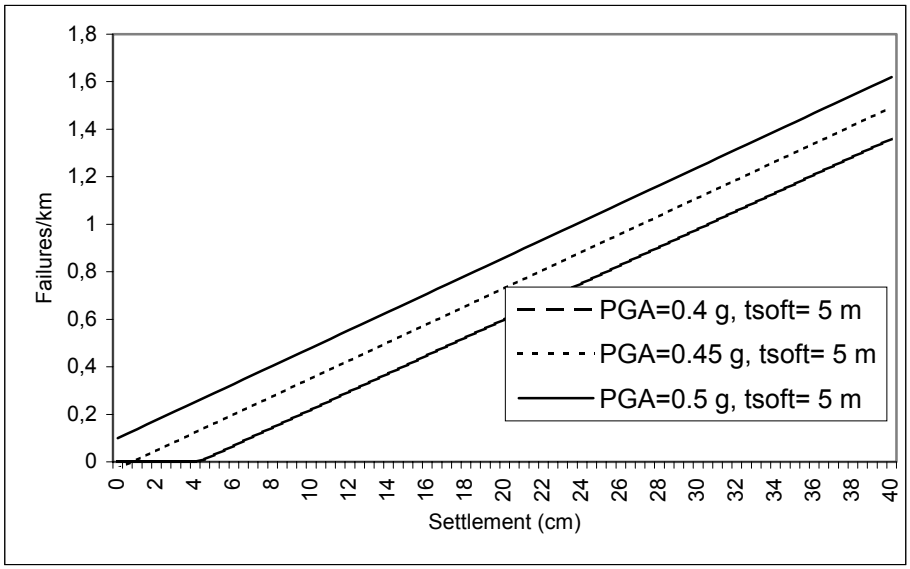

Figure 4.9 Settlement versus damage rates (linear model)

Figure 4.10 presents the effect of settlement on failure rates of buried pipelines of Duzce city calculated by the exponential model. The average settlement estimation for Duzce was 5 cm, the recorded strong ground motion was 0.513 g and the model estimates a 0.2 failures/km for this pair. While using this plot it should be noted that the settlement used in this plot is one type of permanent ground deformation, and stands for only liquefaction induced ground settlements. For the other types of permanent ground deformations (PGD) such as fault offsets or land slides this figure may not give accurate results.

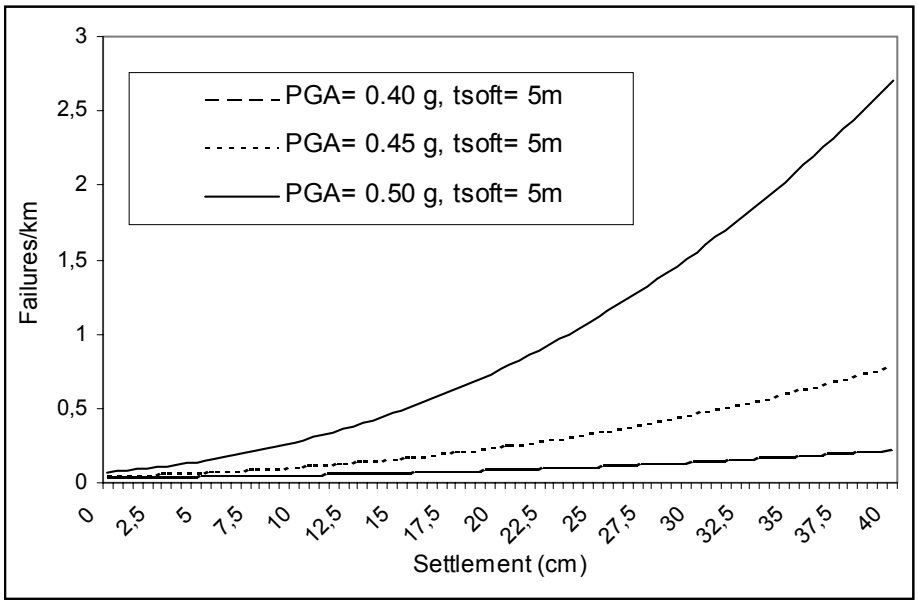

Figure 4.10 Settlement versus damage rates (exponential model)

4.6 Comparison of the Estimated and the Observed Damage Rates

In order to check the efficiency of the proposed model, damage rate estimations obtained from the model are compared with the observed damage rates for certain regions in the city. Regardless of the PGA, settlement or soft layer contours, four districts are selected for this purpose. In Figure 4.11 the location of the selected districts are shown. In Table 4.3 the damage rate obtained from the proposed model and the observed damage rates are given together with the values of PGA, S and t_{soft}. In Table 4.3, O.D.R. stands for the observed damage rate (failures/km), PGA is the average peak ground acceleration in the district in terms of g, S is the average estimated settlement in the district in terms of cm, t_{soft} is the average thickness of soft layers in the district in terms of m and E.D.R. is the estimated damage rate computed from the model. As it is observed from this table, the estimated damage rates are very close to the observed ones, supporting the reliability of the proposed model.

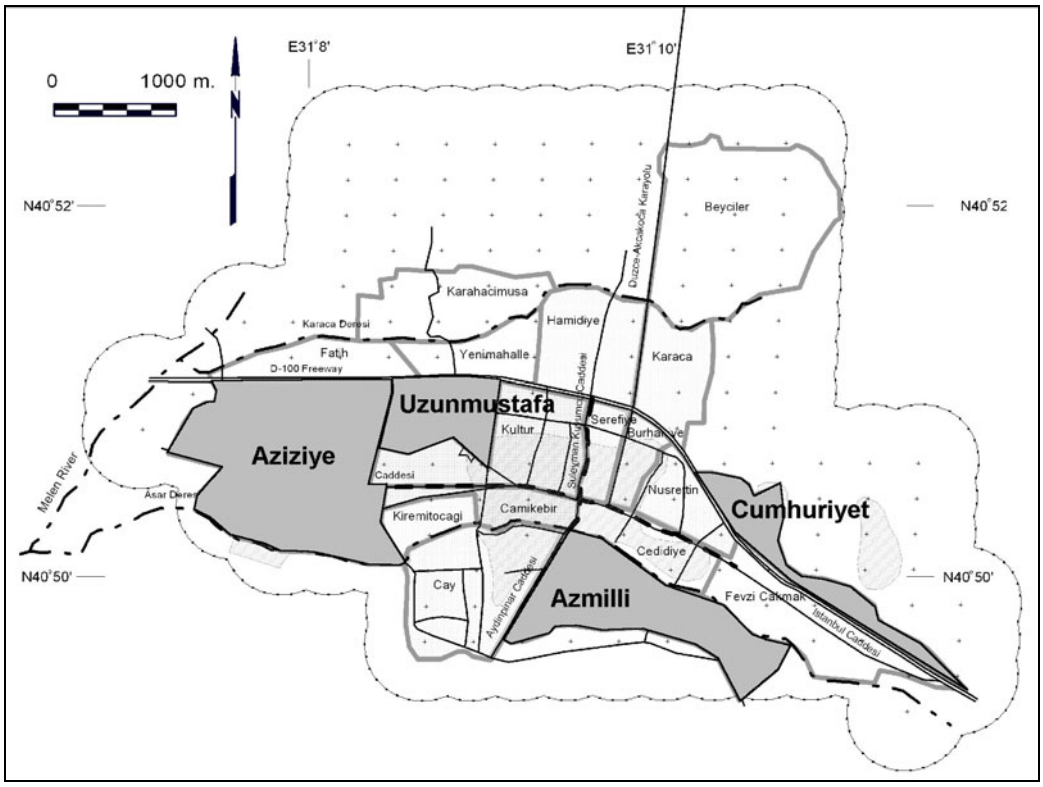

Figure 4.11 Selected districts for checking the accuracy of the model

Table 4.3 Comparison of the observed and estimated damage rates

District	PGA	S	t_{soft}	O.D.R.	E.D.R.
Azmilli	0.54	10.00	3.56	**0.78**	**0.73**
Aziziye	0.45	6.50	3.00	**0.08**	**0.08**
Uzunmustafa	0.48	9.00	2.20	**0.16**	**0.17**
Cumhuriyet	0.53	5.34	3.35	**0.28**	**0.28**

CHAPTER 5

SUMMARY AND CONCLUSIONS

In 1999 two strong earthquakes; August 17, Kocaeli Earthquake (M_w=7.4) and November 12, Duzce Earthquake (M_w=7.2) struck Turkey's urban areas, resulting in widespread economical and life losses, as well as lifeline damage. This study has focused on the understanding of the performance of water delivering pipelines subjected to earthquakes.

Within the scope of these research efforts, pipeline performance case histories have been compiled from Duzce city after the 12 November, 1999 Duzce earthquake. A comprehensive study on Duzce water supply and distribution system has been carried out and pipeline repairs due to Duzce earthquake have been investigated. Correlations of the damage patterns with the system, earthquake and geotechnical characteristics have been developed. Moreover, spatial distributions of the earthquake effects have been transferred into Geographic Information System (GIS) format. As a result of these studies, it was intended to define the seismic, geotechnical and structural parameters, which may explain the spatial variability of the observed seismic pipeline hazard.

Within the scope of this study, a maximum likelihood framework for the probabilistic assessment of seismically induced buried pipeline performance is described. A database, consisting of post-earthquake field observations of buried pipeline performance after Duzce earthquake

in conjunction with in-situ “index” test results, is used for the development of probability-based seismic pipeline performance correlations.

For the purpose of defining important parameters of the problem as well as the possible mathematical form of the relationship among pipe failure rate and select descriptive parameters, series of sensitivity studies were performed. Descriptive variables are selected as; liquefaction induced ground settlements, peak ground acceleration and soft layer thickness. Motivated by the results of discussed sensitivity studies as well as prior research efforts (e.g.: Hwang et al., 1998, Toprak, 1999, Chen et al., 2002), we adopt the following improved model for damage rate estimations, based on the maximum likelihood procedure:

$$DR = 0.038 \times \mathrm{PGA} + 2.6 \times S - 1.2 \tag{5.1}$$

$$DR = (7.62 + \mathrm{S})^{2.39} \times \mathrm{PGA}^{12} \times (3.46 + \mathrm{t_{soft}})^{0.05} - 0.04 \tag{5.2}$$

where;

DR is the damage rate expressed as the number of failures per km of asbestos cement pipeline

S is the estimated liquefaction-induced ground settlements in centimeters as described in section 3.3.2.5

PGA is peak ground acceleration in terms of g

t_{soft} is thickness of the layer in meters with SPT blow counts less than 10 in the upper 10 m

The exponential model compared to the linear one has a higher likelihood value and thus this model is preferred. According to the exponential model, damage rate (DR) exponentially increases with the increase of settlement (S) and peak ground acceleration (PGA) and the influence of soft layer thickness is not significant as opposed to the importance of PGA and settlement.

In order to compare the damage rate estimates of the model and the observed damage rate in the province of Duzce four districts with different damage rates and different variables are selected and it is observed that the damage rate estimates obtained from the model are very close to the observed damage rates. In addition to this regional comparisons, a general comparison can be done by considering the whole city. The average settlement estimation for Duzce was 5 cm, the recorded strong ground motion was 0.513 g and the proposed model estimates a 0.2 failures/km for this pair, which is, exactly equal to the observed damage rate.

While using this model it should be noted that the settlement used in this model is a type of permanent ground deformation (PGD), and stands for only liquefaction induced ground settlements. For the other types of PGD such as fault offsets or landslides, the proposed model and the accompanying figures (Figures 4.6, 4.7, 4.8, 4.9 and 4.10) may not give accurate results.

For future studies, updating the present database with new data from future earthquakes is suggested, as well as adjusting the proposed model in view of buried pipeline performances observed in the future earthquakes of large magnitude.

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APPENDIX A

THE DATABASE OF THE COLLECTED AND PROCESSED DATA

In this appendix for each grid point the data related to the important parameters are presented in the form of a table. First two columns are the coordinates of the grid center, T.P.L. is the total pipe length in the grid in terms of meters, T.#.F. is the total number of pipe failures in the grid, P.L.% (a) is the probability of liquefaction calculated as described in Section 3.3.2.4.a and P.L.% (b) is the probability of liquefaction calculated as described in Section 3.3.2.4.b, S is the estimated settlement in centimeters in the grid, P.G.A. is the peak ground acceleration at the grid center in terms of g, t_{soft} is the thickness of soft layer as described in Section 3.3.2.1 in terms of meters and finally D.R. is the damage rate in the grid and is equal to the ratio of total number of failures (T.#.F.) to total pipe length (T.P.L.).

In the following pages the data is tabulated in Table A1.

Table A1

x	y	T.P.L.	T.#.F	P.L.% (a)	P.L.% (b)	S	P.G.A.	t_{soft}	D.R.
596225.16	4525945.83	242	0	0.69	0.00	1.11	0.48	0.00	0.0000
596225.16	4525645.55	271	0	0.06	0.00	0.33	0.40	0.00	0.0000
595825.13	4525645.55	3051	0	0.00	0.00	0.00	0.48	5.25	0.0000
596625.20	4525345.28	316	0	0.23	0.00	0.65	0.44	0.00	0.0000
596625.20	4525945.83	316	0	0.23	0.00	0.65	0.44	0.00	0.0000
597025.23	4525345.28	783	0	0.23	0.00	0.65	0.44	0.00	0.0000
597025.23	4525945.83	783	0	0.23	0.00	0.65	0.44	0.00	0.0000
596625.20	4525645.55	202	0	0.23	0.00	0.65	0.44	0.00	0.0000
597425.26	4525345.28	229	0	0.23	0.00	0.65	0.44	0.00	0.0000
597425.26	4525945.83	229	0	0.23	0.00	0.65	0.44	0.00	0.0000
597825.30	4525345.28	526	0	0.23	0.00	0.65	0.44	0.00	0.0000
597825.30	4525945.83	526	0	0.23	0.00	0.65	0.44	0.00	0.0000
597825.30	4525645.55	237	0	0.23	0.00	0.67	0.44	0.00	0.0000
597425.26	4525645.55	564	0	0.23	0.00	0.65	0.44	0.00	0.0000
597425.26	4525945.83	776	0	0.23	0.00	0.67	0.44	0.00	0.0000
597825.30	4525945.83	434	0	0.23	0.00	0.67	0.44	0.00	0.0000
597825.30	4525645.55	51	0	0.06	0.00	0.30	0.40	0.00	0.0000
597425.26	4525645.55	420	0	0.06	0.00	0.30	0.40	0.00	0.0000
598225.33	4525345.28	787	0	13.78	1.97	1.35	0.44	0.00	0.0000
598225.33	4525945.83	787	0	0.23	0.00	0.67	0.44	0.00	0.0000
598625.36	4525345.28	602	0	24.78	3.54	1.57	0.48	0.00	0.0000
598625.36	4525945.83	602	0	0.69	0.00	1.16	0.48	0.00	0.0000
598625.36	4525645.55	266	0	24.78	3.54	1.57	0.48	0.00	0.0000
598225.33	4525645.55	534	0	13.78	1.97	1.35	0.44	0.00	0.0000
598225.33	4525945.83	591	0	0.23	0.00	0.67	0.44	0.00	0.0000
598625.36	4525945.83	1397	0	6.18	0.88	1.10	0.40	0.00	0.0000
598625.36	4525645.55	789	0	0.06	0.00	0.30	0.40	0.00	0.0000
598225.33	4525645.55	302	0	0.06	0.00	0.30	0.40	0.00	0.0000
599025.40	4525345.28	382	0	24.78	3.54	1.57	0.48	0.00	0.0000
599025.40	4525945.83	382	0	0.69	0.00	1.16	0.48	0.00	0.0000
599425.43	4525345.28	584	0	24.78	3.54	1.57	0.48	0.00	0.0000
599425.43	4525945.83	584	0	0.69	0.00	1.16	0.48	0.00	0.0000
599425.43	4525645.55	352	0	24.78	3.54	1.57	0.48	0.00	0.0000
599025.40	4525645.55	352	0	24.78	3.54	1.57	0.48	0.00	0.0000
599025.40	4525945.83	309	0	6.18	0.88	1.10	0.40	0.00	0.0000
599425.43	4525945.83	886	0	6.18	0.88	1.10	0.40	0.00	0.0000
599425.43	4525645.55	408	0	6.18	0.88	1.10	0.40	0.00	0.0000
594225.00	4524144.19	1949	0	4.22	0.60	1.40	0.44	0.00	0.0000
594625.03	4524144.19	3417	0	4.22	0.60	1.40	0.44	0.00	0.0000
594625.03	4524444.46	2616	0	4.22	0.60	1.40	0.44	0.00	0.0000
594225.00	4524444.46	770	0	4.22	0.60	1.40	0.44	0.00	0.0000
595025.06	4524144.19	3076	0	75.69	16.52	6.80	0.44	0.00	0.0000
595425.10	4524144.19	3051	0	0.00	0.00	0.00	0.48	5.25	0.0000
595425.10	4524444.46	2660	1	100.00	26.27	15.56	0.48	1.50	0.3759
595025.06	4524444.46	3065	0	86.42	21.65	7.63	0.48	0.00	0.0000

x	y	T.P.L.	T.#.F	P.L.% (a)	P.L.% (b)	S	P.G.A.	t_{soft}	D.R.
595025.06	4524744.73	463	0	86.42	21.65	7.63	0.48	0.00	0.0000
595425.10	4524744.73	1352	0	100.00	26.27	15.56	0.48	1.50	0.0000
595825.13	4524144.19	3204	0	100.00	61.79	25.72	0.48	4.78	0.0000
596225.16	4524144.19	3972	0	100.00	61.79	25.72	0.48	4.78	0.0000
596225.16	4524444.46	2954	0	99.99	30.36	13.81	0.48	4.78	0.0000
595825.13	4524444.46	2817	0	0.26	0.04	0.30	0.48	0.00	0.0000
595825.13	4524744.73	2732	0	0.26	0.04	0.30	0.48	0.00	0.0000
596225.16	4524744.73	3688	0	99.99	30.36	13.81	0.48	4.78	0.0000
596625.20	4524144.19	3163	2	99.64	64.72	21.77	0.48	1.78	0.6323
597025.23	4524144.19	3138	0	97.44	64.52	18.18	0.48	0.00	0.0000
597025.23	4524444.46	2723	0	100.00	14.29	6.68	0.48	7.03	0.0000
596625.20	4524444.46	3419	0	0.00	0.00	0.00	0.48	0.00	0.0000
596625.20	4524744.73	3282	0	0.00	0.00	0.00	0.48	0.00	0.0000
597025.23	4524744.73	3228	0	0.00	0.00	0.00	0.48	0.00	0.0000
597025.23	4525045.01	365	0	0.00	0.00	0.00	0.44	0.00	0.0000
596625.20	4525045.01	1141	0	0.00	0.00	0.00	0.44	0.00	0.0000
597425.26	4524144.19	3204	0	0.01	0.00	0.00	0.48	4.50	0.0000
597825.30	4524144.19	405	0	0.00	0.00	0.00	0.48	3.00	0.0000
597825.30	4524444.46	3232	1	99.98	28.55	12.48	0.48	4.03	0.3094
597425.26	4524444.46	2788	0	100.00	30.57	16.68	0.48	5.80	0.0000
597425.26	4524744.73	1581	0	0.00	0.00	0.00	0.48	0.00	0.0000
597825.30	4524744.73	3258	0	0.00	0.00	0.00	0.48	0.00	0.0000
597825.30	4525045.01	3092	0	0.00	0.00	0.00	0.44	0.00	0.0000
597425.26	4525045.01	2039	0	0.00	0.00	0.00	0.44	0.00	0.0000
598225.33	4524144.19	3350	0	0.00	0.00	0.00	0.48	4.30	0.0000
598625.36	4524144.19	1225	1	33.62	5.94	4.21	0.48	0.00	0.8163
598625.36	4524444.46	392	1	9.39	2.30	4.46	0.48	2.25	2.5510
598225.33	4524444.46	3563	2	9.39	2.30	4.46	0.48	2.25	0.5177
598225.33	4524744.73	534	0	0.40	0.06	0.00	0.44	0.00	0.0000
598625.36	4524744.73	709	0	4.02	0.57	1.52	0.48	1.50	0.0000
598625.36	4525045.01	525	0	4.02	0.57	1.52	0.48	1.50	0.0000
598225.33	4525045.01	916	0	0.00	0.00	0.00	0.48	0.00	0.0000
599025.40	4524144.19	386	0	100.00	26.27	15.56	0.48	1.50	0.0000
599425.43	4524144.19	1071	0	100.00	26.27	15.56	0.48	1.50	0.0000
599425.43	4524444.46	405	0	32.19	5.84	5.01	0.48	0.00	0.0000
599025.40	4524444.46	548	0	32.19	5.84	5.01	0.48	0.00	0.0000
599025.40	4524744.73	578	0	32.19	5.84	5.01	0.48	0.00	0.0000
599425.43	4524744.73	352	0	32.19	5.84	5.01	0.48	0.00	0.0000
599025.40	4525045.01	354	0	32.19	5.84	5.01	0.48	0.00	0.0000
595425.10	4523243.37	588	0	99.85	14.26	5.60	0.48	1.48	0.0000
595025.06	4523543.64	270	0	18.53	2.82	0.04	0.44	0.23	0.0000
595425.10	4523543.64	311	0	59.41	20.25	10.94	0.48	1.73	0.0000
595425.10	4523843.92	405	1	21.15	0.00	3.70	0.48	5.75	2.4691
595025.06	4523843.92	668	0	0.00	0.00	0.00	0.44	3.23	0.0000
596225.16	4523243.37	562	0	99.82	36.88	17.81	0.48	3.75	0.0000
595825.13	4523243.37	439	0	100.00	39.71	20.47	0.48	7.00	0.0000
596225.16	4523543.64	382	0	99.27	28.06	12.37	0.48	6.98	0.0000

x	y	T.P.L.	T.#.F	P.L.% (a)	P.L.% (b)	S	P.G.A.	t_{soft}	D.R.
596225.16	4523843.92	468	0	0.00	0.00	0.00	0.48	1.75	0.0000
595825.13	4523843.92	658	0	0.00	0.00	0.00	0.48	6.00	0.0000
596625.20	4522943.10	387	1	100.00	23.77	8.03	0.52	4.75	1.0000
597025.23	4522943.10	944	0	100.00	21.74	7.68	0.48	4.75	0.0000
597025.23	4523243.37	641	0	87.16	12.45	2.77	0.48	0.23	0.0000
596625.20	4523243.37	405	0	100.00	14.30	6.90	0.48	4.73	0.0000
596625.20	4523543.64	427	1	98.73	14.20	7.43	0.48	6.75	2.3419
597025.23	4523543.64	1070	0	0.00	0.00	0.00	0.48	3.25	0.0000
597025.23	4523843.92	333	0	99.71	18.19	7.89	0.48	5.00	0.0000
596625.20	4523843.92	378	0	50.52	7.88	5.18	0.48	1.98	0.0000
597425.26	4522943.10	500	0	0.13	0.02	0.00	0.48	4.48	0.0000
597825.30	4523243.37	758	1	100.00	43.63	24.53	0.48	7.00	1.3193
597425.26	4523243.37	515	1	100.00	32.88	21.15	0.48	5.75	1.9417
597425.26	4523543.64	844	0	99.66	53.46	26.72	0.48	6.25	0.0000
597825.30	4523543.64	372	0	1.83	0.00	1.52	0.48	7.25	0.0000
597825.30	4523843.92	504	2	67.75	9.71	5.46	0.48	6.98	2.5157
597425.26	4523843.92	478	3	99.76	58.39	33.55	0.48	8.75	2.0921
598225.33	4522943.10	244	0	92.30	29.74	8.23	0.52	0.23	2.7322
598625.36	4522943.10	610	0	0.00	0.00	0.00	0.52	6.05	0.0000
598625.36	4523243.37	376	0	0.00	0.00	0.00	0.52	6.25	0.0000
598225.33	4523243.37	699	2	100.00	28.57	27.56	0.48	11.00	2.8612
598225.33	4523543.64	811	0	100.00	42.86	23.85	0.48	7.75	0.0000
598625.36	4523543.64	314	0	63.94	8.31	9.67	0.48	3.75	0.0000
598625.36	4523843.92	1104	0	100.00	51.65	25.48	0.48	6.25	0.0000
598225.33	4523843.92	678	0	98.11	14.02	5.97	0.48	3.75	0.0000
599025.40	4522943.10	381	1	0.00	0.00	0.00	0.56	6.38	0.0000
599425.43	4522943.10	1596	1	100.00	45.24	15.18	0.52	3.50	1.0471
599425.43	4523243.37	574	1	100.00	45.24	15.18	0.52	3.50	1.5873
599025.40	4523243.37	597	0	0.01	0.00	0.00	0.52	5.23	0.0000
599025.40	4523543.64	985	0	0.00	0.00	0.00	0.52	10.00	0.0000
599425.43	4523543.64	608	0	99.99	14.28	3.66	0.52	3.23	0.0000
599425.43	4523843.92	690	0	0.00	0.00	0.00	0.48	7.55	0.0000
599025.40	4523843.92	449	0	0.00	0.00	0.00	0.48	7.55	0.0000
599825.46	4522943.10	597	0	100.00	23.63	7.72	0.52	4.75	0.0000
600225.50	4522943.10	404	0	0.00	0.00	0.00	0.52	4.75	0.0000
600225.50	4523243.37	606	0	0.93	0.13	0.00	0.52	7.75	0.0000
599825.46	4523243.37	518	0	100.00	23.63	7.72	0.52	4.75	0.0000
599825.46	4523543.64	432	0	0.00	0.00	0.00	0.52	7.50	0.0000
600225.50	4523543.64	536	0	0.00	0.00	0.00	0.52	7.50	0.0000
600225.50	4523843.92	526	0	0.00	0.00	0.00	0.52	7.50	0.0000
599825.46	4523843.92	382	0	99.99	14.28	3.66	0.52	3.23	0.0000
600625.53	4522943.10	807	0	0.00	0.00	0.00	0.52	4.75	0.0000
600625.53	4523243.37	631	0	0.93	0.13	0.00	0.52	7.75	0.0000
600625.53	4523543.64	459	0	100.00	40.68	13.22	0.52	6.25	0.0000
600625.53	4523843.92	229	0	0.00	0.00	0.00	0.52	10.00	0.0000
597025.23	4522342.55	721	1	92.01	0.00	4.62	0.52	9.00	1.3870
597025.23	4522642.82	675	0	92.01	0.00	4.62	0.52	9.00	0.0000

x	y	T.P.L.	T.#.F	P.L.% (a)	P.L.% (b)	S	P.G.A.	t_{soft}	D.R.
596625.20	4522642.82	358	0	92.01	0.00	4.62	0.52	9.00	0.0000
597425.26	4522342.55	380	0	100.00	42.86	17.47	0.52	9.40	0.0000
597825.30	4522342.55	405	0	94.80	25.62	2.63	0.52	0.00	0.0000
597825.30	4522642.82	584	0	94.80	25.62	2.63	0.52	0.00	0.0000
597425.26	4522642.82	562	0	0.00	0.00	0.00	0.52	7.30	0.0000
598225.33	4522342.55	673	0	97.53	29.66	3.09	0.56	0.00	0.0000
598625.36	4522342.55	452	0	0.00	0.00	0.00	0.56	5.60	0.0000
598625.36	4522642.82	206	1	100.00	57.12	25.70	0.56	8.50	4.8544
598225.33	4522642.82	123	1	94.80	25.62	25.00	0.52	0.00	1.6155
599025.40	4522342.55	159	0	0.00	0.00	0.00	0.56	5.60	0.0000
599425.43	4522342.55	502	0	0.00	0.00	0.00	0.56	5.60	0.0000
599425.43	4522642.82	242	0	0.00	0.00	0.00	0.56	5.60	0.0000
599025.40	4522642.82	485	0	0.00	0.00	0.00	0.56	5.60	0.0000
599825.46	4522342.55	762	0	0.00	0.00	0.00	0.56	5.60	0.0000
600225.50	4522342.55	755	0	99.98	14.28	4.00	0.56	0.00	0.0000
600225.50	4522642.82	571	0	99.95	14.28	3.85	0.52	0.00	0.0000
599825.46	4522642.82	577	0	0.00	0.00	0.00	0.52	5.60	0.0000
601025.56	4522042.28	455	0	99.95	14.28	3.85	0.52	0.00	0.0000
600625.53	4522042.28	419	1	99.98	14.28	4.00	0.56	0.00	2.3866
600625.53	4522342.55	843	0	99.98	14.28	4.00	0.56	0.00	0.0000
601025.56	4522342.55	84	0	99.98	14.28	4.00	0.56	0.00	0.0000
600625.53	4522642.82	613	0	99.95	14.28	3.85	0.52	0.00	0.0000

APPENDIX B

THE DATABASE OF THE COLLECTED AND PROCESSED DATA AT THE GRID CENTERS

In this appendix for each grid point the data related to the important parameters are presented in the form of tables. For every grid three tables are presented as geotechnical data, pipeline data and parameters.

For the geotechnical data table, first column is the representative bore hole id, d is the depth of layer, WT is the depth of water table, N_{45} is the standard penetration test blow counts, LL is the liquid limit, PL is the plastic limit, PI is the plasticity index, FC is the fines content, soil types are classified as sand (S), silt (M) and clay (C), σ_v is the overburden pressure, σ'_v is the effective overburden pressure, $N_{1,60}$ is the corrected SPT-N value, S is the estimated settlement, xd is estimated lateral deformation, t_{liq} is the thickness of the liquefiable layer, PL is the probability of liquefaction, t_{soft} and t_{stiff} are the thickness of the soft and stiff layers, and finally d_{liq} is the expected depth of liquefaction.

In the pipeline data table ϕ is the diameter of the pipe, total pipe length is the total pipe length in the grid, number of failures is the observed numbers of failures in the grid and the failure rate is the ratio of the pipe failures to the pipe length.

In the final table the parameters are summarized.

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43	41,4	23,8	17,6	0	C	28	28	61	NC	NC	0,00	NC	0,0	2,3	NA
137	3,00	15,00	63			17,6	15	SC	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			17,6	15	S	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	29		NP	0	21	S	111	111	21	1,08	0,41	1,50	0,3	0,0	0,0	NA
137	7,50	15,00	100			0	21	S	139	139	64	0,00	0,25	1,78	0,0	0,0	1,8	NA
137	9,55	15,00	80			0	21	S	177	177	45	0,00	0,00	1,03	0,0	0,0	1,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	242	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	242	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	8	0	1,08	0,65	0,48	86,05	A.C.	242	0	0,000

Grid No:314 (2)

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
155	1,50	5,00	10	41,4	23,8	17,6	0	C	28	28	14	NC	NC	0,00	NC	0,0	0,0	NA
155	3,00	5,00	12			17,6	15	SC	56	56	12	NC	NC	0,00	NC	0,0	0,0	NA
155	4,50	5,00	27			17,6	15	S	83	83	22	NC	NC	0,00	NC	0,0	0,0	NA
155	6,00	5,00	35		NP	0	21	S	111	101	25	0,00	0,46	1,50	0,0	0,0	0,0	NA
155	7,50	5,00	42			0	21	S	139	114	27	0,00	0,28	1,78	0,0	0,0	0,0	NA
155	9,55	5,00	42			0	21	S	177	131	24	0,00	0,00	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	271	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	271	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	0	0	0,00	0,74	0,40	86,05	A.C.	271	0	0,000

Grid No:315

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
165	1,50	4,50	13			0	0	C	28	28	19	NC	NC	0,00	NC	0,0	0,0	NA
165	3,00	4,50	13			0	15	C	56	56	13	NC	NC	0,00	NC	0,0	0,0	NA
165	4,50	4,50	19			0	15	C	83	83	16	NC	NC	0,00	NC	0,0	0,0	NA
165	6,00	4,50	31			0	21	S	111	96	22	0,57	0,46	1,50	0,1	0,0	0,0	NA
165	7,50	4,50	50		NP	0	21	S	139	109	32	0,00	0,28	1,78	0,0	0,0	1,8	NA
165	9,55	4,50	50			0	21	S	177	126	28	0,00	0,00	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	316	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	316	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	2	0	0,57	0,74	0,44	86,05	A.C.	316	0	0,000

Grid No:321

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
165	1,50	4,50	13			0	0	C	28	28	19	NC	NC	0,00	NC	0,0	0,0	NA
165	3,00	4,50	13			0	15	C	56	56	13	NC	NC	0,00	NC	0,0	0,0	NA
165	4,50	4,50	19			0	15	C	83	83	16	NC	NC	0,00	NC	0,0	0,0	NA
165	6,00	4,50	31			0	21	S	111	96	22	0,57	0,46	1,50	0,1	0,0	0,0	NA
165	7,50	4,50	50		NP	0	21	S	139	109	32	0,00	0,28	1,78	0,0	0,0	1,8	NA
165	9,55	4,50	50			0	21	S	177	126	28	0,00	0,00	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	783	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	783	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	2	0	0,57	0,74	0,44	86,05	A.C.	783	0	0,000

Grid No:322

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
165	1,50	4,50	13			0	0	C	28	28	19	NC	NC	0,00	NC	0,0	0,0	NA
165	3,00	4,50	13			0	15	C	56	56	13	NC	NC	0,00	NC	0,0	0,0	NA
165	4,50	4,50	19			0	15	C	83	83	16	NC	NC	0,00	NC	0,0	0,0	NA
165	6,00	4,50	31			0	21	S	111	96	22	0,57	0,46	1,50	0,1	0,0	0,0	NA
165	7,50	4,50	50		NP	0	21	S	139	109	32	0,00	0,28	1,78	0,0	0,0	1,8	NA
165	9,55	4,50	50			0	21	S	177	126	28	0,00	0,00	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	202	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	202	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	2	0	0,57	0,74	0,44	86,05	A.C.	202	0	0,000

Grid No:324

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
165	1,50	4,50	13			0	0	C	28	28	19	NC	NC	0,00	NC	0,0	0,0	NA
165	3,00	4,50	13			0	15	C	56	56	13	NC	NC	0,00	NC	0,0	0,0	NA
165	4,50	4,50	19			0	15	C	83	83	16	NC	NC	0,00	NC	0,0	0,0	NA
165	6,00	4,50	31			0	21	S	111	96	22	0,57	0,46	1,50	0,1	0,0	0,0	NA
165	7,50	4,50	50		NP	0	21	S	139	109	32	0,00	0,28	1,78	0,0	0,0	1,8	NA
165	9,55	4,50	50			0	21	S	177	126	28	0,00	0,00	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	195	0	0,000
250	34	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	229	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	2	0	0,57	0,74	0,44	86,05	A.C.	229	0	0,000

Grid No:329

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
165	1,50	4,50	13			0	0	C	28	28	19	NC	NC	0,00	NC	0,0	0,0	NA
165	3,00	4,50	13			0	15	C	56	56	13	NC	NC	0,00	NC	0,0	0,0	NA
165	4,50	4,50	19			0	15	C	83	83	16	NC	NC	0,00	NC	0,0	0,0	NA
165	6,00	4,50	31			0	21	S	111	96	22	0,57	0,46	1,50	0,1	0,0	0,0	NA
165	7,50	4,50	50		NP	0	21	S	139	109	32	0,00	0,28	1,78	0,0	0,0	1,8	NA
165	9,55	4,50	50			0	21	S	177	126	28	0,00	0,00	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	44	0	0,000
200	0	0	0,000
250	482	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	526	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	2	0	0,57	0,74	0,44	86,05	A.C.	526	0	0,000

Grid No:330

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	S	28	28	61	0,00	0,00	2,25	0,0	0,0	2,3	NA
137	3,00	15,00	63		NP	0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	30	22,6	19,2	3,4	21	S	111	111	21	0,63	0,34	1,50	0,0	0,0	0,0	NA
137	7,50	15,00	100			3,4	21	S	139	139	64	0,00	0,18	1,50	0,0	0,0	1,5	NA
137	9,00	15,00	80			3,4	21	S	167	167	46	0,00	0,00	0,75	0,0	0,0	0,8	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	237	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	237	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
0	0	6,00	0	8	0	0,63	0,52	0,44	86,05	A.C.	237	0	0,000

Grid No:331

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	C	28	28	61	NC	NC	0,00	NC	0,0	2,3	NA
137	3,00	15,00	63			0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	30			0	21	S	111	111	21	0,63	0,40	1,50	0,0	0,0	0,0	NA
137	7,50	15,00	100		NP	0	21	S	139	139	64	0,00	0,24	1,78	0,0	0,0	1,8	NA
137	9,55	15,00	80			0	21	S	177	177	45	0,00	0,00	1,03	0,0	0,0	1,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	175	0	0,000
200	389	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	564	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	8	0	0,63	0,64	0,44	86,05	A.C.	564	0	0,000

Grid No:332

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	S	28	28	61	0,00	0,00	2,25	0,0	0,0	2,3	NA
137	3,00	15,00	63		NP	0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	30	22,6	19,2	3,4	21	S	111	111	21	0,63	0,34	1,50	0,0	0,0	0,0	NA
137	7,50	15,00	100			3,4	21	S	139	139	64	0,00	0,18	1,50	0,0	0,0	1,5	NA
137	9,00	15,00	80			3,4	21	S	167	167	46	0,00	0,00	0,75	0,0	0,0	0,8	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	472	0	0,000
200	304	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	776	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	6,00	0	8	0	0,63	0,52	0,44	86,05	A.C.	776	0	0,000

Grid No:333

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	S	28	28	61	0,00	0,00	2,25	0,0	0,0	2,3	NA
137	3,00	15,00	63		NP	0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	30	22,6	19,2	3,4	21	S	111	111	21	0,63	0,34	1,50	0,0	0,0	0,0	NA
137	7,50	15,00	100			3,4	21	S	139	139	64	0,00	0,18	1,50	0,0	0,0	1,5	NA
137	9,00	15,00	80			3,4	21	S	167	167	46	0,00	0,00	0,75	0,0	0,0	0,8	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	434	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	434	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
0	0	6,00	0	8	0	0,63	0,52	0,44	86,05	A.C.	434	0	0,000

Grid No:334

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	S	28	28	61	0,00	0,00	2,25	0,0	0,0	2,3	NA
137	3,00	15,00	63		NP	0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	30	22,6	19,2	3,4	21	S	111	111	21	0,38	0,34	1,50	0,0	0,0	0,0	NA
137	7,50	15,00	100			3,4	21	S	139	139	64	0,00	0,17	1,50	0,0	0,0	1,5	NA
137	9,00	15,00	80			3,4	21	S	167	167	46	0,00	0,00	0,75	0,0	0,0	0,8	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	51	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	51	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	6,00	0	8	0	0,38	0,51	0,40	86,05	A.C.	51	0	0,000

Grid No:335

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	S	28	28	61	0,00	0,00	2,25	0,0	0,0	2,3	NA
137	3,00	15,00	63		NP	0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	30	22,6	19,2	3,4	21	S	111	111	21	0,38	0,34	1,50	0,0	0,0	0,0	NA
137	7,50	15,00	100			3,4	21	S	139	139	64	0,00	0,17	1,50	0,0	0,0	1,5	NA
137	9,00	15,00	80			3,4	21	S	167	167	46	0,00	0,00	0,75	0,0	0,0	0,8	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	59	0	0,000
200	361	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	420	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	6,00	0	8	0	0,38	0,51	0,40	86,05	A.C.	420	0	0,000

Grid No:336

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	8,30	18			0	0	S	28	28	26	0,00	0,42	2,25	0,0	0,0	0,0	NA
149	3,00	8,30	19		NP	0	15	S	56	56	19	1,35	0,35	1,50	13,8	0,0	0,0	NA
149	4,50	8,30	57			0	15	S	83	83	47	0,00	0,37	1,50	0,0	0,0	1,5	NA
149	6,00	8,30	44	22,6	19,2	3,4	21	S	111	111	31	0,00	0,39	1,50	0,0	0,0	1,5	NA
149	7,50	8,30	37			3,4	21	S	139	139	24	0,00	0,19	1,50	0,0	0,0	0,0	NA
149	9,00	8,30	46			3,4	21	S	167	160	27	0,00	0,00	0,75	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	63	0	0,000
250	98	0	0,000
300	176	0	0,000
350	0	0	0,000
400	450	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	787	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
14	2	9,00	0	3	0	1,35	1,74	0,44	86,05	A.C.	787	0	0,000

Grid No:337

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	8,30	18			0	0	S	28	28	26	0,00	0,44	2,25	0,0	0,0	0,0	NA
149	3,00	8,30	19		NP	0	15	S	56	56	19	1,57	0,36	1,50	24,8	0,0	0,0	NA
149	4,50	8,30	57			0	15	S	83	83	47	0,00	0,38	1,50	0,0	0,0	1,5	NA
149	6,00	8,30	44	22,6	19,2	3,4	21	S	111	111	31	0,00	0,40	1,50	0,0	0,0	1,5	NA
149	7,50	8,30	37			3,4	21	S	139	139	24	0,00	0,20	1,50	0,0	0,0	0,0	NA
149	9,00	8,30	46			3,4	21	S	167	160	27	0,00	0,00	0,75	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	16	0	0,000
250	359	0	0,000
300	0	0	0,000
350	0	0	0,000
400	227	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	602	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
25	4	9,00	0	3	0	1,57	1,78	0,48	86,05	A.C.	602	0	0,000

Grid No:338

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	8,30	18			0	0	S	28	28	26	0,00	0,44	2,25	0,0	0,0	0,0	NA
149	3,00	8,30	19		NP	0	15	S	56	56	19	1,57	0,36	1,50	24,8	0,0	0,0	NA
149	4,50	8,30	57			0	15	S	83	83	47	0,00	0,38	1,50	0,0	0,0	1,5	NA
149	6,00	8,30	44	22,6	19,2	3,4	21	S	111	111	31	0,00	0,40	1,50	0,0	0,0	1,5	NA
149	7,50	8,30	37			3,4	21	S	139	139	24	0,00	0,20	1,50	0,0	0,0	0,0	NA
149	9,00	8,30	46			3,4	21	S	167	160	27	0,00	0,00	0,75	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	0	0	0,000
250	266	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	266	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
25	4	9,00	0	3	0	1,57	1,78	0,48	86,05	A.C.	266	0	0,000

Grid No:339

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	8,30	18			0	0	S	28	28	26	0,00	0,42	2,25	0,0	0,0	0,0	NA
149	3,00	8,30	19		NP	0	15	S	56	56	19	1,35	0,35	1,50	13,8	0,0	0,0	NA
149	4,50	8,30	57			0	15	S	83	83	47	0,00	0,37	1,50	0,0	0,0	1,5	NA
149	6,00	8,30	44	22,6	19,2	3,4	21	S	111	111	31	0,00	0,39	1,50	0,0	0,0	1,5	NA
149	7,50	8,30	37			3,4	21	S	139	139	24	0,00	0,19	1,50	0,0	0,0	0,0	NA
149	9,00	8,30	46			3,4	21	S	167	160	27	0,00	0,00	0,75	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	272	0	0,000
200	0	0	0,000
250	0	0	0,000
300	262	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	534	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
14	2	9,00	0	3	0	1,35	1,74	0,44	86,05	A.C.	534	0	0,000

Grid No:340

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	S	28	28	61	0,00	0,00	2,25	0,0	0,0	2,3	NA
137	3,00	15,00	63		NP	0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	30	22,6	19,2	3,4	21	S	111	111	21	0,63	0,34	1,50	0,0	0,0	0,0	NA
137	7,50	15,00	100			3,4	21	S	139	139	64	0,00	0,18	1,50	0,0	0,0	1,5	NA
137	9,00	15,00	80			3,4	21	S	167	167	46	0,00	0,00	0,75	0,0	0,0	0,8	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	290	0	0,000
200	0	0	0,000
250	126	0	0,000
300	175	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	591	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	6,00	0	8	0	0,63	0,52	0,44	86,05	A.C.	591	0	0,000

Grid No:341

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	8,30	18			0	0	S	28	28	26	0,00	0,41	2,25	0,0	0,0	0,0	NA
149	3,00	8,30	19		NP	0	15	S	56	56	19	1,10	0,34	1,50	6,2	0,0	0,0	NA
149	4,50	8,30	57			0	15	S	83	83	47	0,00	0,36	1,50	0,0	0,0	1,5	NA
149	6,00	8,30	44	22,6	19,2	3,4	21	S	111	111	31	0,00	0,38	1,50	0,0	0,0	1,5	NA
149	7,50	8,30	37			3,4	21	S	139	139	24	0,00	0,19	1,50	0,0	0,0	0,0	NA
149	9,00	8,30	46			3,4	21	S	167	160	27	0,00	0,00	0,75	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	938	0	0,000
200	262	0	0,000
250	197	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	1397	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
6	1	9,00	0	3	0	1,10	1,69	0,40	86,05	A.C.	1397	0	0,000

Grid No:342

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	S	28	28	61	0,00	0,00	2,25	0,0	0,0	2,3	NA
137	3,00	15,00	63		NP	0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	30	22,6	19,2	3,4	21	S	111	111	21	0,38	0,34	1,50	0,0	0,0	0,0	NA
137	7,50	15,00	100			3,4	21	S	139	139	64	0,00	0,17	1,50	0,0	0,0	1,5	NA
137	9,00	15,00	80			3,4	21	S	167	167	46	0,00	0,00	0,75	0,0	0,0	0,8	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	537	0	0,000
200	252	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	789	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	6,00	0	8	0	0,38	0,51	0,40	86,05	A.C.	789	0	0,000

Grid No:343

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	S	28	28	61	0,00	0,00	2,25	0,0	0,0	2,3	NA
137	3,00	15,00	63		NP	0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	30	22,6	19,2	3,4	21	S	111	111	21	0,38	0,34	1,50	0,0	0,0	0,0	NA
137	7,50	15,00	100			3,4	21	S	139	139	64	0,00	0,17	1,50	0,0	0,0	1,5	NA
137	9,00	15,00	80			3,4	21	S	167	167	46	0,00	0,00	0,75	0,0	0,0	0,8	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	0	0	0,000
250	302	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	302	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	6,00	0	8	0	0,38	0,51	0,40	86,05	A.C.	302	0	0,000

Grid No:344

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	8,30	18			0	0	S	28	28	26	0,00	0,44	2,25	0,0	0,0	0,0	NA
149	3,00	8,30	19		NP	0	15	S	56	56	19	1,57	0,36	1,50	24,8	0,0	0,0	NA
149	4,50	8,30	57			0	15	S	83	83	47	0,00	0,38	1,50	0,0	0,0	1,5	NA
149	6,00	8,30	44	22,6	19,2	3,4	21	S	111	111	31	0,00	0,40	1,50	0,0	0,0	1,5	NA
149	7,50	8,30	37			3,4	21	S	139	139	24	0,00	0,20	1,50	0,0	0,0	0,0	NA
149	9,00	8,30	46			3,4	21	S	167	160	27	0,00	0,00	0,75	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	91	0	0,000
200	291	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	382	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
25	4	9,00	0	3	0	1,57	1,78	0,48	86,05	A.C.	382	0	0,000

Grid No:345

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	8,30	18			0	0	S	28	28	26	0,00	0,44	2,25	0,0	0,0	0,0	NA
149	3,00	8,30	19		NP	0	15	S	56	56	19	1,57	0,36	1,50	24,8	0,0	0,0	NA
149	4,50	8,30	57			0	15	S	83	83	47	0,00	0,38	1,50	0,0	0,0	1,5	NA
149	6,00	8,30	44	22,6	19,2	3,4	21	S	111	111	31	0,00	0,40	1,50	0,0	0,0	1,5	NA
149	7,50	8,30	37			3,4	21	S	139	139	24	0,00	0,20	1,50	0,0	0,0	0,0	NA
149	9,00	8,30	46			3,4	21	S	167	160	27	0,00	0,00	0,75	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	584	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	584	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
25	4	9,00	0	3	0	1,57	1,78	0,48	86,05	A.C.	584	0	0,000

Grid No:346

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	8,30	18			0	0	S	28	28	26	0,00	0,44	2,25	0,0	0,0	0,0	NA
149	3,00	8,30	19		NP	0	15	S	56	56	19	1,57	0,36	1,50	24,8	0,0	0,0	NA
149	4,50	8,30	57			0	15	S	83	83	47	0,00	0,38	1,50	0,0	0,0	1,5	NA
149	6,00	8,30	44	22,6	19,2	3,4	21	S	111	111	31	0,00	0,40	1,50	0,0	0,0	1,5	NA
149	7,50	8,30	37			3,4	21	S	139	139	24	0,00	0,20	1,50	0,0	0,0	0,0	NA
149	9,00	8,30	46			3,4	21	S	167	160	27	0,00	0,00	0,75	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	67	0	0,000
200	285	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	352	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
25	4	9,00	0	3	0	1,57	1,78	0,48	86,05	A.C.	352	0	0,000

Grid No:348

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	8,30	18			0	0	S	28	28	26	0,00	0,41	2,25	0,0	0,0	0,0	NA
149	3,00	8,30	19		NP	0	15	S	56	56	19	1,10	0,34	1,50	6,2	0,0	0,0	NA
149	4,50	8,30	57			0	15	S	83	83	47	0,00	0,36	1,50	0,0	0,0	1,5	NA
149	6,00	8,30	44	22,6	19,2	3,4	21	S	111	111	31	0,00	0,38	1,50	0,0	0,0	1,5	NA
149	7,50	8,30	37			3,4	21	S	139	139	24	0,00	0,19	1,50	0,0	0,0	0,0	NA
149	9,00	8,30	46			3,4	21	S	167	160	27	0,00	0,00	0,75	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	309	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	309	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
6	1	9,00	0	3	0	1,10	1,69	0,40	86,05	A.C.	309	0	0,000

Grid No:349

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	8,30	18			0	0	S	28	28	26	0,00	0,41	2,25	0,0	0,0	0,0	NA
149	3,00	8,30	19		NP	0	15	S	56	56	19	1,10	0,34	1,50	6,2	0,0	0,0	NA
149	4,50	8,30	57			0	15	S	83	83	47	0,00	0,36	1,50	0,0	0,0	1,5	NA
149	6,00	8,30	44	22,6	19,2	3,4	21	S	111	111	31	0,00	0,38	1,50	0,0	0,0	1,5	NA
149	7,50	8,30	37			3,4	21	S	139	139	24	0,00	0,19	1,50	0,0	0,0	0,0	NA
149	9,00	8,30	46			3,4	21	S	167	160	27	0,00	0,00	0,75	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	609	0	0,000
200	277	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	886	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
6	1	9,00	0	3	0	1,10	1,69	0,40	86,05	A.C.	886	0	0,000

Grid No:350

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	8,30	18			0	0	S	28	28	26	0,00	0,41	2,25	0,0	0,0	0,0	NA
149	3,00	8,30	19		NP	0	15	S	56	56	19	1,10	0,34	1,50	6,2	0,0	0,0	NA
149	4,50	8,30	57			0	15	S	83	83	47	0,00	0,36	1,50	0,0	0,0	1,5	NA
149	6,00	8,30	44	22,6	19,2	3,4	21	S	111	111	31	0,00	0,38	1,50	0,0	0,0	1,5	NA
149	7,50	8,30	37			3,4	21	S	139	139	24	0,00	0,19	1,50	0,0	0,0	0,0	NA
149	9,00	8,30	46			3,4	21	S	167	160	27	0,00	0,00	0,75	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	408	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	408	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
6	1	9,00	0	3	0	1,10	1,69	0,40	86,05	A.C.	408	0	0,000

Grid No:351

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	C	28	28	61	NC	NC	0,00	NC	0,0	2,3	NA
137	3,00	15,00	63			0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	63			0	21	S	111	111	45	0,00	0,40	1,50	0,0	0,0	1,5	NA
137	7,50	15,00	100		NP	0	21	S	139	139	64	0,00	0,24	1,78	0,0	0,0	1,8	NA
137	9,55	15,00	80			0	21	S	177	177	45	0,00	0,00	1,03	0,0	0,0	1,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	316	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	316	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	10	0	0,00	0,64	0,44	86,05	A.C.	316	0	0,000

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	C	28	28	61	NC	NC	0,00	NC	0,0	2,3	NA
137	3,00	15,00	63			0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	63			0	21	S	111	111	45	0,00	0,40	1,50	0,0	0,0	1,5	NA
137	7,50	15,00	100		NP	0	21	S	139	139	64	0,00	0,24	1,78	0,0	0,0	1,8	NA
137	9,55	15,00	80			0	21	S	177	177	45	0,00	0,00	1,03	0,0	0,0	1,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	783	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	783	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL max	*PL ave*	*t liq*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	10	0	0,00	0,64	0,44	86,05	A.C.	783	0	0,000

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	C	28	28	61	NC	NC	0,00	NC	0,0	2,3	NA
137	3,00	15,00	63			0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	63			0	21	S	111	111	45	0,00	0,40	1,50	0,0	0,0	1,5	NA
137	7,50	15,00	100		NP	0	21	S	139	139	64	0,00	0,24	1,78	0,0	0,0	1,8	NA
137	9,55	15,00	80			0	21	S	177	177	45	0,00	0,00	1,03	0,0	0,0	1,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	195	0	0,000
250	34	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	229	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	10	0	0,00	0,64	0,44	86,05	A.C.	229	0	0,000

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	C	28	28	61	NC	NC	0,00	NC	0,0	2,3	NA
137	3,00	15,00	63			0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	63			0	21	S	111	111	45	0,00	0,40	1,50	0,0	0,0	1,5	NA
137	7,50	15,00	100		NP	0	21	S	139	139	64	0,00	0,24	1,78	0,0	0,0	1,8	NA
137	9,55	15,00	80			0	21	S	177	177	45	0,00	0,00	1,03	0,0	0,0	1,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	44	0	0,000
200	0	0	0,000
250	482	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	526	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	10	0	0,00	0,64	0,44	86,05	A.C.	526	0	0,000

Grid No:330 (2)

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	S	28	28	61	0,00	0,00	2,25	0,0	0,0	2,3	NA
137	3,00	15,00	63		NP	0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	63	22,6	19,2	3,4	21	S	111	111	45	0,00	0,34	1,50	0,0	0,0	1,5	NA
137	7,50	15,00	100			3,4	21	S	139	139	64	0,00	0,18	1,50	0,0	0,0	1,5	NA
137	9,00	15,00	80			3,4	21	S	167	167	46	0,00	0,00	0,75	0,0	0,0	0,8	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	63	0	0,000
250	98	0	0,000
300	176	0	0,000
350	0	0	0,000
400	450	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	787	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	6,00	0	9	0	0,00	0,52	0,44	86,05	A.C.	787	0	0,000

Grid No:337 (2)

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	S	28	28	61	0,00	0,00	2,25	0,0	0,0	2,3	NA
137	3,00	15,00	63		NP	0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	63	22,6	19,2	3,4	21	S	111	111	45	0,00	0,35	1,50	0,0	0,0	1,5	NA
137	7,50	15,00	100			3,4	21	S	139	139	64	0,00	0,18	1,50	0,0	0,0	1,5	NA
137	9,00	15,00	80			3,4	21	S	167	167	46	0,00	0,00	0,75	0,0	0,0	0,8	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	16	0	0,000
250	359	0	0,000
300	0	0	0,000
350	0	0	0,000
400	227	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	602	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	6,00	0	9	0	0,00	0,52	0,48	86,05	A.C.	602	0	0,000

Grid No:338 (2)

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	S	28	28	61	0,00	0,00	2,25	0,0	0,0	2,3	NA
137	3,00	15,00	63		NP	0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	63	22,6	19,2	3,4	21	S	111	111	45	0,00	0,35	1,50	0,0	0,0	1,5	NA
137	7,50	15,00	100			3,4	21	S	139	139	64	0,00	0,18	1,50	0,0	0,0	1,5	NA
137	9,00	15,00	80			3,4	21	S	167	167	46	0,00	0,00	0,75	0,0	0,0	0,8	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	91	0	0,000
200	291	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	382	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	6,00	0	9	0	0,00	0,52	0,48	86,05	A.C.	382	0	0,000

Grid No:345 (2)

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
137	1,50	15,00	43			0	0	S	28	28	61	0,00	0,00	2,25	0,0	0,0	2,3	NA
137	3,00	15,00	63		NP	0	15	C	56	56	63	NC	NC	0,00	NC	0,0	1,5	NA
137	4,50	15,00	71			0	15	C	83	83	58	NC	NC	0,00	NC	0,0	1,5	NA
137	6,00	15,00	63	22,6	19,2	3,4	21	S	111	111	45	0,00	0,35	1,50	0,0	0,0	1,5	NA
137	7,50	15,00	100			3,4	21	S	139	139	64	0,00	0,18	1,50	0,0	0,0	1,5	NA
137	9,00	15,00	80			3,4	21	S	167	167	46	0,00	0,00	0,75	0,0	0,0	0,8	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	584	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	584	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
0	0	6,00	0	9	0	0,00	0,52	0,48	86,05	A.C.	584	0	0,000

Grid No:346 (2)

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	5,50	13			0	0	S	28	28	19	0,74	0,00	2,25	4,2	0,0	0,0	NA
149	3,00	5,50	36		NP	0	15	C	56	56	36	NC	NC	0,00	NC	0,0	1,5	NA
149	4,50	5,50	42			0	15	C	83	83	35	NC	NC	0,00	NC	0,0	1,5	NA
149	6,00	5,50	50	22,6	19,2	3,4	21	S	111	106	36	0,00	0,39	1,50	0,0	0,0	1,5	NA
149	7,50	5,50	45			3,4	21	S	139	119	29	0,00	0,41	1,50	0,0	0,0	0,0	NA
149	9,00	5,50	45			3,4	21	S	167	132	26	0,00	0,43	1,50	0,0	0,0	0,0	NA
149	10,50	5,50	45		NP	0	24	S	194	144	24	0,32	0,43	1,50	0,0	0,0	0,0	NA
149	12,00	5,50	50			0	24	S	222	157	25	0,00	0,44	1,50	0,0	0,0	0,0	NA
149	13,50	5,50	50			0	24	S	250	170	24	0,03	0,23	1,50	0,0	0,0	0,0	NA
149	15,00	5,50	50			0	24	S	278	183	23	0,32	0,00	0,75	0,2	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	1949	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	1949	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
4	1	12,00	0	5	0,0	1,40	2,32	0,44	86,05	A.C.	1949	0	0,000

Grid No:401-149

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	5,50	13			0	0	S	28	28	19	0,74	0,49	2,25	4,2	0,0	0,0	NA
149	3,00	5,50	36		NP	0	15	C	56	56	36	NC	NC	0,00	NC	0,0	1,5	NA
149	4,50	5,50	42			0	15	C	83	83	35	NC	NC	0,00	NC	0,0	1,5	NA
149	6,00	5,50	50	22,6	19,2	3,4	21	S	111	106	36	0,00	0,37	1,50	0,0	0,0	1,5	NA
149	7,50	5,50	45			3,4	21	S	139	119	29	0,00	0,39	1,50	0,0	0,0	0,0	NA
149	9,00	5,50	45			3,4	21	S	167	132	26	0,00	0,41	1,50	0,0	0,0	0,0	NA
149	10,50	5,50	45		NP	0	24	S	194	144	24	0,32	0,43	1,50	0,0	0,0	0,0	NA
149	12,00	5,50	50			0	24	S	222	157	25	0,00	0,43	1,50	0,0	0,0	0,0	NA
149	13,50	5,50	50			0	24	S	250	170	24	0,03	0,44	1,50	0,0	0,0	0,0	NA
149	15,00	5,50	50			0	24	S	278	183	23	0,32	0,23	0,75	0,2	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	3417	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3417	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
4	1	12,00	0	5	0,0	1,40	3,18	0,44	86,05	A.C.	3417	0	0,000

Grid No:402-149

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	5,50	13			0	0	S	28	28	19	0,74	0,49	2,25	4,2	0,0	0,0	NA
149	3,00	5,50	36		NP	0	15	C	56	56	36	NC	NC	0,00	NC	0,0	1,5	NA
149	4,50	5,50	42			0	15	C	83	83	35	NC	NC	0,00	NC	0,0	1,5	NA
149	6,00	5,50	50	22,6	19,2	3,4	21	S	111	106	36	0,00	0,37	1,50	0,0	0,0	1,5	NA
149	7,50	5,50	45			3,4	21	S	139	119	29	0,00	0,39	1,50	0,0	0,0	0,0	NA
149	9,00	5,50	45			3,4	21	S	167	132	26	0,00	0,41	1,50	0,0	0,0	0,0	NA
149	10,50	5,50	45		NP	0	24	S	194	144	24	0,32	0,43	1,50	0,0	0,0	0,0	NA
149	12,00	5,50	50			0	24	S	222	157	25	0,00	0,43	1,50	0,0	0,0	0,0	NA
149	13,50	5,50	50			0	24	S	250	170	24	0,03	0,44	1,50	0,0	0,0	0,0	NA
149	15,00	5,50	50			0	24	S	278	183	23	0,32	0,23	0,75	0,2	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2616	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	2616	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL max	*PL ave*	*t liq*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
4	1	12,00	0	5	0,0	1,40	3,18	0,44	86,05	A.C.	2616	0	0,000

Grid No:403-149

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
149	1,50	5,50	13			0	0	S	28	28	19	0,74	0,49	2,25	4,2	0,0	0,0	NA
149	3,00	5,50	36		NP	0	15	C	56	56	36	NC	NC	0,00	NC	0,0	1,5	NA
149	4,50	5,50	42			0	15	C	83	83	35	NC	NC	0,00	NC	0,0	1,5	NA
149	6,00	5,50	50	22,6	19,2	3,4	21	S	111	106	36	0,00	0,37	1,50	0,0	0,0	1,5	NA
149	7,50	5,50	45			3,4	21	S	139	119	29	0,00	0,39	1,50	0,0	0,0	0,0	NA
149	9,00	5,50	45			3,4	21	S	167	132	26	0,00	0,41	1,50	0,0	0,0	0,0	NA
149	10,50	5,50	45		NP	0	24	S	194	144	24	0,32	0,43	1,50	0,0	0,0	0,0	NA
149	12,00	5,50	50			0	24	S	222	157	25	0,00	0,43	1,50	0,0	0,0	0,0	NA
149	13,50	5,50	50			0	24	S	250	170	24	0,03	0,44	1,50	0,0	0,0	0,0	NA
149	15,00	5,50	50			0	24	S	278	183	23	0,32	0,23	0,75	0,2	0,0	0,0	NA

Pipeline Data

ϕ	Total pipe	Number of	Failure
150	770	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	770	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
4	1	12,00	0	5	0,0	1,40	3,18	0,44	86,05	A.C.	770	0	0,000

Grid No:404-149

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
151	1,50	5,00	8			0	0	C	28	28	11	NC	NC	0,00	NC	0,0	0,0	NA
151	3,00	5,00	24			0	0	C	56	56	24	NC	NC	0,00	NC	0,0	0,0	NA
151	4,50	5,00	17			0	0	S	83	83	14	2,51	0,44	1,50	75,7	0,0	0,0	5,3
151	6,00	5,00	25			0	0	S	111	101	18	1,17	0,43	1,50	28,3	0,0	0,0	NA
151	7,50	5,00	28		NP	0	20	S	139	114	18	2,73	0,53	1,78	10,6	0,0	0,0	NA
151	9,55	5,00	37			0	20	S	177	131	21	0,39	0,30	1,03	1,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2897	0	0,000
200	179	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3076	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
76	17	5,80	0	0	5,3	6,80	1,69	0,44	86,05	A.C.	3076	0	0,000

Grid No:405-151

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
152	1,50	5,00	9			0	0	C	28	28	13	NC	NC	0,00	NC	0,0	0,0	NA
152	3,00	5,00	14			0	0	C	56	56	14	NC	NC	0,00	NC	0,0	0,0	NA
152	4,50	5,00	18			0	0	S	83	83	15	2,35	0,45	1,50	78,7	0,0	0,0	5,3
152	6,00	5,00	2		NP	0	20	S	111	101	1	12,11	0,93	1,50	100,0	1,5	0,0	6,8
152	7,50	5,00	31			0	20	S	139	114	20	1,09	0,53	1,78	5,2	0,0	0,0	NA
152	9,55	5,00	50			0	20	S	177	131	28	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2308	0	0,000
200	352	1	2,841
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	2660	1	0,376

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	26	5,80	2	0	5,3	15,56	2,18	0,48	86,05	A.C.	2660	1	0,376

Grid No:407-152

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
151	1,50	5,00	8			0	0	C	28	28	11	NC	NC	0,00	NC	0,0	0,0	NA
151	3,00	5,00	24			0	0	C	56	56	24	NC	NC	0,00	NC	0,0	0,0	NA
151	4,50	5,00	17			0	0	S	83	83	14	2,75	0,45	1,50	86,4	0,0	0,0	5,3
151	6,00	5,00	25			0	0	S	111	101	18	1,40	0,44	1,50	43,0	0,0	0,0	6,8
151	7,50	5,00	28		NP	0	20	S	139	114	18	2,96	0,55	1,78	19,5	0,0	0,0	NA
151	9,55	5,00	37			0	20	S	177	131	21	0,53	0,31	1,03	2,6	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2581	0	0,000
200	484	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3065	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
86	22	5,80	0	0	5,3	7,63	1,75	0,48	86,05	A.C.	3065	0	0,000

Grid No:408-151

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
151	1,50	5,00	8			0	0	C	28	28	11	NC	NC	0,00	NC	0,0	0,0	NA
151	3,00	5,00	24			0	0	C	56	56	24	NC	NC	0,00	NC	0,0	0,0	NA
151	4,50	5,00	17			0	0	S	83	83	14	2,75	0,45	1,50	86,4	0,0	0,0	5,3
151	6,00	5,00	25			0	0	S	111	101	18	1,40	0,44	1,50	43,0	0,0	0,0	6,8
151	7,50	5,00	28		NP	0	20	S	139	114	18	2,96	0,55	1,78	19,5	0,0	0,0	NA
151	9,55	5,00	37			0	20	S	177	131	21	0,53	0,31	1,03	2,6	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	463	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	463	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
86	22	5,80	0	0	5,3	7,63	1,75	0,48	86,05	A.C.	463	0	0,000

Grid No:409-151

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
152	1,50	5,00	9			0	0	C	28	28	13	NC	NC	0,00	NC	0,0	0,0	NA
152	3,00	5,00	14			0	0	C	56	56	14	NC	NC	0,00	NC	0,0	0,0	NA
152	4,50	5,00	18			0	0	S	83	83	15	2,35	0,45	1,50	78,7	0,0	0,0	5,3
152	6,00	5,00	2		NP	0	20	S	111	101	1	12,11	0,93	1,50	100,0	1,5	0,0	6,8
152	7,50	5,00	31			0	20	S	139	114	20	1,09	0,53	1,78	5,2	0,0	0,0	NA
152	9,55	5,00	50			0	20	S	177	131	28	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	1352	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	1352	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	26	5,80	2	0	5,3	15,56	2,18	0,48	86,05	A.C.	1352	0	0,000

Grid No:410-152

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
153	1,50	6,00	5			0	0	C	28	28	7	NC	NC	0,00	NC	2,3	0,0	NA
153	3,00	6,00	10	33,4	20,2	13,2	87	C	56	56	10	NC	NC	0,00	NC	1,5	0,0	NA
153	4,50	6,00	13			13,2	87	C	83	83	11	NC	NC	0,00	NC	1,5	0,0	NA
153	6,00	6,00	31			13,2	87	S	111	111	22	0,00	0,41	1,50	0,0	0,0	0,0	NA
153	7,50	6,00	45		NP	0	13	S	139	124	29	0,00	0,48	1,78	0,0	0,0	0,0	NA
153	9,55	6,00	47			0	13	S	177	141	27	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	215	0	0,000
200	453	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	668	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	5	0	0,0	0,00	1,17	0,48	86,05	A.C.	668	0	0,000

Grid No:406-153

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
156	1,50	1,00	13			0	0	M	28	23	19	1,74	0,55	2,25	32,4	0,0	0,0	2,3
156	3,00	1,00	9			0	0	M	56	36	9	6,60	0,63	1,50	100,0	1,5	0,0	3,8
156	4,50	1,00	17			0	0	M	83	48	14	3,39	0,54	1,50	100,0	0,0	0,0	5,3
156	6,00	1,00	13			0	0	M	111	61	9	6,14	0,64	1,50	100,0	1,5	0,0	6,8
156	7,50	1,00	14			0	0	M	139	74	9	7,71	0,78	1,78	100,0	1,8	0,0	8,5
156	9,55	1,00	50		NP	0	17	S	177	91	28	0,13	0,31	1,03	0,2	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2682	0	0,000
200	522	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3204	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	62	9,55	5	0	2,3	25,72	3,46	0,48	86,05	A.C.	3204	0	0,000

Grid No:413-156

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
156	1,50	1,00	13			0	0	M	28	23	19	1,74	0,55	2,25	32,4	0,0	0,0	2,3
156	3,00	1,00	9			0	0	M	56	36	9	6,60	0,63	1,50	100,0	1,5	0,0	3,8
156	4,50	1,00	17			0	0	M	83	48	14	3,39	0,54	1,50	100,0	0,0	0,0	5,3
156	6,00	1,00	13			0	0	M	111	61	9	6,14	0,64	1,50	100,0	1,5	0,0	6,8
156	7,50	1,00	14			0	0	M	139	74	9	7,71	0,78	1,78	100,0	1,8	0,0	8,5
156	9,55	1,00	50		NP	0	17	S	177	91	28	0,13	0,31	1,03	0,2	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	3462	0	0,000
200	510	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3972	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	62	9,55	5	0	2,3	25,72	3,46	0,48	86,05	A.C.	3972	0	0,000

Grid No:414-156

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
158	1,50	5,00	7			0	0	C	28	28	10	NC	NC	0,00	NC	2,3	0,0	NA
158	3,00	5,00	7			0	0	C	56	56	7	NC	NC	0,00	NC	1,5	0,0	NA
158	4,50	5,00	27			0	0	M	83	83	22	0,00	0,41	1,50	2,6	0,0	0,0	NA
158	6,00	5,00	16			0	0	M	111	101	11	4,41	0,50	1,50	98,6	0,0	0,0	6,8
158	7,50	5,00	25	24,8	21,0	3,8	61	M	139	114	16	2,97	0,56	1,78	11,3	0,0	0,0	NA
158	9,55	5,00	8			3,8	61	M	177	131	5	6,43	0,50	1,03	100,0	1,0	0,0	9,6

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2199	0	0,000
200	578	0	0,000
250	90	0	0,000
300	87	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	2954	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	30	5,80	5	0	6,8	13,81	1,97	0,48	86,05	A.C.	2954	0	0,000

Grid No:415-158

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
155	1,50	5,00	10	41,4	23,8	17,6	76	C	28	28	14	NC	NC	0,00	NC	0,0	0,0	NA
155	3,00	5,00	12			17,6	76	SC	56	56	12	NC	NC	0,00	NC	0,0	0,0	NA
155	4,50	5,00	27			17,6	76	S	83	83	22	NC	NC	0,00	NC	0,0	0,0	NA
155	6,00	5,00	35		NP	0	15	S	111	101	25	0,30	0,41	1,50	0,0	0,0	0,0	NA
155	7,50	5,00	42			0	15	S	139	114	27	0,00	0,49	1,78	0,0	0,0	0,0	NA
155	9,55	5,00	42			0	15	S	177	131	24	0,00	0,30	1,03	0,3	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2189	0	0,000
200	628	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	2817	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	0	0,0	0,30	1,20	0,48	86,05	A.C.	2817	0	0,000

Grid No:416-155

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
155	1,50	5,00	10	41,4	23,8	17,6	76	C	28	28	14	NC	NC	0,00	NC	0,0	0,0	NA
155	3,00	5,00	12			17,6	76	SC	56	56	12	NC	NC	0,00	NC	0,0	0,0	NA
155	4,50	5,00	27			17,6	76	S	83	83	22	NC	NC	0,00	NC	0,0	0,0	NA
155	6,00	5,00	35		NP	0	15	S	111	101	25	0,30	0,41	1,50	0,0	0,0	0,0	NA
155	7,50	5,00	42			0	15	S	139	114	27	0,00	0,49	1,78	0,0	0,0	0,0	NA
155	9,55	5,00	42			0	15	S	177	131	24	0,00	0,30	1,03	0,3	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2341	0	0,000
200	391	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	2732	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	0	0,0	0,30	1,20	0,48	86,05	A.C.	2732	0	0,000

Grid No:417-155

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
158	1,50	5,00	7			0	0	C	28	28	10	NC	NC	0,00	NC	2,3	0,0	NA
158	3,00	5,00	7			0	0	C	56	56	7	NC	NC	0,00	NC	1,5	0,0	NA
158	4,50	5,00	27			0	0	M	83	83	22	0,00	0,41	1,50	2,6	0,0	0,0	NA
158	6,00	5,00	16			0	0	M	111	101	11	4,41	0,50	1,50	98,6	0,0	0,0	6,8
158	7,50	5,00	25	24,8	21,0	3,8	61	M	139	114	16	2,97	0,56	1,78	11,3	0,0	0,0	NA
158	9,55	5,00	8			3,8	61	M	177	131	5	6,43	0,50	1,03	100,0	1,0	0,0	9,6

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	3205	0	0,000
200	12	0	0,000
250	471	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3688	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	30	5,80	5	0	6,8	13,81	1,97	0,48	86,05	A.C.	3688	0	0,000

Grid No:418-158

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
163	1,50	6,00	9			0	0		28	28	13	4,03	0,54	2,25	78,9	0,0	0,0	2,3
163	3,00	6,00	12			0	0		56	56	12	4,80	0,49	1,50	99,6	0,0	0,0	3,8
163	4,50	6,00	17			0	0		83	83	14	2,75	0,45	1,50	86,4	0,0	0,0	5,3
163	6,00	6,00	18			0	0		111	111	13	3,56	0,47	1,50	88,5	0,0	0,0	6,8
163	7,50	6,00	15			0	0		139	124	10	6,64	0,63	1,78	99,6	1,8	0,0	8,5
163	9,55	6,00	50		NP	0	20	SM	177	141	28	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2966	2	0,674
200	197	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3163	2	0,632

PARAMETERS													
Geotechnical								**Earthquake**		**Pipeline**			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	65	9,55	2	0	2,3	21,77	2,86	0,48	86,05	A.C.	3163	2	0,632

Grid No:421-163

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
162	1,50	5,50	12			0	0		28	28	17	1,78	0,52	2,25	21,7	0,0	0,0	NA
162	3,00	5,50	14			0	0		56	56	14	4,02	0,47	1,50	97,0	0,0	0,0	3,8
162	4,50	5,50	20			0	0		83	83	16	1,60	0,44	1,50	57,4	0,0	0,0	5,3
162	6,00	5,50	20			0	0		111	106	14	2,93	0,46	1,50	81,7	0,0	0,0	6,8
162	7,50	5,50	19			0	0		139	119	12	5,05	0,60	1,78	97,4	0,0	0,0	8,5
162	9,55	5,50	23			0	0		177	136	13	2,80	0,35	1,03	96,4	0,0	0,0	9,6

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	3138	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3138	0	0,000

PARAMETERS													
Geotechnical								**Earthquake**		**Pipeline**			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
97	65	9,55	0	0	3,8	18,18	2,83	0,48	86,05	A.C.	3138	0	0,000

Grid No:422-162

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
166	1,50	6,50	7			0	0	C	28	28	10	NC	NC	0,00	NC	2,3	0,0	NA
166	3,00	6,50	8			0	0	CS	56	56	8	6,68	0,55	1,50	100,0	1,5	0,0	3,8
166	4,50	6,50	12			0	0	C	83	83	10	NC	NC	0,00	NC	1,5	0,0	NA
166	6,00	6,50	19	29,1	20,0	9,1	98	C	111	111	14	NC	NC	0,00	NC	0,0	0,0	NA
166	7,50	6,50	7			9,1	98	C	139	129	4	NC	NC	0,00	NC	1,8	0,0	NA
166	9,55	6,50	50			9,1	98	S	177	146	28	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2200	0	0,000
200	0	0	0,000
250	121	0	0,000
300	402	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	2723	0	0,000

PARAMETERS													
Geotechnical								**Earthquake**		**Pipeline**			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	14	2,53	7	0	3,8	6,68	0,83	0,48	86,05	A.C.	2723	0	0,000

Grid No:423-166

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
161	1,50	6,00	10			0	0	C	28	28	14	NC	NC	0,00	NC	0,0	0,0	NA
161	3,00	6,00	39			0	0	C	56	56	39	NC	NC	0,00	NC	0,0	1,5	NA
161	4,50	6,00	21			0	0	C	83	83	17	NC	NC	0,00	NC	0,0	0,0	NA
161	6,00	6,00	21			0	0	C	111	111	15	NC	NC	0,00	NC	0,0	0,0	NA
161	7,50	6,00	43			0	0	S	139	124	27	0,00	0,48	1,78	0,0	0,0	0,0	NA
161	9,55	6,00	50		NP	0	19	S	177	141	28	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	3007	0	0,000
200	0	0	0,000
250	0	0	0,000
300	412	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3419	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	2,80	0	2	0,0	0,00	0,76	0,48	86,05	A.C.	3419	0	0,000

Grid No:424-161

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
161	1,50	6,00	10			0	0	C	28	28	14	NC	NC	0,00	NC	0,0	0,0	NA
161	3,00	6,00	39			0	0	C	56	56	39	NC	NC	0,00	NC	0,0	1,5	NA
161	4,50	6,00	21			0	0	C	83	83	17	NC	NC	0,00	NC	0,0	0,0	NA
161	6,00	6,00	21			0	0	C	111	111	15	NC	NC	0,00	NC	0,0	0,0	NA
161	7,50	6,00	43			0	0	S	139	124	27	0,00	0,48	1,78	0,0	0,0	0,0	NA
161	9,55	6,00	50		NP	0	19	S	177	141	28	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2999	0	0,000
200	0	0	0,000
250	283	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3282	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	2,80	0	2	0,0	0,00	0,76	0,48	86,05	A.C.	3282	0	0,000

Grid No:425-161

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
165	1,50	4,50	13			0	0	C	28	28	19	NC	NC	0,00	NC	0,0	0,0	NA
165	3,00	4,50	13			0	0	C	56	56	13	NC	NC	0,00	NC	0,0	0,0	NA
165	4,50	4,50	19			0	0	C	83	83	16	NC	NC	0,00	NC	0,0	0,0	NA
165	6,00	4,50	50			0	0	S	111	96	36	0,00	0,38	1,50	0,0	0,0	1,5	NA
165	7,50	4,50	50		NP	0	18	S	139	109	32	0,00	0,48	1,78	0,0	0,0	1,8	NA
165	9,55	4,50	50			0	18	S	177	126	28	0,00	0,29	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2915	0	0,000
200	111	0	0,000
250	202	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3228	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	3	0,0	0,00	1,15	0,48	86,05	A.C.	3228	0	0,000

Grid No:426-165

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
165	1,50	4,50	13			0	0	C	28	28	19	NC	NC	0,00	NC	0,0	0,0	NA
165	3,00	4,50	13			0	0	C	56	56	13	NC	NC	0,00	NC	0,0	0,0	NA
165	4,50	4,50	19			0	0	C	83	83	16	NC	NC	0,00	NC	0,0	0,0	NA
165	6,00	4,50	50			0	0	S	111	96	36	0,00	0,38	1,50	0,0	0,0	1,5	NA
165	7,50	4,50	50		NP	0	18	S	139	109	32	0,00	0,47	1,78	0,0	0,0	1,8	NA
165	9,55	4,50	50			0	18	S	177	126	28	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	365	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	365	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	3	0,0	0,00	1,12	0,44	86,05	A.C.	365	0	0,000

Grid No:427-165

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
165	1,50	4,50	13			0	0	C	28	28	19	NC	NC	0,00	NC	0,0	0,0	NA
165	3,00	4,50	13			0	0	C	56	56	13	NC	NC	0,00	NC	0,0	0,0	NA
165	4,50	4,50	19			0	0	C	83	83	16	NC	NC	0,00	NC	0,0	0,0	NA
165	6,00	4,50	50			0	0	S	111	96	36	0,00	0,38	1,50	0,0	0,0	1,5	NA
165	7,50	4,50	50		NP	0	18	S	139	109	32	0,00	0,47	1,78	0,0	0,0	1,8	NA
165	9,55	4,50	50			0	18	S	177	126	28	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	1141	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	1141	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	0	3	0,0	0,00	1,12	0,44	86,05	A.C.	1141	0	0,000

Grid No:428-165

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
167	1,50	5,10	11			0	0	C	28	28	16	NC	NC	0,00	NC	0,0	0,0	NA
167	3,00	5,10	9			0	0	C	56	56	9	NC	NC	0,00	NC	1,5	0,0	NA
167	4,50	5,10	9			0	0	C	83	83	7	NC	NC	0,00	NC	1,5	0,0	NA
167	6,00	5,10	11			0	0	C	111	102	8	NC	NC	0,00	NC	1,5	0,0	NA
167	7,50	5,10	18			0	0	C	139	115	11	NC	NC	0,00	NC	0,0	0,0	NA
167	9,55	5,10	50			0	0	S	177	132	28	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	3125	0	0,000
200	79	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3204	0	0,000

PARAMETERS													
Geotechnical								**Earthquake**		**Pipeline**			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	1,03	5	0	0,0	0,00	0,28	0,48	86,05	A.C.	3204	0	0,000

Grid No:429-167

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
169	1,50	5,50	9			0	0	C	28	28	13	NC	NC	0,00	NC	0,0	0,0	NA
169	3,00	5,50	5			0	0	C	56	56	5	NC	NC	0,00	NC	1,5	0,0	NA
169	4,50	5,50	8			0	0	C	83	83	7	NC	NC	0,00	NC	1,5	0,0	NA
169	6,00	5,50	48			0	0	CS	111	106	34	0,00	0,38	1,50	0,0	0,0	1,5	NA
169	7,50	5,50	50	22,7	19,3	3,4	14	S	139	119	32	0,00	0,47	1,78	0,0	0,0	1,8	NA
169	9,55	5,50	50			3,4	14	S	177	136	28	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	3176	2	0,630
200	405	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3581	2	0,559

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	4,30	3	3	0,0	0,00	1,13	0,48	86,05	A.C.	3581	2	0,559

Grid No:430-169

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
171	1,50	5,50	3			0	0	C	28	28	4	NC	NC	0,00	NC	2,3	0,0	NA
171	3,00	5,50	13			0	0	S	56	56	13	4,40	0,48	1,50	98,8	0,0	0,0	3,8
171	4,50	5,50	30			0	0	CS	83	83	25	0,00	0,40	1,50	0,2	0,0	0,0	NA
171	6,00	5,50	41			0	0	S	111	106	29	0,00	0,39	1,50	0,0	0,0	1,5	NA
171	7,50	5,50	12			0	0	S	139	119	8	8,08	0,69	1,78	100,0	1,8	0,0	8,5
171	9,55	5,50	43			0	0	S	177	136	24	0,00	0,29	1,03	0,9	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	1887	0	0,000
200	358	0	0,000
250	126	0	0,000
300	730	0	0,000
350	131	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3232	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	29	7,30	4	2	3,8	12,48	2,24	0,48	86,05	A.C.	3232	0	0,000

Grid No:431-171

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
148	1,50	2,90	11	33,2	19,2	14	81	CM	28	28	16	0,00	0,52	2,25	0,5	0,0	0,0	NA
148	3,00	2,90	16			14	81	CM	56	55	16	1,62	0,45	1,50	13,4	0,0	0,0	NA
148	4,50	2,90	13	45,9	19,8	26,1	80	C	83	67	11	NC	NC	0,00	NC	1,5	0,0	NA
148	6,00	2,90	9			26,1	80	C	111	80	6	NC	NC	0,00	NC	1,5	0,0	NA
148	7,50	2,90	9	26,5	20,1	6,4	42	CM	139	93	6	9,95	0,84	1,78	100,0	1,8	0,0	8,5
148	9,55	2,90	13			6,4	42	CM	177	110	7	5,11	0,46	1,03	100,0	1,0	0,0	9,6

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2149	0	0,000
200	0	0	0,000
250	0	0	0,000
300	639	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	2788	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	31	6,55	6	0	8,5	16,68	2,28	0,48	86,05	A.C.	2788	0	0,000

Grid No:432-148

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
182	1,50	6,50	16			0	0	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
182	3,00	6,50	16			0	0	C	56	56	16	NC	NC	0,00	NC	0,0	0,0	NA
182	4,50	6,50	19			0	0	C	83	83	16	NC	NC	0,00	NC	0,0	0,0	NA
182	6,00	6,50	26			0	0	C	111	111	19	NC	NC	0,00	NC	0,0	0,0	NA
182	7,50	6,50	50	20,3	17,6	2,7	51	S	139	129	32	0,00	0,46	1,78	0,0	0,0	1,8	NA
182	9,55	6,50	50			2,7	51	S	177	146	28	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	1291	0	0,000
200	0	0	0,000
250	0	0	0,000
300	290	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	1581	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	2,80	0	2	0,0	0,00	0,74	0,48	86,05	A.C.	1581	0	0,000

Grid No:433-182

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
182	1,50	6,50	16			0	0	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
182	3,00	6,50	16			0	0	C	56	56	16	NC	NC	0,00	NC	0,0	0,0	NA
182	4,50	6,50	19			0	0	C	83	83	16	NC	NC	0,00	NC	0,0	0,0	NA
182	6,00	6,50	26			0	0	C	111	111	19	NC	NC	0,00	NC	0,0	0,0	NA
182	7,50	6,50	50	20,3	17,6	2,7	51	S	139	129	32	0,00	0,46	1,78	0,0	0,0	1,8	NA
182	9,55	6,50	50			2,7	51	S	177	146	28	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	3120	0	0,000
200	138	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3258	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	2,80	0	2	0,0	0,00	0,74	0,48	86,05	A.C.	3258	0	0,000

Grid No:434-182

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
182	1,50	6,50	16			0	0	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
182	3,00	6,50	16			0	0	C	56	56	16	NC	NC	0,00	NC	0,0	0,0	NA
182	4,50	6,50	19			0	0	C	83	83	16	NC	NC	0,00	NC	0,0	0,0	NA
182	6,00	6,50	26			0	0	C	111	111	19	NC	NC	0,00	NC	0,0	0,0	NA
182	7,50	6,50	50	20,3	17,6	2,7	51	S	139	129	32	0,00	0,45	1,78	0,0	0,0	1,8	NA
182	9,55	6,50	50			2,7	51	S	177	146	28	0,00	0,27	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	3092	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	3092	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	2,80	0	2	0,0	0,00	0,72	0,44	86,05	A.C.	3092	0	0,000

Grid No:435-182

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
182	1,50	6,50	16			0	0	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
182	3,00	6,50	16			0	0	C	56	56	16	NC	NC	0,00	NC	0,0	0,0	NA
182	4,50	6,50	19			0	0	C	83	83	16	NC	NC	0,00	NC	0,0	0,0	NA
182	6,00	6,50	26			0	0	C	111	111	19	NC	NC	0,00	NC	0,0	0,0	NA
182	7,50	6,50	50	20,3	17,6	2,7	51	S	139	129	32	0,00	0,45	1,78	0,0	0,0	1,8	NA
182	9,55	6,50	50			2,7	51	S	177	146	28	0,00	0,27	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2039	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	2039	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
0	0	2,80	0	2	0,0	0,00	0,72	0,44	86,05	A.C.	2039	0	0,000

Grid No:436-182

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
172	1,50	6,00	15			0	0	C	28	28	21	NC	NC	0,00	NC	0,0	0,0	NA
172	3,00	6,00	12			0	0	C	56	56	12	NC	NC	0,00	NC	0,0	0,0	NA
172	4,50	6,00	19			0	0	C	83	83	16	NC	NC	0,00	NC	0,0	0,0	NA
172	6,00	6,00	7			0	0	C	111	111	5	NC	NC	0,00	NC	1,5	0,0	NA
172	7,50	6,00	11			0	0	C	139	124	7	NC	NC	0,00	NC	1,8	0,0	NA
172	9,55	6,00	11			0	0	C	177	141	6	NC	NC	0,00	NC	1,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2618	0	0,000
200	356	0	0,000
250	0	0	0,000
300	65	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	311	2	6,431
Total	3350	2	0,597

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,00	4	0	0,0	0,00	0,00	0,48	86,05	A.C.	3350	2	0,597

Grid No:437-172

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
176	1,50	7,50	18			0	0	M	28	28	26	0,00	0,50	2,25	0,0	0,0	0,0	NA
176	3,00	7,50	24			0	0	M	56	56	24	1,08	0,41	1,50	3,3	0,0	0,0	NA
176	4,50	7,50	22			0	0	S	83	83	18	0,89	0,43	1,50	33,6	0,0	0,0	5,3
176	6,00	7,50	28		NP	0	5	S	111	111	20	2,24	0,43	1,50	4,7	0,0	0,0	NA
176	7,50	7,50	50			0	5	S	139	139	32	0,00	0,45	1,78	0,0	0,0	1,8	NA
176	9,55	7,50	50			0	5	S	177	156	28	0,00	0,27	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	758	1	1,319
200	175	0	0,000
250	292	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	1225	1	0,816

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
34	6	9,55	0	2	5,3	4,21	2,49	0,48	86,05	A.C.	1225	1	0,816

Grid No:438-176

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
174	1,50	9,00	7			0	0	C	28	28	10	NC	NC	0,00	NC	2,3	0,0	NA
174	3,00	9,00	12	44,4	24,0	20,4	95	C	56	56	12	NC	NC	0,00	NC	0,0	0,0	NA
174	4,50	9,00	14			20,4	95	C	83	83	12	NC	NC	0,00	NC	0,0	0,0	NA
174	6,00	9,00	34			20,4	95	S	111	111	24	NC	NC	0,00	NC	0,0	0,0	NA
174	7,50	9,00	29		NP	0	7	S	139	139	18	3,22	0,52	1,78	6,7	0,0	0,0	NA
174	9,55	9,00	31			0	7	S	177	171	17	1,23	0,30	1,03	9,4	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	240	1	4,166
200	152	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	392	1	2,551

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
9	2	2,80	2	0	0,0	4,46	0,82	0,48	86,05	A.C.	392	1	2,551

Grid No:439-174

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
174	1,50	9,00	7			0	0	C	28	28	10	NC	NC	0,00	NC	2,3	0,0	NA
174	3,00	9,00	12	44,4	24,0	20,4	95	C	56	56	12	NC	NC	0,00	NC	0,0	0,0	NA
174	4,50	9,00	14			20,4	95	C	83	83	12	NC	NC	0,00	NC	0,0	0,0	NA
174	6,00	9,00	34			20,4	95	S	111	111	24	NC	NC	0,00	NC	0,0	0,0	NA
174	7,50	9,00	29		NP	0	7	S	139	139	18	3,22	0,52	1,78	6,7	0,0	0,0	NA
174	9,55	9,00	31			0	7	S	177	171	17	1,23	0,30	1,03	9,4	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	2868	2	0,697
200	56	0	0,000
250	0	0	0,000
300	116	0	0,000
350	203	0	0,000
400	0	0	0,000
450	0	0	0,000
500	320	0	0,000
Total	3563	2	0,561

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
9	2	2,80	2	0	0,0	4,46	0,82	0,48	86,05	A.C.	3563	2	0,561

Grid No:440-174

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
173	1,50	7,80	16			0	0	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
173	3,00	7,80	22			0	0	C	56	56	22	NC	NC	0,00	NC	0,0	0,0	NA
173	4,50	7,80	28			0	0	S	83	83	23	0,00	0,39	1,50	0,4	0,0	0,0	NA
173	6,00	7,80	39		NP	0	25	S	111	111	28	0,00	0,38	1,50	0,0	0,0	0,0	NA
173	7,50	7,80	43			0	25	S	139	139	27	0,00	0,45	1,78	0,0	0,0	0,0	NA
173	9,55	7,80	49			0	25	S	177	159	28	0,00	0,27	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	270	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	264	0	0,000
Total	534	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	5,80	0	0	0,0	0,00	1,49	0,44	86,05	A.C.	534	0	0,000

Grid No:441-173

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
177	1,50	6,50	18			0	0	C	28	28	26	NC	NC	0,00	NC	0,0	0,0	NA
177	3,00	6,50	15			0	0	C	56	56	15	NC	NC	0,00	NC	0,0	0,0	NA
177	4,50	6,50	13			0	0	C	83	83	11	NC	NC	0,00	NC	1,5	0,0	NA
177	6,00	6,50	20			0	0	C	111	111	14	NC	NC	0,00	NC	0,0	0,0	NA
177	7,50	6,50	27			0	0	C	139	129	17	NC	NC	0,00	NC	0,0	0,0	NA
177	9,55	6,50	30	24,1	18,5	5,6	46	S	177	146	17	1,52	0,32	1,03	4,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	709	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	709	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
4	1	1,03	2	0	0,0	1,52	0,32	0,48	86,05	A.C.	709	0	0,000

Grid No:442-177

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
177	1,50	6,50	18			0	0	C	28	28	26	NC	NC	0,00	NC	0,0	0,0	NA
177	3,00	6,50	15			0	0	C	56	56	15	NC	NC	0,00	NC	0,0	0,0	NA
177	4,50	6,50	13			0	0	C	83	83	11	NC	NC	0,00	NC	1,5	0,0	NA
177	6,00	6,50	20			0	0	C	111	111	14	NC	NC	0,00	NC	0,0	0,0	NA
177	7,50	6,50	27			0	0	C	139	129	17	NC	NC	0,00	NC	0,0	0,0	NA
177	9,55	6,50	30	24,1	18,5	5,6	46	S	177	146	17	1,52	0,32	1,03	4,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	525	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	525	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
4	1	1,03	2	0	0,0	1,52	0,32	0,48	86,05	A.C.	525	0	0,000

Grid No:443-177

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
175	1,50	8,00	18	29,6	20,2	9,4	78	C	28	28	26	NC	NC	0,00	NC	0,0	0,0	NA
175	3,00	8,00	14			9,4	78	C	56	56	14	NC	NC	0,00	NC	0,0	0,0	NA
175	4,50	8,00	14			9,4	78	C	83	83	12	NC	NC	0,00	NC	0,0	0,0	NA
175	6,00	8,00	17			9,4	78	C	111	111	12	NC	NC	0,00	NC	0,0	0,0	NA
175	7,50	8,00	25			9,4	78	C	139	139	16	NC	NC	0,00	NC	0,0	0,0	NA
175	9,55	8,00	32	24,8	19,0	5,8	32	C	177	161	18	NC	NC	0,00	NC	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	561	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	355	0	0,000
Total	916	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,00	0	0	0,0	0,00	0,00	0,48	86,05	A.C.	916	0	0,000

Grid No:444-175

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
152	1,50	5,00	9			0	0	C	28	28	13	NC	NC	0,00	NC	0,0	0,0	NA
152	3,00	5,00	14			0	0	C	56	56	14	NC	NC	0,00	NC	0,0	0,0	NA
152	4,50	5,00	18			0	0	S	83	83	15	2,35	0,45	1,50	78,7	0,0	0,0	5,3
152	6,00	5,00	2		NP	0	20	S	111	101	1	12,11	0,93	1,50	100,0	1,5	0,0	6,8
152	7,50	5,00	31			0	20	S	139	114	20	1,09	0,53	1,78	5,2	0,0	0,0	NA
152	9,55	5,00	50			0	20	S	177	131	28	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	386	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	386	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
100	26	5,80	2	0	5,3	15,56	2,18	0,48	86,05	A.C.	386	0	0,000

Grid No:445-152

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
152	1,50	5,00	9			0	0	C	28	28	13	NC	NC	0,00	NC	0,0	0,0	NA
152	3,00	5,00	14			0	0	C	56	56	14	NC	NC	0,00	NC	0,0	0,0	NA
152	4,50	5,00	18			0	0	S	83	83	15	2,35	0,45	1,50	78,7	0,0	0,0	5,3
152	6,00	5,00	2		NP	0	20	S	111	101	1	12,11	0,93	1,50	100,0	1,5	0,0	6,8
152	7,50	5,00	31			0	20	S	139	114	20	1,09	0,53	1,78	5,2	0,0	0,0	NA
152	9,55	5,00	50			0	20	S	177	131	28	0,00	0,28	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	426	0	0,000
200	645	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	1071	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
100	26	5,80	2	0	5,3	15,56	2,18	0,48	86,05	A.C.	1071	0	0,000

Grid No:446-152

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
181	1,50	8,00	16	23,6	17,5	6,1	46	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
181	3,00	8,00	25			6,1	46	S	56	56	25	0,00	0,40	1,50	0,0	0,0	0,0	NA
181	4,50	8,00	36			6,1	46	S	83	83	30	0,00	0,38	1,50	0,0	0,0	1,5	NA
181	6,00	8,00	34			6,1	46	S	111	111	24	0,00	0,40	1,50	0,0	0,0	0,0	NA
181	7,50	8,00	29		NP	0	4	S	139	139	18	3,40	0,52	1,78	8,7	0,0	0,0	NA
181	9,55	8,00	29			0	4	S	177	161	16	1,61	0,31	1,03	32,2	0,0	0,0	9,6

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	236	0	0,000
200	169	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	405	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
32	6	7,30	0	2	9,6	5,01	2,02	0,48	86,05	A.C.	405	0	0,000

Grid No:447-181

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
181	1,50	8,00	16	23,6	17,5	6,1	46	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
181	3,00	8,00	25			6,1	46	S	56	56	25	0,00	0,40	1,50	0,0	0,0	0,0	NA
181	4,50	8,00	36			6,1	46	S	83	83	30	0,00	0,38	1,50	0,0	0,0	1,5	NA
181	6,00	8,00	34			6,1	46	S	111	111	24	0,00	0,40	1,50	0,0	0,0	0,0	NA
181	7,50	8,00	29		NP	0	4	S	139	139	18	3,40	0,52	1,78	8,7	0,0	0,0	NA
181	9,55	8,00	29			0	4	S	177	161	16	1,61	0,31	1,03	32,2	0,0	0,0	9,6

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	513	0	0,000
200	35	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	548	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
32	6	7,30	0	2	9,6	5,01	2,02	0,48	86,05	A.C.	548	0	0,000

Grid No:448-181

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
181	1,50	8,00	16	23,6	17,5	6,1	46	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
181	3,00	8,00	25			6,1	46	S	56	56	25	0,00	0,40	1,50	0,0	0,0	0,0	NA
181	4,50	8,00	36			6,1	46	S	83	83	30	0,00	0,38	1,50	0,0	0,0	1,5	NA
181	6,00	8,00	34			6,1	46	S	111	111	24	0,00	0,40	1,50	0,0	0,0	0,0	NA
181	7,50	8,00	29		NP	0	4	S	139	139	18	3,40	0,52	1,78	8,7	0,0	0,0	NA
181	9,55	8,00	29			0	4	S	177	161	16	1,61	0,31	1,03	32,2	0,0	0,0	9,6

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	578	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	578	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
32	6	7,30	0	2	9,6	5,01	2,02	0,48	86,05	A.C.	578	0	0,000

Grid No:449-181

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
181	1,50	8,00	16	23,6	17,5	6,1	46	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
181	3,00	8,00	25			6,1	46	S	56	56	25	0,00	0,40	1,50	0,0	0,0	0,0	NA
181	4,50	8,00	36			6,1	46	S	83	83	30	0,00	0,38	1,50	0,0	0,0	1,5	NA
181	6,00	8,00	34			6,1	46	S	111	111	24	0,00	0,40	1,50	0,0	0,0	0,0	NA
181	7,50	8,00	29		NP	0	4	S	139	139	18	3,40	0,52	1,78	8,7	0,0	0,0	NA
181	9,55	8,00	29			0	4	S	177	161	16	1,61	0,31	1,03	32,2	0,0	0,0	9,6

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	352	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	352	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
32	6	7,30	0	2	9,6	5,01	2,02	0,48	86,05	A.C.	352	0	0,000

Grid No:450-181

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
181	1,50	8,00	16	23,6	17,5	6,1	46	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
181	3,00	8,00	25			6,1	46	S	56	56	25	0,00	0,40	1,50	0,0	0,0	0,0	NA
181	4,50	8,00	36			6,1	46	S	83	83	30	0,00	0,38	1,50	0,0	0,0	1,5	NA
181	6,00	8,00	34			6,1	46	S	111	111	24	0,00	0,40	1,50	0,0	0,0	0,0	NA
181	7,50	8,00	29		NP	0	4	S	139	139	18	3,40	0,52	1,78	8,7	0,0	0,0	NA
181	9,55	8,00	29			0	4	S	177	161	16	1,61	0,31	1,03	32,2	0,0	0,0	9,6

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	354	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	354	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
32	6	7,30	0	2	9,6	5,01	2,02	0,48	86,05	A.C.	354	0	0,000

Grid No:452-181

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
69	1,50	3,50	11	42,2	22,6	19,6	95	CL	28	28	16	NC	NC	0,00	NC	0,0	0,0	NA
69	3,00	3,50	12			19,6	95	CL	56	56	12	NC	NC	0,00	NC	0,0	0,0	NA
69	4,50	3,50	15			19,6	95	CL	83	73	12	NC	NC	0,00	NC	0,0	0,0	NA
69	6,00	3,50	27	50,4	24,5	25,9	99	CH	111	86	19	NC	NC	0,00	NC	0,0	0,0	NA
69	7,50	3,50	21			25,9	99	CH	139	99	13	NC	NC	0,00	NC	0,0	0,0	NA
69	9,55	3,50	15		NP	0	45	SM	177	116	8	4,59	0,43	1,03	99,9	1,0	0,0	9,6

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	571	0	0,000
200	17	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	588	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	14	1,03	1	0	10	4,59	0,43	0,48	86,05	A.C.	588	0	0,000

Grid No:507-69

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
68	1,50	2,20	14			0	0	CL	28	28	20	NC	NC	0,00	NC	0,0	0,0	NA
68	3,50	2,20	24			0	0	CL	65	52	22	NC	NC	0,00	NC	0,0	0,0	NA
68	4,50	2,20	19			0	0	CL	83	60	16	NC	NC	0,00	NC	0,0	0,0	NA
68	6,00	2,20	32			0	0	SM	111	73	23	0,00	0,44	1,50	18,5	0,0	0,0	NA
68	7,50	2,20	42			0	0	SM	139	86	27	0,00	0,51	1,78	1,2	0,0	0,0	NA
68	9,55	2,20	50		NP	0	15	SM	177	103	28	0,03	0,30	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	270	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	270	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
19	3	4,30	0	0	0	0,03	1,24	0,44	86,05	A.C.	270	0	0,000

Grid No:509-68

DATA OF GRID

Geotechnical Data

10

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
66	1,50	4,00	10			0	0	CL	28	28	14	NC	NC	0,00	NC	0,0	0,0	NA
66	3,00	4,00	13	41,4	22,5	18,9	68	CL	56	56	13	NC	NC	0,00	NC	0,0	0,0	NA
66	4,50	4,00	9			18,9	68	CL	83	78	7	NC	NC	0,00	NC	1,5	0,0	NA
66	6,00	4,00	19	23,6	19,9	3,7	80	ML	111	91	14	3,45	0,49	1,50	39,6	0,0	0,0	6,8
66	7,50	4,00	20			3,7	80	ML	139	104	13	4,85	0,61	1,78	59,4	0,0	0,0	8,5
66	9,55	4,00	27		NP	0	50	SM	177	121	15	2,17	0,34	1,03	42,8	0,0	0,0	9,6

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	311	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	311	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
59	20	4,30	2	0	7	10,47	1,45	0,48	86,05	A.C.	311	0	0,000

Grid No:510-66

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
65	1,50	2,65	11			0	0	CL	28	28	16	NC	NC	0,00	NC	0,0	0,0	NA
65	3,50	2,65	9			0	0	CL	65	56	8	NC	NC	0,00	NC	1,5	0,0	NA
65	4,50	2,65	12			0	0	CL	83	65	10	NC	NC	0,00	NC	1,3	0,0	NA
65	6,00	2,65	13	45,0	23,2	21,8	95	CL	111	78	9	NC	NC	0,00	NC	1,5	0,0	NA
65	7,50	2,65	17			21,8	95	CL	139	90	11	NC	NC	0,00	NC	1,5	0,0	NA
65	9,00	2,65	45		NP	0	95	SM	167	103	26	0,00	0,37	1,25	0,0	0,0	0,0	NA
65	10,00	2,65	47			0	95	SM	185	112	26	0,00	0,45	1,50	0,0	0,0	0,0	NA
65	12,00	2,65	42		NP	0	15	SM	222	129	21	2,72	0,57	1,75	21,2	0,0	0,0	NA
65	13,50	2,65	50			0	15		250	141	24	0,47	0,47	1,50	5,0	0,0	0,0	NA
65	15,00	2,65	50			0	15		278	154	23	0,51	0,24	0,75	12,4	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	405	1	2,469
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	405	1	2,469

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
21	0	6,75	6	0	0	3,70	2,09	0,48	86,05	A.C.	405	1	2,469

Grid No:511-65

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
67	1,50	2,70	9			0	0	CL	28	28	13	NC	NC	0,00	NC	0,0	0,0	NA
67	3,00	2,70	8	37,7	21,2	16,5	88	CL	56	53	8	NC	NC	0,00	NC	1,5	0,0	NA
67	4,50	2,70	9			16,5	88	CL	83	65	7	NC	NC	0,00	NC	1,5	0,0	NA
67	6,00	2,70	36		NP	0	88	SM	111	78	26	0,00	0,42	1,50	0,0	0,0	0,0	NA
67	7,50	2,70	47		NP	0	27	SM	139	91	30	0,00	0,49	1,78	0,0	0,0	1,8	NA
67	9,55	2,70	50			0	27	SM	177	108	28	0,00	0,29	1,03	0,0	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	668	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	668	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
0	0	4,30	3	2	0	0,00	1,20	0,44	86,05	A.C.	668	0	0,000

Grid No:512-67

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)
56	1,50	2,70	17			0	0	SM	28	28	24	0,00	0,50	2,25	0,0	0,0	0,0
56	3,00	2,70	12			0	0	SM	56	53	12	5,66	0,58	1,75	99,8	0,0	0,0
56	5,00	2,70	21			0	65	CL	93	70	16	NC	NC	0,00	NC	0,0	0,0
56	6,00	2,70	23			0	65	CL	111	78	16	NC	NC	0,00	NC	0,0	0,0
56	7,50	2,70	17			0	65	CL	139	91	11	NC	NC	0,00	NC	1,5	0,0
56	9,00	2,70	25		NP	0	36	SM	167	104	15	2,98	0,44	1,25	83,7	0,0	0,0
56	10,00	2,70	28			0	36	SM	185	112	15	3,31	0,53	1,50	74,6	0,0	0,0
56	12,00	2,70	24			0	36	SM	222	129	12	5,85	0,67	1,75	97,7	0,0	0,0
56	13,50	2,70	15	44,9	23,7	21,2	92	CL	250	142	7	NC	NC	0,00	NC	1,5	0,0
56	15,00	2,70	15			21,2	92	CL	278	155	7	NC	NC	0,00	NC	0,8	0,0

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	461	0	0,000
250	101	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	562	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	37	8,50	4	0	4	17,81	2,72	0,48	86,05	A.C.	562	0	0,000

Grid No:515-56

d_{liq} (m)
NA
4,0
NA
NA
NA
9,5
11,0
12,8
NA
NA

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)
62	1,50	2,80	10			0	0	SW	28	28	14	4,07	0,63	2,50	78,0	0,0	0,0
62	3,50	2,80	6	27,1	18,5	8,6	59	SW	65	58	6	7,78	0,64	1,50	100,0	1,5	0,0
62	4,50	2,80	8			8,6	59	SW	83	66	7	6,13	0,53	1,25	100,0	1,3	0,0
62	6,00	2,80	13			8,6	59	CL	111	79	9	NC	NC	0,00	NC	1,5	0,0
62	7,50	2,80	16	31,2	19,4	11,8	90	CL	139	92	10	NC	NC	0,00	NC	1,5	0,0
62	9,00	2,80	15			11,8	90	CL	167	105	9	NC	NC	0,00	NC	1,3	0,0
62	10,00	2,80	44		np	0	90	SM	185	113	24	0,00	0,45	1,50	0,0	0,0	0,0
62	12,00	2,80	50		NP	0	13	SM	222	130	25	1,53	0,53	1,75	1,0	0,0	0,0
62	13,50	2,80	50			0	13	SM	250	143	24	0,46	0,47	1,50	5,6	0,0	0,0
62	15,00	2,80	50			0	13	SM	278	156	23	0,50	0,24	0,75	13,5	0,0	0,0

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	439	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	439	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	40	10,75	7	0	3	20,47	3,50	0,48	86,05	A.C.	439	0	0,000

Grid No:516!-62

d_{liq} (m)
2,5
4,0
5,3
NA
NA
NA
NA
NA
NA
NA

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
58	1,50	2,70	11	39,1	21,5	17,6	82	CL	28	28	16	NC	NC	0,00	NC	0,0	0,0	NA
58	3,00	2,70	10		NP	0	37	SM	56	53	10	5,50	0,61	1,75	99,3	1,8	0,0	4,0
58	5,00	2,70	24			0	37	CL	93	70	19	NC	NC	0,00	NC	0,0	0,0	NA
58	7,50	2,70	19			0	37	SM	139	91	12	6,87	0,83	2,28	97,1	0,0	0,0	8,5
58	9,55	2,70	21		26,9	NA	17	SM	177	108	12	NC	NC	0,00	NC	0,0	0,0	NA
58	10,00					NA	17					NC	NC	0,00	NC	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	262	0	0,000
200	120	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	382	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
99	28	4,03	2	0	4	12,37	1,44	0,48	86,05	A.C.	382	0	0,000

Grid No:518-58

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
59	1,50	3,30	10	37,2	21,6	15,6	84	CL	28	28	14	NC	NC	0,00	NC	0,0	0,0	NA
59	3,00	3,30	7			15,6	84	CL	56	56	7	NC	NC	0,00	NC	1,5	0,0	NA
59	4,50	3,30	21			15,6	84	CL	83	71	17	NC	NC	0,00	NC	0,0	0,0	NA
59	6,00	3,30	19			15,6	84	CL	111	84	14	NC	NC	0,00	NC	0,0	0,0	NA
59	7,50	3,30	21			15,6	84	CL	139	97	13	NC	NC	0,00	NC	0,0	0,0	NA
59	9,50	3,30	20			15,6	84	CL	176	114	11	NC	NC	0,00	NC	0,0	0,0	NA
59	10					15,6	84					NC	NC	0,00	NC	0,3	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	468	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	468	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
0	0	0,00	2	0	0	0,00	0,00	0,48	86,05	A.C.	468	0	0,000

Grid No:519-59

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
64	1,50	2,50	8			0	0	CL	28	28	11	NC	NC	0,00	NC	0,0	0,0	NA
64	3,50	2,50	14			0	0	CL	65	55	13	NC	NC	0,00	NC	0,0	0,0	NA
64	4,50	2,50	12			0	0	CL	83	63	10	NC	NC	0,00	NC	1,3	0,0	NA
64	6,00	2,50	12			0	0	CL	111	76	9	NC	NC	0,00	NC	1,5	0,0	NA
64	7,50	2,50	10			0	0	CL	139	89	6	NC	NC	0,00	NC	1,8	0,0	NA
64	9,50	2,50	9	27,4	19,1	8,3	87	CL	176	106	5	NC	NC	0,00	NC	1,3	0,0	NA
	10					8,3	NA					0,00	0,00	0,25	NA	0,3	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	658	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	658	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,25	6	0	0	0,00	0,00	0,48	86,05	A.C.	658	0	0,000

Grid No:520-64

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
71	1,50	0,80	9	46,6	24,2	22,4	78	CL	28	21	13	NC	NC	0,00	NC	0,0	0,0	NA
71	3,00	0,80	11			22,4	78	CL	56	34	11	NC	NC	0,00	NC	0,0	0,0	NA
71	4,50	0,80	26	21,0	18,4	2,6	24	SM	83	46	21	1,27	0,49	1,50	66,4	0,0	0,0	5,3
71	6,00	0,80	12			2,6	24	SM	111	59	9	6,76	0,70	1,50	100,0	1,5	0,0	6,8
71	7,50	0,80	11	52,9	25,1	27,8	95	CH	139	72	7	NC	NC	0,00	NC	1,8	0,0	NA
71	9,55	0,80	12			27,8	95	CH	177	89	7	NC	NC	0,00	NC	1,3	0,0	NA
	10					27,8	NA					NC	NC	0,00	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	387	1	2,584
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	387	1	2,584

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	24	3,00	5	0	5	8,03	1,19	0,52	86,05	A.C.	387	1	2,584

Grid No:521-71

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
71	1,50	0,80	9	46,6	24,2	22,4	78	CL	28	21	13	NC	NC	0,00	NC	0,0	0,0	NA
71	3,00	0,80	11			22,4	78	CL	56	34	11	NC	NC	0,00	NC	0,0	0,0	NA
71	4,50	0,80	26	21,0	18,4	2,6	24	SM	83	46	21	1,09	0,48	1,50	52,2	0,0	0,0	5,3
71	6,00	0,80	12			2,6	24	SM	111	59	9	6,59	0,67	1,50	100,0	1,5	0,0	6,8
71	7,50	0,80	11	52,9	25,1	27,8	95	CH	139	72	7	NC	NC	0,00	NC	1,8	0,0	NA
71	9,55	0,80	12			27,8	95	CH	177	89	7	NC	NC	0,00	NC	1,3	0,0	NA
	10					27,8	NA					NC	NC	0,00	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	685	1	1,460
200	259	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	944	1	1,059

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	22	3,00	5	0	5	7,68	1,15	0,48	86,05	A.C.	944	1	1,059

Grid No:522-71

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
70	1,50	1,40	9			0	0	CL	28	27	13	NC	NC	0,00	NC	0,0	0,0	NA
70	3,50	1,40	16			0	0	CL	65	44	15	NC	NC	0,00	NC	0,0	0,0	NA
70	4,50	1,40	17			0	0	CL	83	52	14	NC	NC	0,00	NC	0,0	0,0	NA
70	6,00	1,40	28			0	0	CL	111	65	20	NC	NC	0,00	NC	0,0	0,0	NA
70	7,50	1,40	18			0	0	CL	139	78	11	NC	NC	0,00	NC	0,0	0,0	NA
70	9,55	1,40	31		NP	0	17	SM	177	95	17	2,77	0,44	1,25	87,2	0,0	0,0	9,8
	10					0	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	520	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	121	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	641	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
87	12	1,48	0	0	10	2,77	0,44	0,48	86,05	A.C.	641	0	0,000

Grid No:523-70

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
52	1,50	2,20	14	21,3	18,2	3,1	38	SM	28	28	20	0,00	0,60	2,50	0,1	0,0	0,0	NA
52	3,50	2,20	8		NP	0	22	CL	65	52	7	NC	NC	0,00	NC	1,5	0,0	NA
52	4,50	2,20	9			0	22	SM	83	60	7	6,90	0,64	1,50	100,0	1,5	0,0	5,5
52	6,50	2,20	14			0	22	CL	120	77	10	NC	NC	0,00	NC	1,5	0,0	NA
52	7,50	2,20	18			0	22	CL	139	86	11	NC	NC	0,00	NC	0,0	0,0	NA
52	9,55	2,20	50		NP	0	43	SM	177	103	28	0,00	0,36	1,25	0,0	0,0	0,0	NA
	10					0	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	105	0	0,000
250	300	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	405	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	14	5,48	5	0	6	6,90	1,60	0,48	86,05	A.C.	405	0	0,000

Grid No:524-52

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
53	1,50	2,10	7			0	0	CL	28	28	10	NC	NC	0,00	NC	2,3	0,0	NA
53	3,00	2,10	7			0	0	CL	56	47	7	NC	NC	0,00	NC	1,5	0,0	NA
53	4,50	2,10	15			0	0	CL	83	59	12	NC	NC	0,00	NC	0,0	0,0	NA
53	6,00	2,10	12			0	0	CL	111	72	9	NC	NC	0,00	NC	1,5	0,0	NA
53	7,50	2,10	15			0	0	CL	139	85	10	NC	NC	0,00	NC	1,5	0,0	NA
53	9,00	2,10	49			0	0	SM	167	98	28	0,00	0,36	1,25	0,7	0,0	0,0	NA
53	10,00	2,10	25		NP	0	20	SM	185	106	14	4,65	0,56	1,50	98,7	0,0	0,0	11,0
53	12,00	2,10	50			0	20	SM	222	123	25	0,00	0,53	1,75	0,7	0,0	0,0	NA
53	13,50	2,10	40			0	20	SM	250	136	19	2,25	0,51	1,50	57,2	0,0	0,0	14,3
53	15,00	2,10	50			0	20	SM	278	149	23	0,53	0,24	0,75	10,8	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	258	1	3,876
250	89	0	0,000
300	80	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	427	1	2,342

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
99	14	6,75	7	0	11	7,43	2,22	0,48	86,05	A.C.	427	1	2,342

Grid No:525-53

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
50	1,50	2,70	38			0	15	SM	28	28	54	0,00	0,48	2,25	0,0	0,0	2,3	NA
50	3,00	2,70	50	22,6	19,4	3,2	19	SM	56	53	50	0,00	0,36	1,50	0,0	0,0	1,5	NA
50	4,50	2,70	22			3,2	19	CL	83	65	18	NC	NC	0,00	NC	0,0	0,0	NA
50	6,00	2,70	27	28,2	19,5	8,7	47	CL	111	78	19	NC	NC	0,00	NC	0,0	0,0	NA
50	7,50	2,70	14			8,7	47	CL	139	91	9	NC	NC	0,00	NC	1,8	0,0	NA
50	9,55	2,70	13	42,9	23,1	19,8	94	CL	177	108	7	NC	NC	0,00	NC	1,3	0,0	NA
	10					19,8	NA					NC	NC	0,00	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	276	0	0,000
200	139	0	0,000
250	0	0	0,000
300	341	0	0,000
350	263	0	0,000
400	51	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	1070	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	3,75	3	4	0	0,00	0,84	0,48	86,05	A.C.	1070	0	0,000

Grid No:526-50

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
41	1,50	2,80	9			0	0	CL	28	28	13	NC	NC	0,00	NC	0,0	0,0	NA
41	3,00	2,80	7			0	0	CL	56	54	7	NC	NC	0,00	NC	1,8	0,0	NA
41	5,00	2,80	19			0	0	CL	93	71	15	NC	NC	0,00	NC	0,0	0,0	NA
41	6,00	2,80	26		NP	0	33	SM	111	79	19	1,34	0,40	1,25	27,6	0,0	0,0	NA
41	7,50	2,80	16			0	33	ML	139	92	10	6,55	0,69	1,78	99,7	1,8	0,0	8,5
41	9,55	2,80	18	21,1	3,5	17,6	69	ML	177	109	10	NC	NC	0,00	NC	1,3	0,0	NA
	10					17,6	NA					NC	NC	0,00	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	333	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	333	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	18	3,03	5	0	9	7,89	1,08	0,48	86,05	A.C.	333	0	0,000

Grid No:527-41

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
51	1,50	4,30	17	29,1	19,7	9,4	55	CL	28	28	24	NC	NC	0,00	NC	0,0	0,0	NA
51	3,00	4,30	20			9,4	55	SM	56	56	20	0,00	0,42	1,50	0,8	0,0	0,0	NA
51	4,50	4,30	10			9,4	55	CL	83	81	8	NC	NC	0,00	NC	1,8	0,0	NA
51	6,50	4,30	18			9,4	55	CL	120	98	12	NC	NC	0,00	NC	0,0	0,0	NA
51	7,50	4,30	22	31,4	20,7	10,7	62	SM	139	107	14	3,57	0,51	1,53	50,5	0,0	0,0	8,5
51	9,55	4,30	32			10,7	62	SM	177	124	18	1,60	0,39	1,25	3,9	0,0	0,0	NA
	10					10,7	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	0	0	0,000
250	378	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	378	0	0,000

PARAMETERS													
Geotechnical								**Earthquake**		**Pipeline**			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
51	8	4,50	2	0	9	5,18	1,33	0,48	86,05	A.C.	378	0	0,000

Grid No:528-51

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
78	2,00	3,00	12			0	0	CL	37	37	15	NC	NC	0,00	NC	0,0	0,0	NA
78	3,00	3,00	5			0	0	CL	56	56	5	NC	NC	0,00	NC	1,3	0,0	NA
78	4,50	3,00	2			0	0	CL	83	68	2	NC	NC	0,00	NC	1,5	0,0	NA
78	6,00	3,00	12			0	0	CL	111	81	9	NC	NC	0,00	NC	1,5	0,0	NA
78	7,50	3,00	45			0	0	GW	139	94	29	0,00	0,50	1,78	0,1	0,0	0,0	NA
78	9,55	3,00	20	30,4	12,8	17,6	72	CL	177	111	11	NC	NC	0,00	NC	0,0	0,0	NA
	10					17,6	NA					NC	NC	0,00	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	344	0	0,000
200	156	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	500	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	1,78	4	0	0	0,00	0,50	0,48	86,05	A.C.	500	0	0,000

Grid No:529-78

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
87	1,50	3,30	6		NP	0	46	SM	28	28	9	5,18	0,56	2,25	86,2	2,3	0,0	2,3
87	3,00	3,30	19			0	46	SG	56	56	19	0,28	0,43	1,50	3,4	0,0	0,0	NA
87	4,50	3,30	22			0	46	SG	83	71	18	1,10	0,45	1,50	7,4	0,0	0,0	NA
87	6,00	3,30	29			0	46	SG	111	84	21	0,49	0,45	1,50	1,2	0,0	0,0	NA
87	7,50	3,30	23		NP	0	19	SM	139	97	15	4,64	0,61	1,78	89,5	0,0	0,0	8,5
87	9,55	3,30	23			0	19	SM	177	114	13	3,57	0,45	1,25	97,4	0,0	0,0	9,8
	10					0	NA					0,00	0,00	0,23	NA	0,2	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	488	2	4,098
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	488	2	4,098

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
97	41	10,00	2	0	2	15,25	2,95	0,48	86,05	A.C.	488	2	4,098

Grid No:530-87

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)
84	1,50	3,30	13		NP	0	21	SM	28	28	19	0,00	0,52	2,25	1,2	0,0	0,0
84	3,00	3,30	10			0	21	SM	56	56	10	5,08	0,51	1,50	99,6	1,5	0,0
84	4,50	3,30	5			0	21	SM	83	71	4	9,13	0,70	1,50	100,0	1,5	0,0
84	6,00	3,30	7	23,8	20,3	3,5	57	ML	111	84	5	8,73	0,71	1,50	100,0	1,5	0,0
84	7,50	3,30	30			3,5	57	ML	139	97	19	1,60	0,55	1,75	4,7	0,0	0,0
84	9,50	3,30	9	48,3	22,7	25,6	92	CL	176	114	5	NC	NC	0,00	NC	1,3	0,0
84	10,00	3,30	13			25,6	92	CL	185	118	7	NC	NC	0,00	NC	1,3	0,0
84	12,00	3,30	41		NP	0	22	SM	222	135	21	2,39	0,56	1,75	10,8	0,0	0,0
84	13,50	3,30	50			0	22	SM	250	148	24	0,42	0,47	1,50	1,3	0,0	0,0
84	15,00	3,30	50			0	22	SM	278	161	23	0,97	0,48	1,50	4,2	0,0	0,0
84	16,50	3,30	50			0	22	SM	305	173	21	1,48	0,49	1,50	10,8	0,0	0,0
84	18,00	3,30	50		NP	0	19	SM	333	186	21	2,78	0,51	1,50	25,5	0,0	0,0
84	19,50	3,30	50			0	19	SM	361	199	20	1,17	0,26	0,75	39,0	0,0	0,0

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	433	1	2,309
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	325	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	758	1	1,319

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	44	8,50	7	0	4	24,53	2,99	0,48	86,05	A.C.	758	1	1,319

Grid No:531-84

d_{liq} (m)
NA
3,8
5,3
6,8
NA
NA
NA
NA
NA
NA
NA
NA
19,5

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)
79	1,50	3,40	8			0	0	CL	28	28	11	NC	NC	0,00	NC	0,0	0,0
79	3,00	3,40	22	25,5	19,7	5,8	13	SC-SM	56	56	22	0,75	0,42	1,50	3,9	0,0	0,0
79	4,50	3,40	23			5,8	13	SC-SM	83	72	19	0,73	0,44	1,50	26,3	0,0	0,0
79	6,00	3,40	7			5,8	13	CL	111	85	5	NC	NC	0,00	NC	1,8	0,0
79	8,00	3,40	5			5,8	13	CL	148	102	3	NC	NC	0,00	NC	1,5	0,0
79	9,00	3,40	11			5,8	13	SM	167	111	6	5,40	0,47	1,00	100,0	1,0	0,0
79	10,00	3,40	19			5,8	13	SM	185	119	10	5,64	0,59	1,50	99,9	1,5	0,0
79	12,00	3,40	30		NP	0	40	SM	222	136	15	4,13	0,61	1,75	64,8	0,0	0,0
79	13,50	3,40	36			0	40	SM	250	149	17	2,91	0,52	1,50	39,8	0,0	0,0
79	15,00	3,40	37			0	40	SM	278	162	17	1,60	0,26	0,75	48,0	0,0	0,0

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	315	1	3,175
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	200	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	515	1	1,942

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	33	9,50	6	0	10	21,15	3,31	0,48	86,05	A.C.	515	1	1,942

Grid No:532-79

d_{liq} (m)
NA
NA
NA
NA
NA
9,5
11,0
12,8
14,3
15,0

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
45	1,50	5,00	12			0	0	C	28	28	17	NC	NC	0,00	NC	0,0	0,0	NA
45	3,00	5,00	11	20,4	18,1	2,3	78	M	56	56	11	4,08	0,50	1,50	83,8	0,0	0,0	3,8
45	4,50	5,00	9			2,3	78	M	83	83	7	6,44	0,54	1,50	95,6	1,5	0,0	5,3
45	6,00	5,00	11			2,3	78	S	111	101	8	6,49	0,56	1,50	95,2	1,5	0,0	6,8
45	7,50	5,00	9	33,4	20,8	12,6	82	M	139	114	6	9,71	0,77	1,78	99,7	1,8	0,0	8,5
45	9,55	5,00	12			12,6	82	C	177	131	7	NC	NC	0,00	NC	1,3	0,0	NA
	10					12,6	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	585	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	259	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	844	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	53	6,50	6	0	4	26,72	2,37	0,48	86,05	A.C.	844	0	0,000

Grid No:533-45

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
4	1,50	4,00	18			0	0	S	28	28	26	0,00	0,50	2,25	0,0	0,0	0,0	NA
4	3,00	4,00	28		NP	0	16	S	56	56	28	0,00	0,40	1,50	0,0	0,0	0,0	NA
4	4,50	4,00	9			0	16	C	83	78	7	NC	NC	0,00	NC	1,5	0,0	NA
4	6,00	4,00	10			0	16	C	111	91	7	NC	NC	0,00	NC	1,5	0,0	NA
4	7,50	4,00	8			0	16	C	139	104	5	NC	NC	0,00	NC	1,5	0,0	NA
4	9,00	4,00	9			0	16	C	167	117	5	NC	NC	0,00	NC	1,3	0,0	NA
4	10,00	4,00	9			0	16	C	185	125	5	NC	NC	0,00	NC	1,5	0,0	NA
4	12,00	4,00	50			0	16	S	222	142	25	0,00	0,52	1,75	0,2	0,0	0,0	NA
4	13,50	4,00	50	27,1	20,7	6,4	25	S	250	155	24	1,06	0,46	1,50	0,4	0,0	0,0	NA
4	15,00	4,00	50			6,4	25	S	278	168	23	0,46	0,24	0,75	1,8	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	372	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	372	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
2	0	7,75	7	0	0	1,52	2,12	0,48	86,05	A.C.	372	0	0,000

Grid No:534-4

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
11	1,50	4,60	6	31,2	19,6	11,6	53	C	28	28	9	NC	NC	0,00	NC	2,3	0,0	NA
11	3,00	4,60	6			11,6	53	C	56	56	6	NC	NC	0,00	NC	1,5	0,0	NA
11	4,50	4,60	7			11,6	53	C	83	83	6	NC	NC	0,00	NC	1,5	0,0	NA
11	6,00	4,60	13			11,6	53	C	111	97	9	NC	NC	0,00	NC	1,5	0,0	NA
11	7,50	4,60	20			11,6	53	S	139	110	13	4,78	0,60	1,78	67,8	0,0	0,0	8,5
11	9,55	4,60	37			11,6	53	S	177	127	21	0,68	0,38	1,25	0,2	0,0	0,0	NA
	10					11,6	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	109	2	18,347
200	395	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	504	2	3,968

PARAMETERS													
Geotechnical								**Earthquake**		**Pipeline**			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
68	10	3,25	7	0	9	5,46	0,98	0,48	86,05	A.C.	504	2	3,968

Grid No:535-11

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
27	1,50	4,50	6	32,2	20,9	11,3	94	C	28	28	9	NC	NC	0,00	NC	2,3	0,0	NA
27	3,00	4,50	7			11,3	94	S	56	56	7	6,54	0,57	1,50	99,2	1,5	0,0	3,8
27	4,50	4,50	5			11,3	94	M	83	83	4	8,96	0,64	1,50	99,7	1,5	0,0	5,3
27	6,00	4,50	7			11,3	94	S	111	96	5	8,59	0,66	1,50	99,8	1,5	0,0	6,8
27	7,50	4,50	13	32,3	19,7	12,6	61	M	139	109	8	7,71	0,70	1,78	98,7	1,8	0,0	8,5
27	9,55	4,50	33	20,9	18,5	2,4	28	S	177	126	19	1,74	0,39	1,25	11,3	0,0	0,0	NA
	10					2,4	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	478	1	2,092
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	478	1	2,092

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	58	7,75	9	0	4	33,55	2,97	0,48	86,05	A.C.	478	3	2,092

Grid No:536-27

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
90	1,50	2,80	44			0	0	S	28	28	63	0,00	0,48	2,25	0,0	0,0	2,3	NA
90	3,00	2,80	33	27,8	21,4	6,4	30	S	56	54	33	0,00	0,39	1,50	0,0	0,0	1,5	NA
90	4,50	2,80	39			6,4	30	S	83	66	32	0,00	0,41	1,50	0,0	0,0	1,5	NA
90	6,00	2,80	26			6,4	30	S	111	79	19	1,61	0,48	1,50	40,3	0,0	0,0	6,8
90	7,50	2,80	23			6,4	30	S	139	92	15	4,14	0,63	1,78	92,3	0,0	0,0	8,5
90	9,55	2,80	29			6,4	30	S	177	109	16	2,47	0,43	1,25	75,6	0,0	0,0	9,8
	10					6,4	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	0	0	0,000
250	244	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	244	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	30	0,00	0	5	7	0,00	0,00	0,52	86,05	A.C.	244	0	0,000

Grid No:537-90

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
94	1,50	3,10	16			0	0	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
94	3,40	3,10	34			0	0	C	63	60	32	NC	NC	0,00	NC	0,0	1,5	NA
94	4,50	3,10	9			0	0	C	83	69	7	NC	NC	0,00	NC	1,5	0,0	NA
94	6,40	3,10	7			0	0	C	118	85	5	NC	NC	0,00	NC	1,5	0,0	NA
94	7,50	3,10	14	39,6	16,3	23,3	54	C	139	95	9	NC	NC	0,00	NC	1,6	0,0	NA
94	9,55	3,10	17			23,3	54	C	177	112	10	NC	NC	0,00	NC	1,3	0,0	NA
	10					23,3	NA					NC	NC	0,00	NA	0,2	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	0	0	0,000
250	94	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	516	0	0,000
Total	610	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,00	6	2	0	0,00	0,00	0,52	86,05	A.C.	610	0	0,000

Grid No:538-94

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
95	1,50	1,50	14			0	0	C	28	28	20	NC	NC	0,00	NC	0,0	0,0	NA
95	3,00	1,50	14			0	0	C	56	41	14	NC	NC	0,00	NC	0,0	0,0	NA
95	4,50	1,50	9	34,8	21,7	13,1	52	C	83	53	7	NC	NC	0,00	NC	1,5	0,0	NA
95	6,00	1,50	9			13,1	52	C	111	66	6	NC	NC	0,00	NC	1,5	0,0	NA
95	7,50	1,50	16			13,1	52	C	139	79	10	NC	NC	0,00	NC	1,8	0,0	NA
95	9,55	1,50	18			13,1	52	C	177	96	10	NC	NC	0,00	NC	1,3	0,0	NA
	10					13,1	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	376	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	376	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,23	6	0	0	0,00	0,00	0,52	86,05	A.C.	376	0	0,000

Grid No:539-95

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)
22	1,50	4,00	6			0	0	C	28	28	9	NC	NC	0,00	NC	2,3	0,0
22	3,00	4,00	5			0	0	C	56	56	5	NC	NC	0,00	NC	1,5	0,0
22	4,50	4,00	6			0	0	C	83	78	5	NC	NC	0,00	NC	1,5	0,0
22	6,00	4,00	6			0	0	S	111	91	4	9,24	0,71	1,50	100,0	1,5	0,0
22	7,50	4,00	14		NP	0	13	C	139	104	9	NC	NC	0,00	NC	1,5	0,0
22	9,00	4,00	9			0	13	C	167	117	5	NC	NC	0,00	NC	1,3	0,0
22	10,00	4,00	14	30,2	19,3	10,9	39	S	185	125	8	7,24	0,65	1,50	100,0	1,5	0,0
22	12,00	4,00	36			10,9	39	S	222	142	18	2,60	0,57	1,75	13,8	0,0	0,0
22	13,50	4,00	41			10,9	39	S	250	155	19	1,92	0,49	1,50	7,5	0,0	0,0
22	15,00	4,00	50			10,9	39	S	278	168	23	0,93	0,47	1,50	0,4	0,0	0,0
22	16,50	4,00	50			10,9	39	S	305	180	21	1,44	0,49	1,50	1,5	0,0	0,0
22	18,00	4,00	50		NP	0	15	S	333	193	21	2,99	0,51	1,53	25,9	0,0	0,0
22	19,55	4,00	50			0	15	S	362	206	20	1,20	0,26	0,78	40,1	0,0	0,0

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	260	2	7,692
200	312	0	0,000
250	127	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	699	2	2,861

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	29	11,55	0	0	7	27,56	4,16	0,48	86,05	A.C.	699	2	2,861

Grid No:540-22

d_{liq} (m)
NA
NA
NA
6,8
NA
NA
11,0
NA
NA
NA
NA
NA
19,6

100LÜK 2 AC kırığı 150lk işlendi

Grid No:540-22

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
21	1,50	3,20	8			0	0	C	28	28	11	NC	NC	0,00	NC	0,0	0,0	NA
21	3,00	3,20	3			0	0	C	56	56	3	NC	NC	0,00	NC	1,5	0,0	NA
21	4,50	3,20	8			0	0	S	83	70	7	7,20	0,61	1,50	100,0	1,5	0,0	5,3
21	6,00	3,20	6			0	0	S	111	83	4	9,33	0,75	1,50	100,0	1,5	0,0	6,8
21	7,50	3,20	7	37,2	21,0	16,2	70	C	139	96	4	NC	NC	0,00	NC	1,8	0,0	NA
21	9,55	3,20	10	22,4	19,0	3,4	25	S	177	113	6	7,33	0,62	1,25	100,0	1,3	0,0	9,8
	10					3,4	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	625	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	186	0	0,000
Total	811	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	43	4,48	8	0	5	23,85	1,98	0,48	86,05	A.C.	811	0	0,000

Grid No:541-21

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
96	1,50	3,80	7			0	0	C	28	28	10	NC	NC	0,00	NC	2,3	0,0	NA
96	3,00	3,80	6			0	0	C	56	56	6	NC	NC	0,00	NC	1,5	0,0	NA
96	4,50	3,80	45			0	0	S	83	76	37	0,00	0,38	1,50	0,0	0,0	1,5	NA
96	6,00	3,80	41		NP	0	15	S	111	89	29	0,00	0,41	1,50	0,0	0,0	1,5	NA
96	7,50	3,80	38			0	15	S	139	102	24	0,00	0,43	1,50	0,5	0,0	0,0	NA
96	9,00	3,80	42			0	15	S	167	115	24	0,00	0,37	1,25	0,5	0,0	0,0	NA
96	10,00	3,80	32			0	15	S	185	123	18	2,27	0,49	1,50	57,2	0,0	0,0	11,0
96	12,00	3,80	34			0	15	S	222	140	17	3,09	0,58	1,75	63,9	0,0	0,0	12,8
96	13,50	3,80	38		NP	0	23	S	250	153	18	3,07	0,51	1,50	43,8	0,0	0,0	14,3
96	15,00	3,80	41			0	23	S	278	166	18	1,22	0,25	0,75	38,7	0,0	0,0	15,0

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	314	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	314	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
64	8	11,25	4	3	11	9,67	3,42	0,48	86,05	A.C.	314	0	0,000

Grid No:542-96

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
33	1,50	3,50	10	23,8	20,2	3,6	44	C	28	28	14	NC	NC	0,00	NC	0,0	0,0	NA
33	3,00	3,50	14			3,6	44	S	56	56	14	2,53	0,47	1,50	63,3	0,0	0,0	3,8
33	4,50	3,50	6			3,6	44	M	83	73	5	8,40	0,65	1,50	100,0	1,5	0,0	5,3
33	6,00	3,50	6	22,1	18,7	3,4	16	S	111	86	4	9,51	0,77	1,50	100,0	1,5	0,0	6,8
33	7,50	3,50	12			3,4	16	C	139	99	8	NC	NC	0,00	NC	1,8	0,0	NA
33	9,55	3,50	17	26,5	20,4	6,1	66	S	177	116	10	5,04	0,50	1,25	98,3	1,3	0,0	9,8
	10					6,1	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	762	0	0,000
200	0	0	0,000
250	342	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	1104	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	52	5,98	6	0	4	25,48	2,38	0,48	86,05	A.C.	1104	0	0,000

Grid No:543-33

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
6	1,50	3,20	7	45,5	24,2	21,3	90	C	28	28	10	NC	NC	0,00	NC	2,3	0,0	NA
6	3,00	3,20	16			21,3	90	S	56	56	16	NC	NC	0,00	NC	0,0	0,0	NA
6	4,50	3,20	17			21,3	90	S	83	70	14	NC	NC	0,00	NC	0,0	0,0	NA
6	6,00	3,20	15	31,5	19,7	11,8	43	S	111	83	11	5,01	0,55	1,50	98,1	1,5	0,0	6,8
6	7,50	3,20	29			11,8	43	C	139	96	18	NC	NC	0,00	NC	0,0	0,0	NA
6	9,00	3,20	44			11,8	43	S	167	109	26	0,00	0,37	1,25	0,0	0,0	0,0	NA
6	10,00	3,20	50	30,6	19,4	11,2	16	S	185	117	28	0,31	0,44	1,50	0,0	0,0	0,0	NA
6	12,00	3,20	50			11,2	16	S	222	134	25	0,00	0,52	1,75	0,4	0,0	0,0	NA
6	13,50	3,20	50			11,2	16	S	250	147	24	0,36	0,40	1,28	3,0	0,0	0,0	NA
6	14,55	3,20	50			11,2	16	S	269	156	23	0,29	0,17	0,53	6,6	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	300	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	378	0	0,000
Total	678	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
98	14	7,80	4	0	7	5,97	2,44	0,48	86,05	A.C.	678	0	0,000

Grid No:544-6

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)
101	1,50	2,70	10			0	0	C	28	28	14	NC	NC	0,00	NC	0,0
101	2,75	2,70	14			0	0	C	51	50	15	NC	NC	0,00	NC	0,0
101	4,50	2,70	5	26,1	19,7	6,4	44	C	83	65	4	NC	NC	0,00	NC	1,6
101	6,00	2,70	8			6,4	44	C	111	78	6	NC	NC	0,00	NC	1,5
101	7,50	2,70	7			6,4	44	C	139	91	4	NC	NC	0,00	NC	1,8
101	9,55	2,70	9			6,4	44	C	177	108	5	NC	NC	0,00	NC	1,3
	10					6,4	NA					0,00	0,00	0,23	NA	0,2

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	0	0	0,000
250	67	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	314	0	0,000
Total	381	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL max	*PL ave*	*t liq*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,23	6	0	0	0,00	0,00	0,56	86,05	A.C.	381	0	0,000

Grid No:545-101

t_{stiff} (m)	d_{liq} (m)
0,0	NA
0,0	NA
0,0	NA
0,0	NA
0,0	NA
0,0	NA
0,0	NA

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
107	1,50	2,10	13			0	0	S	28	28	19	1,47	0,54	2,25	17,8	0,0	0,0	NA
107	3,00	2,10	14		NP	0	15	S	56	47	14	3,80	0,52	1,50	99,4	0,0	0,0	3,8
107	4,50	2,10	17			0	15	S	83	59	14	3,35	0,53	1,50	99,5	0,0	0,0	5,3
107	6,00	2,10	12			0	15	S	111	72	9	6,56	0,65	1,50	100,0	1,5	0,0	6,8
107	7,50	2,10	15	44,5	23,3	21,2	93	C	139	85	10	NC	NC	0,00	NC	1,8	0,0	NA
107	9,55	2,10	20			21,2	93	C	177	102	11	NC	NC	0,00	NC	0,0	0,0	NA
	10					21,2	NA					NC	NC	0,00	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	198	0	0,000
250	291	0	0,000
300	948	0	0,000
350	159	2	12,578
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	1596	2	1,253

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	45	6,75	4	0	4	15,18	2,23	0,52	86,05	A.C.	1596	2	1,253

Grid No:546-107

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
107	1,50	2,10	13			0	0	S	28	28	19	1,47	0,54	2,25	17,8	0,0	0,0	NA
107	3,00	2,10	14		NP	0	15	S	56	47	14	3,80	0,52	1,50	99,4	0,0	0,0	3,8
107	4,50	2,10	17			0	15	S	83	59	14	3,35	0,53	1,50	99,5	0,0	0,0	5,3
107	6,00	2,10	12			0	15	S	111	72	9	6,56	0,65	1,50	100,0	1,5	0,0	6,8
107	7,50	2,10	15	44,5	23,3	21,2	93	C	139	85	10	NC	NC	0,00	NC	1,8	0,0	NA
107	9,55	2,10	20			21,2	93	C	177	102	11	NC	NC	0,00	NC	0,0	0,0	NA
	10					21,2	NA					NC	NC	0,00	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	350	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	224	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	574	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	45	6,75	4	0	4	15,18	2,23	0,52	86,05	A.C.	574	0	0,000

Grid No:547-107

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
104	3,00	2,10	36			0	0	S	56	47	36	0,00	0,86	3,75	0,0	0,0	3,8	NA
104	4,50	2,10	42			0	0	S	83	59	35	0,00	0,42	1,50	0,0	0,0	1,5	NA
104	6,00	2,10	48	26,9	20,5	6,4	35	S	111	72	34	0,00	0,42	1,50	0,0	0,0	1,5	NA
104	7,50	2,10	49			6,4	35	S	139	85	31	0,00	0,51	1,78	0,0	0,0	1,8	NA
104	9,55	2,10	50			6,4	35	S	177	102	28	0,00	0,31	1,03	0,0	0,0	0,0	NA
104						NA	35					NC	NC	0,00	NC	0,2	0,0	NA
	10					NA	NA					NC	NC	0,00	NA	5,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	334	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	64	1	15,623
400	199	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	597	1	1,675

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	9,55	5	9	0	0,00	2,52	0,52	86,05	A.C.	597	1	1,675

Grid No:548-104

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
103	1,90	3,70	6			0	0	C	35	35	8	NC	NC	0,00	NC	2,5	0,0	NA
103	3,00	3,70	8	29,0	19,2	9,8	62	C	56	56	8	NC	NC	0,00	NC	1,3	0,0	NA
103	4,50	3,70	11			9,8	62	C	83	75	9	NC	NC	0,00	NC	1,5	0,0	NA
103	6,00	3,70	5			9,8	62	C	111	88	4	NC	NC	0,00	NC	1,5	0,0	NA
103	7,50	3,70	10			9,8	62	C	139	101	6	NC	NC	0,00	NC	1,8	0,0	NA
103	9,55	3,70	13	23,3	19,7	3,6	77	C	177	118	7	NC	NC	0,00	NC	1,3	0,0	NA
	10					3,6	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	370	0	0,000
200	0	0	0,000
250	385	0	0,000
300	230	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	985	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,23	10	0	0	0,00	0,00	0,52	86,05	A.C.	985	0	0,000

Grid No:549-103

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
106	1,50	0,80	20	22,5	19,3	3,2	17	S	28	21	28	0,00	0,56	2,25	0,0	0,0	0,0	NA
106	3,00	0,80	15			3,2	17	S	56	34	15	3,66	0,55	1,50	100,0	0,0	0,0	3,8
106	4,50	0,80	7			3,2	17	C	83	46	6	NC	NC	0,00	NC	1,5	0,0	NA
106	6,00	0,80	7	22,7	19,1	3,6	80	C	111	59	5	NC	NC	0,00	NC	1,5	0,0	NA
106	7,50	0,80	25			3,6	80	C	139	72	16	NC	NC	0,00	NC	0,0	0,0	NA
106	9,55	0,80	22			3,6	80	C	177	89	12	NC	NC	0,00	NC	0,0	0,0	NA
	10					3,6	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	248	0	0,000
200	111	0	0,000
250	0	0	0,000
300	249	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	608	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	14	3,98	3	0	4	3,66	1,11	0,52	86,05	A.C.	608	0	0,000

Grid No:550-106

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
102	1,90	4,00	10			0	0	C	35	35	13	NC	NC	0,00	NC	0,0	0,0	NA
102	3,00	4,00	7			0	0	C	56	56	7	NC	NC	0,00	NC	1,3	0,0	NA
102	4,50	4,00	7	41,0	22,1	18,9	86	S	83	78	6	NC	NC	0,00	NC	1,5	0,0	NA
102	6,00	4,00	10			18,9	86	C	111	91	7	NC	NC	0,00	NC	1,5	0,0	NA
102	7,50	4,00	15	36,9	20,5	16,4	84	C	139	104	10	NC	NC	0,00	NC	1,8	0,0	NA
102	9,55	4,00	16			16,4	84	C	177	121	9	NC	NC	0,00	NC	1,3	0,0	NA
	10					16,4	NA					NC	NC	0,00	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	212	0	0,000
200	104	0	0,000
250	282	0	0,000
300	92	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	690	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,00	8	0	0	0,00	0,00	0,48	86,05	A.C.	690	0	0,000

Grid No:551-102

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
102	1,90	4,00	10			0	0	C	35	35	13	NC	NC	0,00	NC	0,0	0,0	NA
102	3,00	4,00	7			0	0	C	56	56	7	NC	NC	0,00	NC	1,3	0,0	NA
102	4,50	4,00	7	41,0	22,1	18,9	86	S	83	78	6	NC	NC	0,00	NC	1,5	0,0	NA
102	6,00	4,00	10			18,9	86	C	111	91	7	NC	NC	0,00	NC	1,5	0,0	NA
102	7,50	4,00	15	36,9	20,5	16,4	84	C	139	104	10	NC	NC	0,00	NC	1,8	0,0	NA
102	9,55	4,00	16			16,4	84	C	177	121	9	NC	NC	0,00	NC	1,3	0,0	NA
	10					16,4	NA					NC	NC	0,00	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	449	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	449	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
0	0	0,00	8	0	0	0,00	0,00	0,48	86,05	A.C.	449	0	0,000

Grid No:552-102

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
110	1,50	1,00	11		NP	0	14	S	28	23	16	2,29	0,61	2,25	65,4	0,0	0,0	2,3
110	3,00	1,00	11			0	14	S	56	36	11	5,43	0,61	1,50	100,0	0,0	0,0	3,8
110	4,50	1,00	14			0	14	C	83	48	12	NC	NC	0,00	NC	0,0	0,0	NA
110	6,00	1,00	10			0	14	C	111	61	7	NC	NC	0,00	NC	1,5	0,0	NA
110	7,50	1,00	10			0	14	C	139	74	6	NC	NC	0,00	NC	1,8	0,0	NA
110	9,55	1,00	13			0	14	C	177	91	7	NC	NC	0,00	NC	1,3	0,0	NA
	10					0	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	597	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	597	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	24	3,98	5	0	2	7,72	1,21	0,52	86,05	A.C.	597	0	0,000

Grid No:553-110

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
113	1,50	0,30	14			0	0	C	28	16	20	NC	NC	0,00	NC	0,0	0,0	NA
113	3,00	0,30	16			0	0	C	56	29	16	NC	NC	0,00	NC	0,0	0,0	NA
113	4,50	0,30	16			0	0	C	83	41	13	NC	NC	0,00	NC	0,0	0,0	NA
113	6,00	0,30	3			0	0	C	111	54	2	NC	NC	0,00	NC	1,5	0,0	NA
113	7,50	0,30	8			0	0	C	139	67	5	NC	NC	0,00	NC	1,8	0,0	NA
113	9,55	0,30	12			0	0	C	177	84	7	NC	NC	0,00	NC	1,3	0,0	NA
	10					0	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	404	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	404	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,23	5	0	0	0,00	0,00	0,52	86,05	A.C.	404	0	0,000

Grid No:554-113

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
112	1,50	0,50	19			0	0	S	28	18	27	0,00	0,58	2,25	0,9	0,0	0,0	NA
112	3,00	0,50	8			0	0	C	56	31	8	NC	NC	0,00	NC	1,4	0,0	NA
112	4,30	0,50	9			0	0	C	80	42	8	NC	NC	0,00	NC	1,5	0,0	NA
112	6,00	0,50	7	46,4	23,8	22,6	72	C	111	56	5	NC	NC	0,00	NC	1,6	0,0	NA
112	7,50	0,50	8			22,6	72	C	139	69	5	NC	NC	0,00	NC	1,8	0,0	NA
112	9,55	0,50	7			22,6	72	C	177	86	4	NC	NC	0,00	NC	1,3	0,0	NA
	10					22,6	NA					NC	NC	0,00	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	606	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	606	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
1	0	2,25	8	0	0	0,00	0,58	0,52	86,05	A.C.	606	0	0,000

Grid No:555-112

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
110	1,50	1,00	11		NP	0	14	S	28	23	16	2,29	0,61	2,25	65,4	0,0	0,0	2,3
110	3,00	1,00	11			0	14	S	56	36	11	5,43	0,61	1,50	100,0	0,0	0,0	3,8
110	4,50	1,00	14			0	14	C	83	48	12	NC	NC	0,00	NC	0,0	0,0	NA
110	6,00	1,00	10			0	14	C	111	61	7	NC	NC	0,00	NC	1,5	0,0	NA
110	7,50	1,00	10			0	14	C	139	74	6	NC	NC	0,00	NC	1,8	0,0	NA
110	9,55	1,00	13			0	14	C	177	91	7	NC	NC	0,00	NC	1,3	0,0	NA
	10					0	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	435	0	0,000
200	83	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	518	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL max	*PL ave*	*t liq*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	24	3,98	5	0	2	7,72	1,21	0,52	86,05	A.C.	518	0	0,000

Grid No:556-110

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
111	1,50	0,80	14			0	0	C	28	21	20	NC	NC	0,00	NC	0,0	0,0	NA
111	3,50	0,80	9	38,5	22,1	16,4	59	C	65	38	8	NC	NC	0,00	NC	1,5	0,0	NA
111	4,50	0,80	10			16,4	59	C	83	46	8	NC	NC	0,00	NC	1,3	0,0	NA
111	6,00	0,80	4			16,4	59	C	111	59	3	NC	NC	0,00	NC	1,5	0,0	NA
111	7,50	0,80	14			16,4	59	C	139	72	9	NC	NC	0,00	NC	1,8	0,0	NA
111	9,55	0,80	16			16,4	59	C	177	89	9	NC	NC	0,00	NC	1,3	0,0	NA
	10					16,4	NA					NC	NC	0,00	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	30	0	0,000
200	402	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	432	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,00	8	0	0	0,00	0,00	0,52	86,05	A.C.	432	0	0,000

Grid No:557-111

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
111	1,50	0,80	14			0	0	C	28	21	20	NC	NC	0,00	NC	0,0	0,0	NA
111	3,50	0,80	9	38,5	22,1	16,4	59	C	65	38	8	NC	NC	0,00	NC	1,5	0,0	NA
111	4,50	0,80	10			16,4	59	C	83	46	8	NC	NC	0,00	NC	1,3	0,0	NA
111	6,00	0,80	4			16,4	59	C	111	59	3	NC	NC	0,00	NC	1,5	0,0	NA
111	7,50	0,80	14			16,4	59	C	139	72	9	NC	NC	0,00	NC	1,8	0,0	NA
111	9,55	0,80	16			16,4	59	C	177	89	9	NC	NC	0,00	NC	1,3	0,0	NA
	10					16,4	NA					NC	NC	0,00	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	169	0	0,000
200	367	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	536	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,00	8	0	0	0,00	0,00	0,52	86,05	A.C.	536	0	0,000

Grid No:558-111

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
111	1,50	0,80	14			0	0	C	28	21	20	NC	NC	0,00	NC	0,0	0,0	NA
111	3,50	0,80	9	38,5	22,1	16,4	59	C	65	38	8	NC	NC	0,00	NC	1,5	0,0	NA
111	4,50	0,80	10			16,4	59	C	83	46	8	NC	NC	0,00	NC	1,3	0,0	NA
111	6,00	0,80	4			16,4	59	C	111	59	3	NC	NC	0,00	NC	1,5	0,0	NA
111	7,50	0,80	14			16,4	59	C	139	72	9	NC	NC	0,00	NC	1,8	0,0	NA
111	9,55	0,80	16			16,4	59	C	177	89	9	NC	NC	0,00	NC	1,3	0,0	NA
	10					16,4	NA					NC	NC	0,00	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	415	0	0,000
200	111	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	526	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,00	8	0	0	0,00	0,00	0,52	86,05	A.C.	526	0	0,000

Grid No:559-111

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
106	1,50	0,80	20	22,5	19,3	3,2	17	S	28	21	28	0,00	0,56	2,25	0,0	0,0	0,0	NA
106	3,00	0,80	15			3,2	17	S	56	34	15	3,66	0,55	1,50	100,0	0,0	0,0	3,8
106	4,50	0,80	7			3,2	17	C	83	46	6	NC	NC	0,00	NC	1,5	0,0	NA
106	6,00	0,80	7	22,7	19,1	3,6	80	C	111	59	5	NC	NC	0,00	NC	1,5	0,0	NA
106	7,50	0,80	25			3,6	80	C	139	72	16	NC	NC	0,00	NC	0,0	0,0	NA
106	9,55	0,80	22			3,6	80	C	177	89	12	NC	NC	0,00	NC	0,0	0,0	NA
	10					3,6	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	382	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	382	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	14	3,98	3	0	4	3,66	1,11	0,52	86,05	A.C.	382	0	0,000

Grid No:560-106

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
113	1,50	0,30	14			0	0	C	28	16	20	NC	NC	0,00	NC	0,0	0,0	NA
113	3,00	0,30	16			0	0	C	56	29	16	NC	NC	0,00	NC	0,0	0,0	NA
113	4,50	0,30	16			0	0	C	83	41	13	NC	NC	0,00	NC	0,0	0,0	NA
113	6,00	0,30	3			0	0	C	111	54	2	NC	NC	0,00	NC	1,5	0,0	NA
113	7,50	0,30	8			0	0	C	139	67	5	NC	NC	0,00	NC	1,8	0,0	NA
113	9,55	0,30	12			0	0	C	177	84	7	NC	NC	0,00	NC	1,3	0,0	NA
	10					0	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	807	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	807	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,23	5	0	0	0,00	0,00	0,52	86,05	A.C.	807	0	0,000

Grid No:561-113

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
112	1,50	0,50	19			0	0	S	28	18	27	0,00	0,58	2,25	0,9	0,0	0,0	NA
112	3,00	0,50	8			0	0	C	56	31	8	NC	NC	0,00	NC	1,4	0,0	NA
112	4,30	0,50	9			0	0	C	80	42	8	NC	NC	0,00	NC	1,5	0,0	NA
112	6,00	0,50	7	46,4	23,8	22,6	72	C	111	56	5	NC	NC	0,00	NC	1,6	0,0	NA
112	7,50	0,50	8			22,6	72	C	139	69	5	NC	NC	0,00	NC	1,8	0,0	NA
112	9,55	0,50	7			22,6	72	C	177	86	4	NC	NC	0,00	NC	1,3	0,0	NA
	10					22,6	NA					NC	NC	0,00	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	631	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	631	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
1	0	2,25	8	0	0	0,00	0,58	0,52	86,05	A.C.	631	0	0,000

Grid No:564-112

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
114	1,50	1,30	10			0	0	S	28	26	14	3,71	0,57	2,25	84,8	0,0	0,0	2,3
114	3,00	1,30	13	31,5	20,2	11,3	17	S	56	39	13	4,34	0,57	1,50	100,0	0,0	0,0	3,8
114	4,50	1,30	13			11,3	17	S	83	51	11	5,17	0,61	1,50	100,0	1,5	0,0	5,3
114	6,00	1,30	10			11,3	17	C	111	64	7	NC	NC	0,00	NC	1,5	0,0	NA
114	7,50	1,30	9			11,3	17	C	139	77	6	NC	NC	0,00	NC	1,8	0,0	NA
114	9,55	1,30	11			11,3	17	C	177	94	6	NC	NC	0,00	NC	1,3	0,0	NA
	10					11,3	NA					0,00	0,00	0,23	NA	0,2	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	459	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	459	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	41	5,48	6	0	2	13,22	1,75	0,52	86,05	A.C.	459	0	0,000

Grid No:565-114

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq}(m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
0						0	0					#NUM!	#NUM!	#NUM!	NA	0,0	0,0	NA
0						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
0						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
0						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
0						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
0						NA	NA					NC	NC	0,00	NA	5,0	0,0	NA
	10					NA	NA					NC	NC	0,00	NA	5,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA
						NA	NA					NC	NC	0,00	NA	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	229	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	229	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0,00	0,00	#NUM!	10	0	0	#NUM!	#NUM!	0,52	86,05	A.C.	229	0	0,000

Grid No:568-NA

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
1	1,50	4,50	39			0	15	D	28	28	56	NC	NC	0,00	0,0	0,0	2,3	NA
1	3,00	4,50	6			0	15	C	56	56	6	NC	NC	0,00	NC	1,5	0,0	NA
1	4,50	4,50	6			0	15	C	83	83	5	NC	NC	0,00	NC	1,5	0,0	NA
1	6,00	4,50	5			0	15	C	111	96	4	NC	NC	0,00	NC	1,5	0,0	NA
1	7,50	4,50	11			0	15	C	139	109	7	NC	NC	0,00	NC	1,5	0,0	NA
1	9,00	4,50	10	41,1	22,4	18,7	78	C	167	122	6	NC	NC	0,00	NC	1,5	0,0	NA
1	10,50	4,50	19			18,7	78	C	194	134	10	NC	NC	0,00	NC	1,5	0,0	NA
1	12,00	4,50	26	30,2	20,0	10,2	34	S	222	147	13	4,62	0,56	1,50	92,0	0,0	0,0	12,8
1	13,50	4,50	50			10,2	34	C	250	160	24	NC	NC	0,00	NC	0,0	0,0	NA
1	15,00	4,50	50			10,2	34	C	278	173	23	NC	NC	0,00	NC	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	0	0	No pipe

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
92	0	1,50	9	2	13	4,62	0,56	0,52	86,05	A.C.	0	0	No pipe

Grid No:625-1E

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
1	1,50	4,50	39			0	0	D	28	28	56	NC	NC	0,00	0,0	0,0	2,3	NA
1	3,00	4,50	6			0	0	C	56	56	6	NC	NC	0,00	NC	1,5	0,0	NA
1	4,50	4,50	6			0	0	C	83	83	5	NC	NC	0,00	NC	1,5	0,0	NA
1	6,00	4,50	5			0	0	C	111	96	4	NC	NC	0,00	NC	1,5	0,0	NA
1	7,50	4,50	11			0	0	C	139	109	7	NC	NC	0,00	NC	1,5	0,0	NA
1	9,00	4,50	10	41,1	22,4	18,7	78	C	167	122	6	NC	NC	0,00	NC	1,5	0,0	NA
1	10,50	4,50	19			18,7	78	C	194	134	10	NC	NC	0,00	NC	1,5	0,0	NA
1	12,00	4,50	26	30,2	20,0	10,2	34	S	222	147	13	4,62	0,56	1,50	92,0	0,0	0,0	12,8
1	13,50	4,50	50			10,2	34	C	250	160	24	NC	NC	0,00	NC	0,0	0,0	NA
1	15,00	4,50	50			10,2	34	C	278	173	23	NC	NC	0,00	NC	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	465	1	2,150
200	115	0	0,000
250	0	0	0,000
300	141	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	721	1	1,387

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
92	0	1,50	9	2	13	4,62	0,56	0,52	86,05	A.C.	721	1	1,387

Grid No:626-1E

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
1	1,50	4,50	39			0	0	D	28	28	56	NC	NC	0,00	0,0	0,0	2,3	NA
1	3,00	4,50	6			0	0	C	56	56	6	NC	NC	0,00	NC	1,5	0,0	NA
1	4,50	4,50	6			0	0	C	83	83	5	NC	NC	0,00	NC	1,5	0,0	NA
1	6,00	4,50	5			0	0	C	111	96	4	NC	NC	0,00	NC	1,5	0,0	NA
1	7,50	4,50	11			0	0	C	139	109	7	NC	NC	0,00	NC	1,5	0,0	NA
1	9,00	4,50	10	41,1	22,4	18,7	78	C	167	122	6	NC	NC	0,00	NC	1,5	0,0	NA
1	10,50	4,50	19			18,7	78	C	194	134	10	NC	NC	0,00	NC	1,5	0,0	NA
1	12,00	4,50	26	30,2	20,0	10,2	34	S	222	147	13	4,62	0,56	1,50	92,0	0,0	0,0	12,8
1	13,50	4,50	50			10,2	34	C	250	160	24	NC	NC	0,00	NC	0,0	0,0	NA
1	15,00	4,50	50			10,2	34	C	278	173	23	NC	NC	0,00	NC	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	360	0	0,000
200	315	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	675	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
92	0	1,50	9	2	13	4,62	0,56	0,52	86,05	A.C.	675	0	0,000

Grid No:627-1E

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
1	1,50	4,50	39			0	0	D	28	28	56	NC	NC	0,00	0,0	0,0	2,3	NA
1	3,00	4,50	6			0	0	C	56	56	6	NC	NC	0,00	NC	1,5	0,0	NA
1	4,50	4,50	6			0	0	C	83	83	5	NC	NC	0,00	NC	1,5	0,0	NA
1	6,00	4,50	5			0	0	C	111	96	4	NC	NC	0,00	NC	1,5	0,0	NA
1	7,50	4,50	11			0	0	C	139	109	7	NC	NC	0,00	NC	1,5	0,0	NA
1	9,00	4,50	10	41,1	22,4	18,7	78	C	167	122	6	NC	NC	0,00	NC	1,5	0,0	NA
1	10,50	4,50	19			18,7	78	C	194	134	10	NC	NC	0,00	NC	1,5	0,0	NA
1	12,00	4,50	26	30,2	20,0	10,2	34	S	222	147	13	4,62	0,56	1,50	92,0	0,0	0,0	12,8
1	13,50	4,50	50			10,2	34	C	250	160	24	NC	NC	0,00	NC	0,0	0,0	NA
1	15,00	4,50	50			10,2	34	C	278	173	23	NC	NC	0,00	NC	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	358	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	358	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
92	0	1,50	9	2	13	4,62	0,56	0,52	86,05	A.C.	358	0	0,000

Grid No:628-1E

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
77	1,50	1,50	4			0	0	C	28	28	6	NC	NC	0,00	NC	2,5	0,0	NA
77	3,40	1,50	11			0	0	C	63	44	10	NC	NC	0,00	NC	1,5	0,0	NA
77	4,50	1,50	13			0	0	C	83	53	11	NC	NC	0,00	NC	1,6	0,0	NA
77	6,50	1,50	12			0	0	CM	120	70	8	6,86	0,68	1,50	100,0	1,5	0,0	7,0
77	7,50	1,50	16			0	0	CM	139	79	10	5,73	0,62	1,45	100,0	1,5	0,0	8,5
77	9,40	1,50	13			0	0	CM	174	95	7	4,87	0,46	0,95	100,0	1,0	0,0	9,4

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	64	0	0,000
200	0	0	0,000
250	0	0	0,000
300	316	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	380	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
100	43	3,90	9	0	7	17,47	1,76	0,52	86,05	A.C.	380	0	0,000

Grid No:633-77

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
88	1,50	1,10	29			0	0	S	28	24	41	0,00	0,51	2,25	0,0	0,0	2,3	NA
88	3,00	1,10	23	22,1	19,4	2,7	13	S	56	37	23	1,11	0,47	1,50	61,2	0,0	0,0	3,8
88	4,50	1,10	23			2,7	13	S	83	49	19	1,43	0,50	1,50	94,8	0,0	0,0	5,3
88	6,00	1,10	49			2,7	13	S	111	62	35	0,00	0,43	1,50	0,0	0,0	1,5	NA
88	7,50	1,10	43			2,7	13	S	139	75	27	0,00	0,53	1,75	3,3	0,0	0,0	NA
88	9,50	1,10	43			2,7	13	S	176	92	24	0,09	0,32	1,00	20,1	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	0	0	0,000
250	0	0	0,000
300	405	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	405	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
95	26	9,50	0	4	4	2,63	2,76	0,52	86,05	A.C.	405	0	0,000

Grid No:634-88

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
88	1,50	1,10	29			0	0	S	28	24	41	0,00	0,51	2,25	0,0	0,0	2,3	NA
88	3,00	1,10	23	22,1	19,4	2,7	13	S	56	37	23	1,11	0,47	1,50	61,2	0,0	0,0	3,8
88	4,50	1,10	23			2,7	13	S	83	49	19	1,43	0,50	1,50	94,8	0,0	0,0	5,3
88	6,00	1,10	49			2,7	13	S	111	62	35	0,00	0,43	1,50	0,0	0,0	1,5	NA
88	7,50	1,10	43			2,7	13	S	139	75	27	0,00	0,53	1,75	3,3	0,0	0,0	NA
88	9,50	1,10	43			2,7	13	S	176	92	24	0,09	0,32	1,00	20,1	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	595	1	1,681
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	595	1	1,681

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL max	*PL ave*	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
95	26	9,50	0	4	4	2,63	2,76	0,52	86,05	A.C.	595	1	1,681

Grid No:635-88

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
83	1,50	1,80	30		NP	0	20	S	28	28	43	0,00	0,50	2,25	0,0	0,0	2,3	NA
83	3,00	1,80	7			0	20	C	56	44	7	NC	NC	0,00	NC	1,5	0,0	NA
83	4,50	1,80	2			0	20	C	83	56	2	NC	NC	0,00	NC	1,5	0,0	NA
83	6,00	1,80	5			0	20	C	111	69	4	NC	NC	0,00	NC	1,5	0,0	NA
83	7,50	1,80	5	21,8	18,6	3,2	58	C	139	82	3	NC	NC	0,00	NC	1,8	0,0	NA
83	9,55	1,80	6			3,2	58	C	177	99	3	NC	NC	0,00	NC	1,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	562	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	562	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
0	0	2,25	7	2	0	0,00	0,50	0,52	86,05	A.C.	562	0	0,000

Grid No:636-83

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
88	1,50	1,10	29			0	0	S	28	24	41	0,00	0,52	2,25	0,0	0,0	2,3	NA
88	3,00	1,10	23	22,1	19,4	2,7	13	S	56	37	23	1,28	0,48	1,50	73,6	0,0	0,0	3,8
88	4,50	1,10	23			2,7	13	S	83	49	19	1,61	0,51	1,50	97,5	0,0	0,0	5,3
88	6,00	1,10	49			2,7	13	S	111	62	35	0,00	0,43	1,50	0,0	0,0	1,5	NA
88	7,50	1,10	43			2,7	13	S	139	75	27	0,00	0,54	1,75	6,5	0,0	0,0	NA
88	9,50	1,10	43			2,7	13	S	176	92	24	0,20	0,32	1,00	30,0	0,0	0,0	9,5

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	248	0	0,000
200	0	0	0,000
250	0	0	0,000
300	77	0	0,000
350	348	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	673	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
98	30	9,50	0	4	4	3,09	2,82	0,56	86,05	A.C.	673	0	0,000

Grid No:641-88

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
94	1,50	3,10	16			0	0	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
94	3,40	3,10	34			0	0	C	63	60	32	NC	NC	0,00	NC	0,0	1,5	NA
94	4,50	3,10	9			0	0	C	83	69	7	NC	NC	0,00	NC	1,5	0,0	NA
94	6,40	3,10	7			0	0	C	118	85	5	NC	NC	0,00	NC	1,5	0,0	NA
94	7,50	3,10	14	39,6	16,3	23,3	54	C	139	95	9	NC	NC	0,00	NC	1,6	0,0	NA
94	9,55	3,10	17			23,3	54	C	177	112	10	NC	NC	0,00	NC	1,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	452	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	452	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,00	6	2	0	0,00	0,00	0,56	86,05	A.C.	452	0	0,000

Grid No:642-94

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
93	1,50	3,20	7			0	0	CM	28	28	10	7,45	0,71	2,45	99,9	2,5	0,0	2,5
93	3,40	3,20	8			0	0	CM	63	61	8	7,34	0,61	1,50	100,0	1,5	0,0	4,0
93	4,50	3,20	11			0	0	CM	83	70	9	5,21	0,52	1,30	100,0	1,3	0,0	5,3
93	6,00	3,20	14			0	0	CM	111	83	10	5,70	0,60	1,50	100,0	1,5	0,0	6,8
93	7,50	3,20	15	34,6	12,8	21,8	44	C	139	96	10	NC	NC	0,00	NC	1,8	0,0	NA
93	9,50	3,20	21			21,8	44	C	176	113	12	NC	NC	0,00	NC	0,0	0,0	NA

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Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	206	1	4,854
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	206	1	4,854

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	57	6,75	9	0	2	25,70	2,44	0,56	86,05	A.C.	206	1	4,854

Grid No:643-93

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
88	1,50	1,10	29			0	0	S	28	24	41	0,00	0,51	2,25	0,0	0,0	2,3	NA
88	3,00	1,10	23	22,1	19,4	2,7	13	S	56	37	23	1,11	0,47	1,50	61,2	0,0	0,0	3,8
88	4,50	1,10	23			2,7	13	S	83	49	19	1,43	0,50	1,50	94,8	0,0	0,0	5,3
88	6,00	1,10	49			2,7	13	S	111	62	35	0,00	0,43	1,50	0,0	0,0	1,5	NA
88	7,50	1,10	43			2,7	13	S	139	75	27	0,00	0,53	1,75	3,3	0,0	0,0	NA
88	9,50	1,10	43			2,7	13	S	176	92	24	0,09	0,32	1,00	20,1	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	623	1	1,605
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	623	1	1,605

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL max	*PL ave*	*t liq*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
95	26	9,50	0	4	4	2,63	2,76	0,52	86,05	A.C.	623	1	1,605

Grid No:644-88

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
94	1,50	3,10	16			0	0	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
94	3,40	3,10	34			0	0	C	63	60	32	NC	NC	0,00	NC	0,0	1,5	NA
94	4,50	3,10	9			0	0	C	83	69	7	NC	NC	0,00	NC	1,5	0,0	NA
94	6,40	3,10	7			0	0	C	118	85	5	NC	NC	0,00	NC	1,5	0,0	NA
94	7,50	3,10	14	39,6	16,3	23,3	54	C	139	95	9	NC	NC	0,00	NC	1,6	0,0	NA
94	9,55	3,10	17			23,3	54	C	177	112	10	NC	NC	0,00	NC	1,0	0,0	NA

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Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	159	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	159	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,00	6	2	0	0,00	0,00	0,56	86,05	A.C.	159	0	0,000

Grid No:649-94

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
94	1,50	3,10	16			0	0	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
94	3,40	3,10	34			0	0	C	63	60	32	NC	NC	0,00	NC	0,0	1,5	NA
94	4,50	3,10	9			0	0	C	83	69	7	NC	NC	0,00	NC	1,5	0,0	NA
94	6,40	3,10	7			0	0	C	118	85	5	NC	NC	0,00	NC	1,5	0,0	NA
94	7,50	3,10	14	39,6	16,3	23,3	54	C	139	95	9	NC	NC	0,00	NC	1,6	0,0	NA
94	9,55	3,10	17			23,3	54	C	177	112	10	NC	NC	0,00	NC	1,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	502	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	502	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,00	6	2	0	0,00	0,00	0,56	86,05	A.C.	502	0	0,000

Grid No:650-94

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
94	1,50	3,10	16			0	0	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
94	3,40	3,10	34			0	0	C	63	60	32	NC	NC	0,00	NC	0,0	1,5	NA
94	4,50	3,10	9			0	0	C	83	69	7	NC	NC	0,00	NC	1,5	0,0	NA
94	6,40	3,10	7			0	0	C	118	85	5	NC	NC	0,00	NC	1,5	0,0	NA
94	7,50	3,10	14	39,6	16,3	23,3	54	C	139	95	9	NC	NC	0,00	NC	1,6	0,0	NA
94	9,55	3,10	17			23,3	54	C	177	112	10	NC	NC	0,00	NC	1,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	0	0	0,000
250	242	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	242	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,00	6	2	0	0,00	0,00	0,56	86,05	A.C.	242	0	0,000

Grid No:651-94

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
94	1,50	3,10	16			0	0	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
94	3,40	3,10	34			0	0	C	63	60	32	NC	NC	0,00	NC	0,0	1,5	NA
94	4,50	3,10	9			0	0	C	83	69	7	NC	NC	0,00	NC	1,5	0,0	NA
94	6,40	3,10	7			0	0	C	118	85	5	NC	NC	0,00	NC	1,5	0,0	NA
94	7,50	3,10	14	39,6	16,3	23,3	54	C	139	95	9	NC	NC	0,00	NC	1,6	0,0	NA
94	9,55	3,10	17			23,3	54	C	177	112	10	NC	NC	0,00	NC	1,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	485	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	485	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	S	xd	PGA	PGV	P.T.	T.P.L.	T.#.F	T.F.R.
0	0	0,00	6	2	0	0,00	0,00	0,56	86,05	A.C.	485	0	0,000

Grid No:652-94

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
94	1,50	3,10	16			0	0	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
94	3,40	3,10	34			0	0	C	63	60	32	NC	NC	0,00	NC	0,0	1,5	NA
94	4,50	3,10	9			0	0	C	83	69	7	NC	NC	0,00	NC	1,5	0,0	NA
94	6,40	3,10	7			0	0	C	118	85	5	NC	NC	0,00	NC	1,5	0,0	NA
94	7,50	3,10	14	39,6	16,3	23,3	54	C	139	95	9	NC	NC	0,00	NC	1,6	0,0	NA
94	9,55	3,10	17			23,3	54	C	177	112	10	NC	NC	0,00	NC	1,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	481	0	0,000
200	281	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	762	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,00	6	2	0	0,00	0,00	0,56	86,05	A.C.	762	0	0,000

Grid No:657-94

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
125	1,50	1,60	30			0	0	S	28	28	43	0,00	0,50	2,25	0,0	0,0	2,3	NA
125	3,00	1,60	41	21,7	18,9	2,8	14	S	56	42	41	0,00	0,41	1,55	0,0	0,0	1,6	NA
125	4,60	1,60	40			2,8	14	S	85	55	33	0,00	0,43	1,50	0,0	0,0	1,5	NA
125	6,00	1,60	19			2,8	14	S	111	67	14	4,00	0,56	1,45	100,0	0,0	0,0	6,8
125	7,50	1,60	24	27,9	19,3	8,6	41	C	139	80	15	NC	NC	0,00	NC	0,0	0,0	NA
125	9,55	1,60	33			8,6	41	C	177	97	19	NC	NC	0,00	NC	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	253	0	0,000
250	502	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	755	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	14	6,75	0	5	7	4,00	1,91	0,56	86,05	A.C.	755	0	0,000

Grid No:658-125

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
125	1,50	1,60	30			0	0	S	28	28	43	0,00	0,50	2,25	0,0	0,0	2,3	NA
125	3,00	1,60	41	21,7	18,9	2,8	14	S	56	42	41	0,00	0,41	1,55	0,0	0,0	1,6	NA
125	4,60	1,60	40			2,8	14	S	85	55	33	0,00	0,42	1,50	0,0	0,0	1,5	NA
125	6,00	1,60	19			2,8	14	S	111	67	14	3,85	0,54	1,45	99,9	0,0	0,0	6,8
125	7,50	1,60	24	27,9	19,3	8,6	41	C	139	80	15	NC	NC	0,00	NC	0,0	0,0	NA
125	9,55	1,60	33			8,6	41	C	177	97	19	NC	NC	0,00	NC	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	106	0	0,000
200	410	0	0,000
250	55	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	571	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	14	6,75	0	5	7	3,85	1,87	0,52	86,05	A.C.	571	0	0,000

Grid No:659-125

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
94	1,50	3,10	16			0	0	C	28	28	23	NC	NC	0,00	NC	0,0	0,0	NA
94	3,40	3,10	34			0	0	C	63	60	32	NC	NC	0,00	NC	0,0	1,5	NA
94	4,50	3,10	9			0	0	C	83	69	7	NC	NC	0,00	NC	1,5	0,0	NA
94	6,40	3,10	7			0	0	C	118	85	5	NC	NC	0,00	NC	1,5	0,0	NA
94	7,50	3,10	14	39,6	16,3	23,3	54	C	139	95	9	NC	NC	0,00	NC	1,6	0,0	NA
94	9,55	3,10	17			23,3	54	C	177	112	10	NC	NC	0,00	NC	1,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	180	0	0,000
250	49	0	0,000
300	348	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	577	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
0	0	0,00	6	2	0	0,00	0,00	0,52	86,05	A.C.	577	0	0,000

Grid No:660-94

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
125	1,50	1,60	30			0	0	S	28	28	43	0,00	0,50	2,25	0,0	0,0	2,3	NA
125	3,00	1,60	41	21,7	18,9	2,8	14	S	56	42	41	0,00	0,41	1,55	0,0	0,0	1,6	NA
125	4,60	1,60	40			2,8	14	S	85	55	33	0,00	0,42	1,50	0,0	0,0	1,5	NA
125	6,00	1,60	19			2,8	14	S	111	67	14	3,85	0,54	1,45	99,9	0,0	0,0	6,8
125	7,50	1,60	24	27,9	19,3	8,6	41	C	139	80	15	NC	NC	0,00	NC	0,0	0,0	NA
125	9,55	1,60	33			8,6	41	C	177	97	19	NC	NC	0,00	NC	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	0	0	No pipe

PARAMETERS													
Geotechnical								**Earthquake**		**Pipeline**			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	14	6,75	0	5	7	3,85	1,87	0,52	86,05	A.C.	0	0	No pipe

Grid No:661-125

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
125	1,50	1,60	30			0	0	S	28	28	43	0,00	0,50	2,25	0,0	0,0	2,3	NA
125	3,00	1,60	41	21,7	18,9	2,8	14	S	56	42	41	0,00	0,41	1,55	0,0	0,0	1,6	NA
125	4,60	1,60	40			2,8	14	S	85	55	33	0,00	0,42	1,50	0,0	0,0	1,5	NA
125	6,00	1,60	19			2,8	14	S	111	67	14	3,85	0,54	1,45	99,9	0,0	0,0	6,8
125	7,50	1,60	24	27,9	19,3	8,6	41	C	139	80	15	NC	NC	0,00	NC	0,0	0,0	NA
125	9,55	1,60	33			8,6	41	C	177	97	19	NC	NC	0,00	NC	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	321	0	0,000
200	134	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	455	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	*PL_{ave}*	*t_{liq}*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	14	6,75	0	5	7	3,85	1,87	0,52	86,05	A.C.	455	0	0,000

Grid No:663-125

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
125	1,50	1,60	30			0	0	S	28	28	43	0,00	0,50	2,25	0,0	0,0	2,3	NA
125	3,00	1,60	41	21,7	18,9	2,8	14	S	56	42	41	0,00	0,41	1,55	0,0	0,0	1,6	NA
125	4,60	1,60	40			2,8	14	S	85	55	33	0,00	0,43	1,50	0,0	0,0	1,5	NA
125	6,00	1,60	19			2,8	14	S	111	67	14	4,00	0,56	1,45	100,0	0,0	0,0	6,8
125	7,50	1,60	24	27,9	19,3	8,6	41	C	139	80	15	NC	NC	0,00	NC	0,0	0,0	NA
125	9,55	1,60	33			8,6	41	C	177	97	19	NC	NC	0,00	NC	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	155	1	6,451
200	264	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	419	1	2,387

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	14	6,75	0	5	7	4,00	1,91	0,56	86,05	A.C.	419	1	2,387

Grid No:664-125

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
125	1,50	1,60	30			0	0	S	28	28	43	0,00	0,50	2,25	0,0	0,0	2,3	NA
125	3,00	1,60	41	21,7	18,9	2,8	14	S	56	42	41	0,00	0,41	1,55	0,0	0,0	1,6	NA
125	4,60	1,60	40			2,8	14	S	85	55	33	0,00	0,43	1,50	0,0	0,0	1,5	NA
125	6,00	1,60	19			2,8	14	S	111	67	14	4,00	0,56	1,45	100,0	0,0	0,0	6,8
125	7,50	1,60	24	27,9	19,3	8,6	41	C	139	80	15	NC	NC	0,00	NC	0,0	0,0	NA
125	9,55	1,60	33			8,6	41	C	177	97	19	NC	NC	0,00	NC	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	372	0	0,000
200	471	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	843	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	14	6,75	0	5	7	4,00	1,91	0,56	86,05	A.C.	843	0	0,000

Grid No:665-125

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
125	1,50	1,60	30			0	0	S	28	28	43	0,00	0,50	2,25	0,0	0,0	2,3	NA
125	3,00	1,60	41	21,7	18,9	2,8	14	S	56	42	41	0,00	0,41	1,55	0,0	0,0	1,6	NA
125	4,60	1,60	40			2,8	14	S	85	55	33	0,00	0,43	1,50	0,0	0,0	1,5	NA
125	6,00	1,60	19			2,8	14	S	111	67	14	4,00	0,56	1,45	100,0	0,0	0,0	6,8
125	7,50	1,60	24	27,9	19,3	8,6	41	C	139	80	15	NC	NC	0,00	NC	0,0	0,0	NA
125	9,55	1,60	33			8,6	41	C	177	97	19	NC	NC	0,00	NC	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	84	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	84	0	0,000

PARAMETERS													
Geotechnical								**Earthquake**		**Pipeline**			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	14	6,75	0	5	7	4,00	1,91	0,56	86,05	A.C.	84	0	0,000

Grid No:666-125

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
125	1,50	1,60	30			0	0	S	28	28	43	0,00	0,50	2,25	0,0	0,0	2,3	NA
125	3,00	1,60	41	21,7	18,9	2,8	14	S	56	42	41	0,00	0,41	1,55	0,0	0,0	1,6	NA
125	4,60	1,60	40			2,8	14	S	85	55	33	0,00	0,42	1,50	0,0	0,0	1,5	NA
125	6,00	1,60	19			2,8	14	S	111	67	14	3,85	0,54	1,45	99,9	0,0	0,0	6,8
125	7,50	1,60	24	27,9	19,3	8,6	41	C	139	80	15	NC	NC	0,00	NC	0,0	0,0	NA
125	9,55	1,60	33			8,6	41	C	177	97	19	NC	NC	0,00	NC	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	0	0	0,000
200	0	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	0	0	No pipe

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL max	*PL ave*	*t liq*	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	14	6,75	0	5	7	3,85	1,87	0,52	86,05	A.C.	0	0	No pipe

Grid No:667-125

DATA OF GRID

Geotechnical Data

Bore Hole No	d (m)	WT (m)	N_{45}	LL (%)	PL (%)	PI (%)	FC (%)	Soil Type	σ_v (kPa)	σ_v' (kPa)	$N_{1,60}$	S (cm)	xd (cm)	t_{liq} (m)	PL	t_{soft} (m)	t_{stiff} (m)	d_{liq} (m)
125	1,50	1,60	30			0	0	S	28	28	43	0,00	0,50	2,25	0,0	0,0	2,3	NA
125	3,00	1,60	41	21,7	18,9	2,8	14	S	56	42	41	0,00	0,41	1,55	0,0	0,0	1,6	NA
125	4,60	1,60	40			2,8	14	S	85	55	33	0,00	0,42	1,50	0,0	0,0	1,5	NA
125	6,00	1,60	19			2,8	14	S	111	67	14	3,85	0,54	1,45	99,9	0,0	0,0	6,8
125	7,50	1,60	24	27,9	19,3	8,6	41	C	139	80	15	NC	NC	0,00	NC	0,0	0,0	NA
125	9,55	1,60	33			8,6	41	C	177	97	19	NC	NC	0,00	NC	0,0	0,0	NA

Pipeline Data

ϕ (mm)	Total pipe Length (m)	Number of Failures	Failure Rate
150	480	0	0,000
200	133	0	0,000
250	0	0	0,000
300	0	0	0,000
350	0	0	0,000
400	0	0	0,000
450	0	0	0,000
500	0	0	0,000
Total	613	0	0,000

PARAMETERS													
Geotechnical								Earthquake		Pipeline			
PL_{max}	PL_{ave}	t_{liq}	t_{soft}	t_{stiff}	d_{liq}	*S*	*xd*	*PGA*	*PGV*	*P.T.*	*T.P.L.*	*T.#.F*	*T.F.R.*
100	14	6,75	0	5	7	3,85	1,87	0,52	86,05	A.C.	613	0	0,000

Grid No:668-125