Derin Kazıklı Temellerde Yapısal Problemlerin Saptanması ve Çözüm Yöntemleri

İMO ISTANBUL ŞUBESI
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17 ARALIK 2015

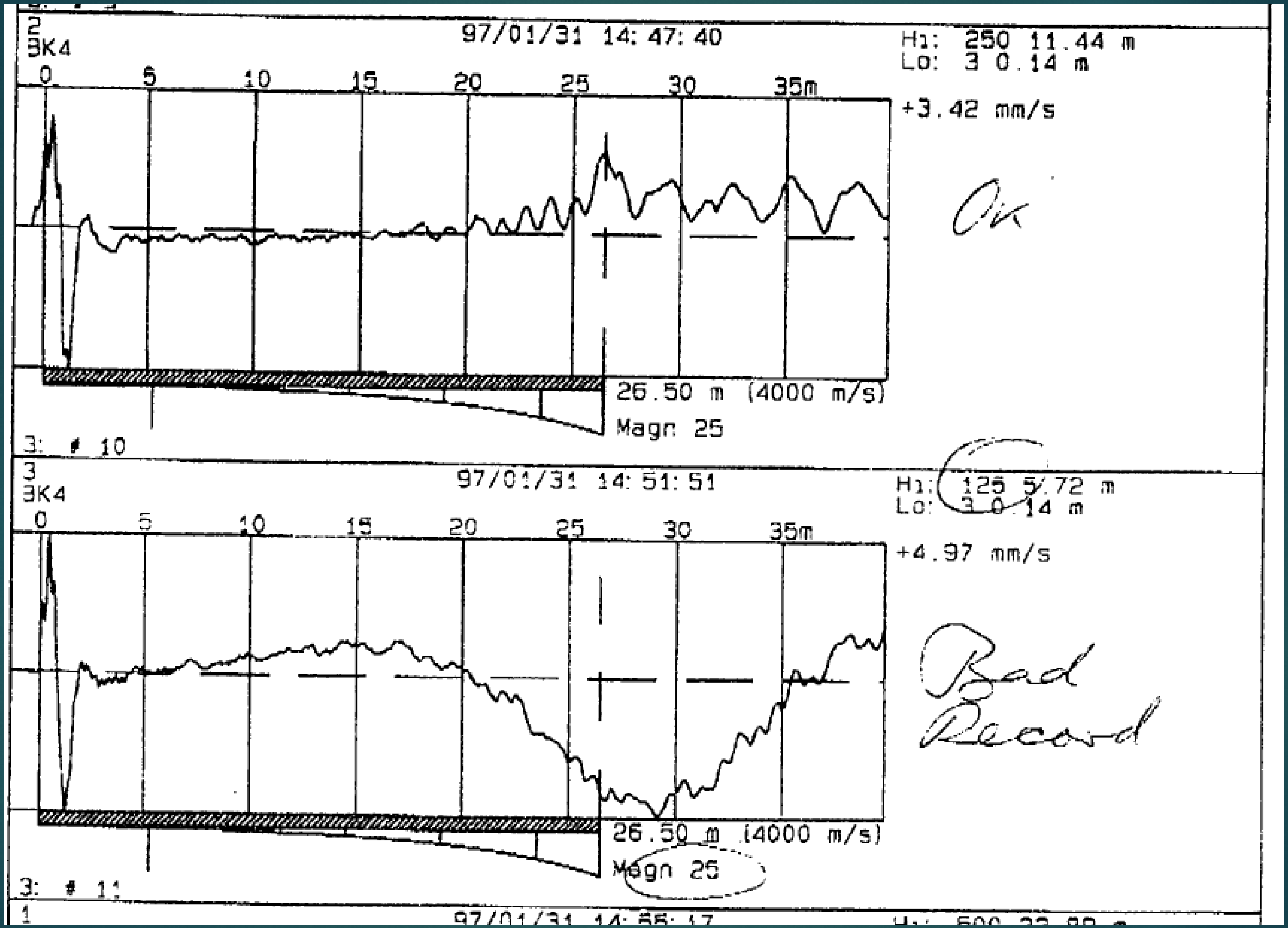
Ana Başlıklar

- Giriş
- Kazık Süreklilik Deneyi / Pile Integrity Testing (PIT)
- Durum Analizi 1
- Karşı Kuyu Sonik Log Deneyi / Cross Hole Sonic Logging Test (CSL)
- Yüksek Şekil Değiştimeli Deneyler / High Strain Testing (CAPWAP)
- Kazık Yükleme Deneyleri (Tahribatlı Yöntemler)
- Durum Analizi 2
- Durum Analizi 3
- Sonuç ve Öneriler

Neden Kazıklı Temellerde Kalite Problemleri Yaşıyoruz?

...ve bunların ne kadarı raporlanıp kayıt altına alınıyor?

Kazık Süreklilik Deneyleri
Pile Integrity Testing (PIT)


2
3K4
97/01/31 14:47:40
Hi: 250 11.44 m
Lo: 3 0.14 m
0 5 10 15 20 25 30 35m
+3.42 mm/s
Ok
26.50 m (4000 m/s)
Magn 25
3: # 10
3
3K4
97/01/31 14:51:51
Hi: 125 5.72 m
Lo: 3 0.14 m
0 5 10 15 20 25 30 35m
+4.97 mm/s
Bad Record
26.50 m (4000 m/s)
Magn 25
3: # 11

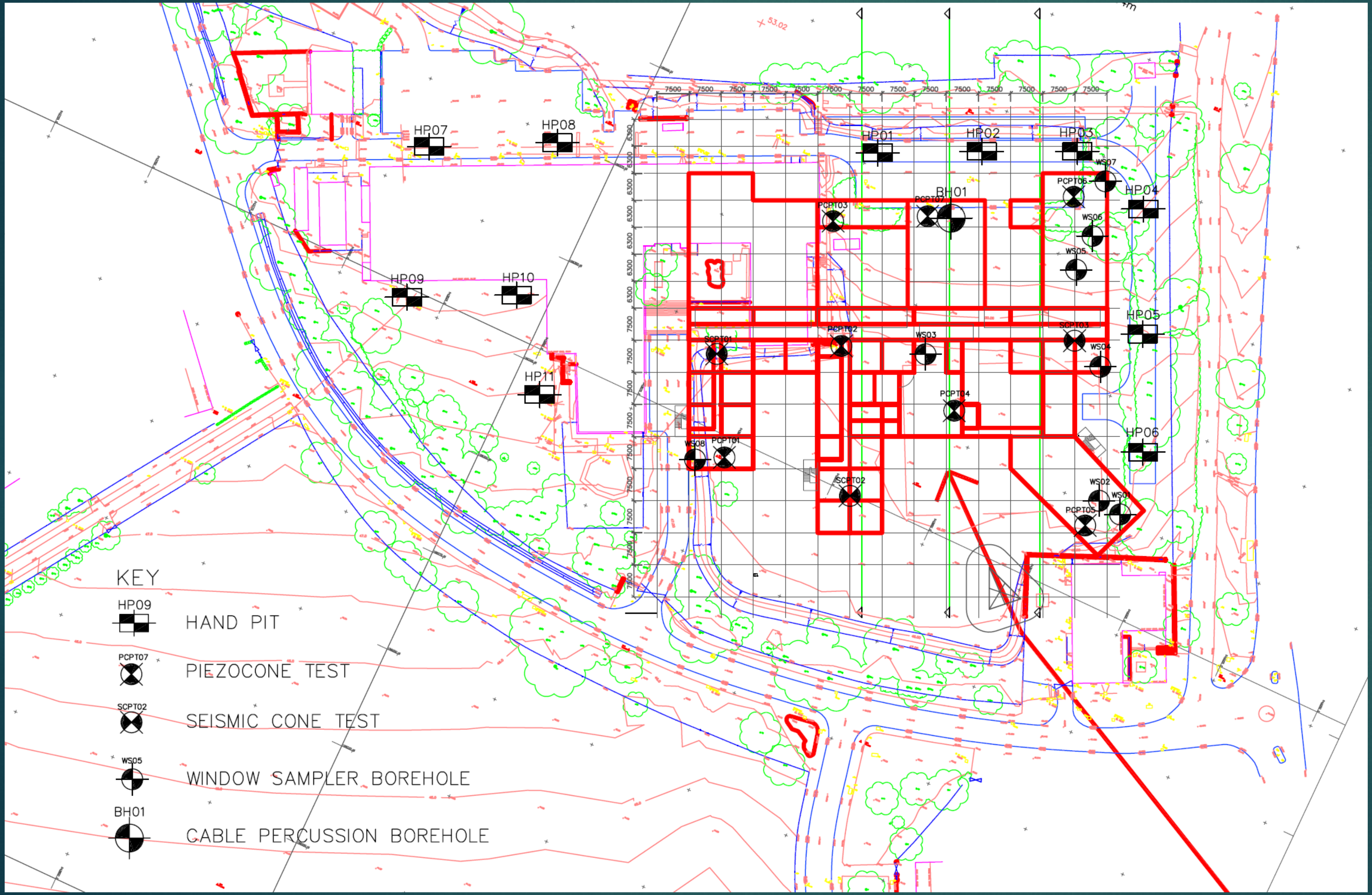
Avantajları:

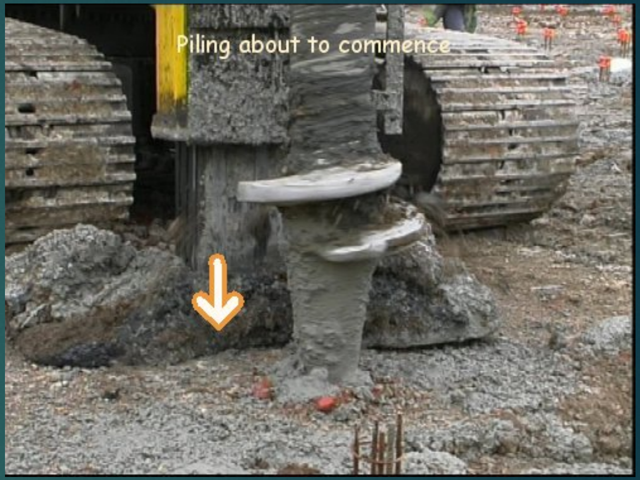
- ✓ Nispeten ekonomik bir test tekniğidir.
- ✓ Kazık başlığında minimum hazırlık yaparak test hızlı bir şekilde gerçekleştirilir.
- ✓ Büyük hatalı bulabilir (kılcal çatlaklar bazen büyük hata olarak gözükebilir).
- ✓ Tamamlanmış yapılarda bazen kazık başlığı dökümünden sonra uygulanabilir.

Dezavantajları:

- ➢ Katı bir beton kesiti gerektirdiğinden daha çok betonarme fore kazıklarda uygulama yapılabilir.
- ➢ Kazık Boy/Çap oranı 40 civarını geçerse ölçümler sağlıklı olmayabilir.
- ➢ Üniform olmayan kazık kesitlerinde yorum yapmak zor olabilir.
- ➢ Problemin kazık kesitinin hangi bölgesine düştüğünü gösteremez.
- ➢ Büyük çaplı kazıklarda sadece bir noktadan ölçüm almak yetmeyebilir.
- ➢ Kazıklar çok yakın olduğunda uygulaması sınırlıdır (iksa projeleri?)

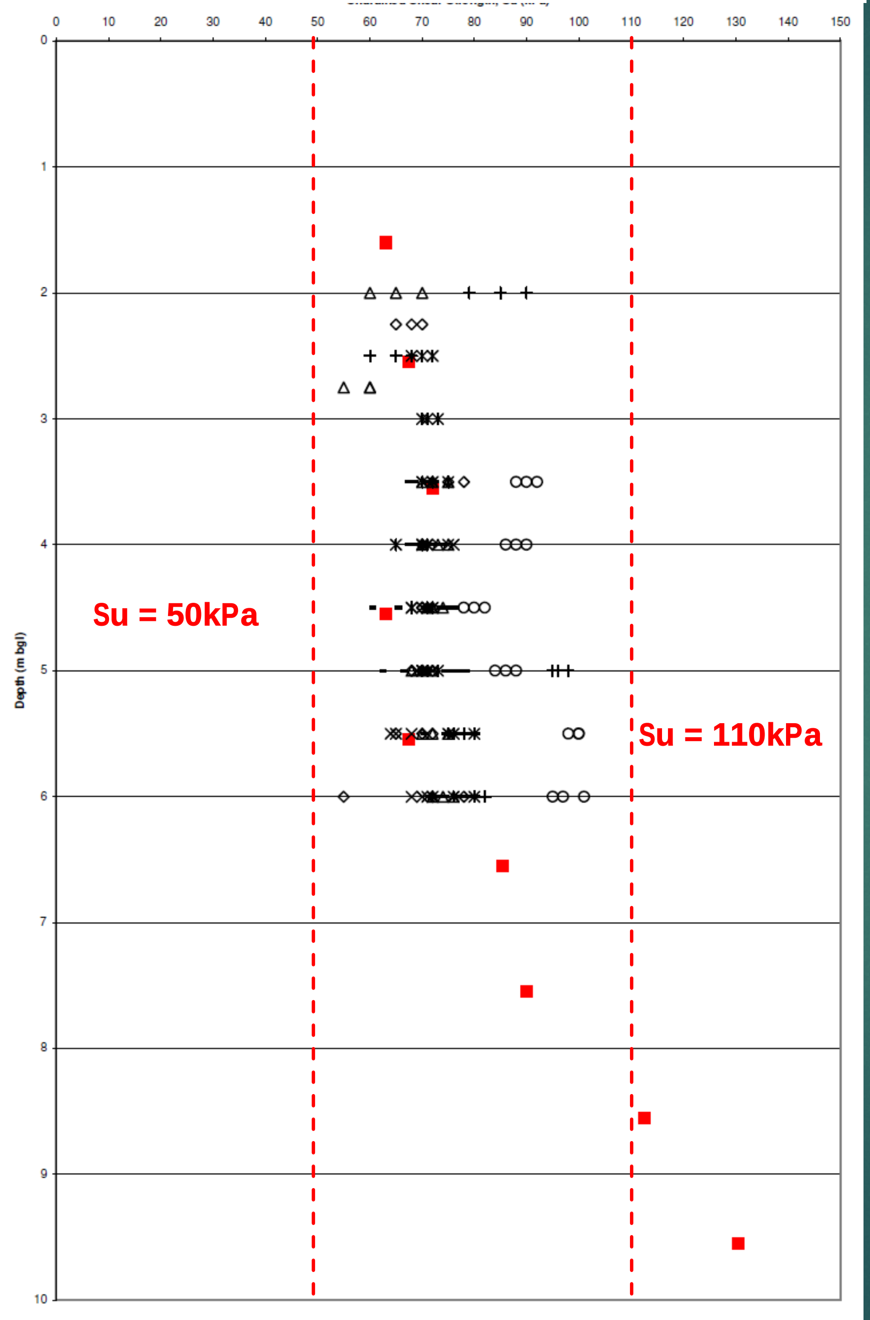
Durum Analiz 1 - PIT Sonuçlarının İncelemesi



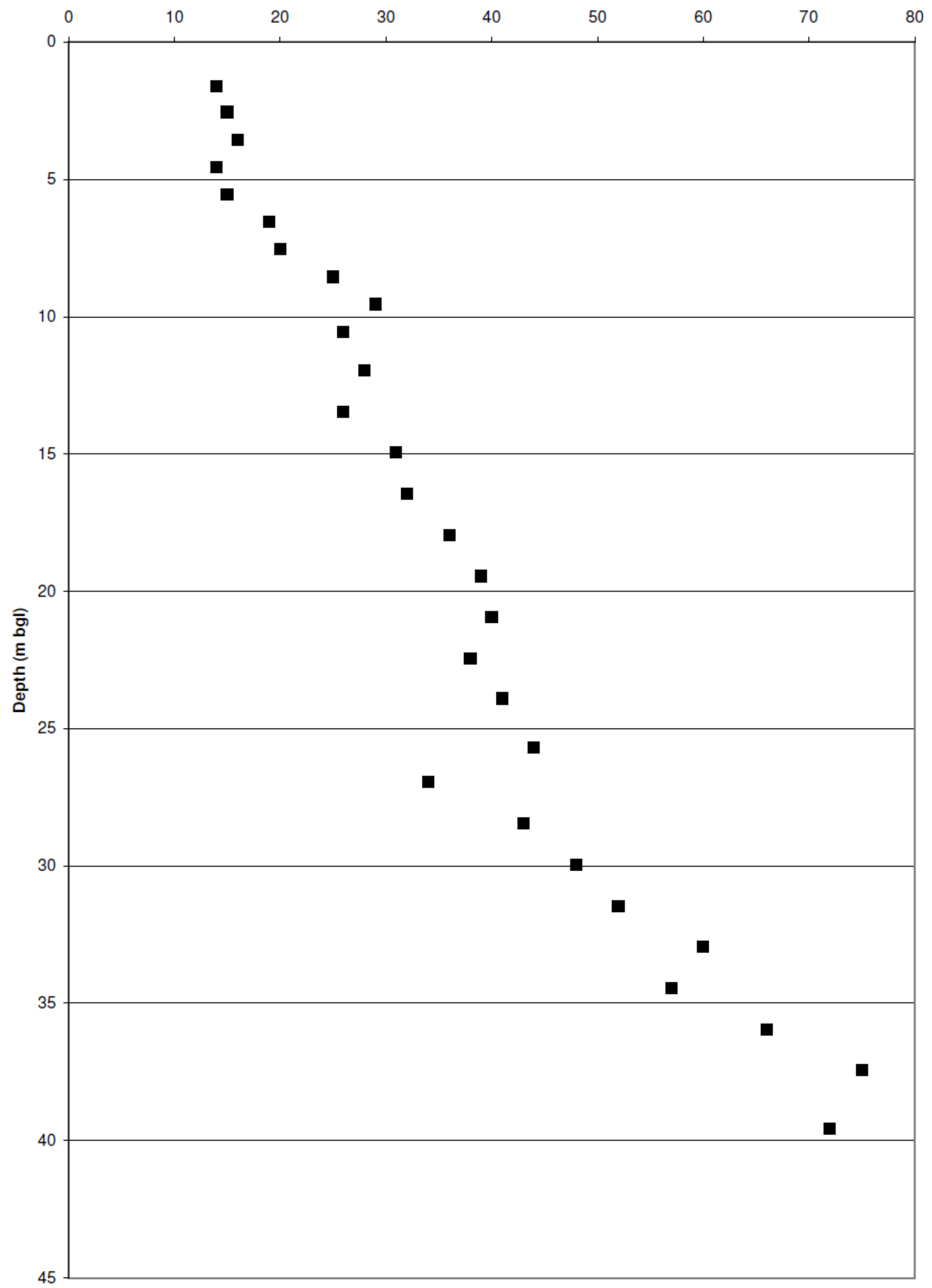


Continuous Helical Displacement (CHD) Kazık Uygulaması (Roger Bullivant)

Drenajsız Kayma Mukavemeti (kPa)



SPT-N Darbe Sayısı



Pile No.	Acoustic Status	TL re PPL (m)	Notes	Data quality	Estimated penetration of test (m)	Depth to 1st anom re TL (m)	Suspected nature of 1st anomaly	Corroboration	Certainty / likely significance of 1st anomaly		Depth to 2nd anom re TL (m)	Suspected nature of 2nd anomaly	Corroboration	Certainty / likely significance of 2nd anomaly		Suggested Actions
4	ANOMALOUS	2.8		med	6.5	6m	fracture	other wall piles known to be fractured at this level.	high	?						Undertake an engineering review of the pile.
5	ANOMALOUS	2.8		med	6.0	6m	fracture	other wall piles known to be fractured at this level.	high	?						Undertake an engineering review of the pile.
Total No. of	New	piles	with	ANOMALOUS		status in this site area is:-			4							
6	OK	2.8		med	9.5											
Total No. of	New	piles	with	OK		status in this site area is:-			1							
Total tests in this area									5							

Summary and Conclusions

Pile Integrity Evaluation Survey Visit No. 26

Piles retested	0	
New piles tested	10	
Total tests	10	
Satisfactory piles	6	(within the defined capabilities of the tests)
Piles requiring actions	4	

PIT ölçümlerini alan firma ile kazık imalatını yapan firma ayrı olmalıdır.

Pile No.	Acoustic Status	TL re PPL (m)	Notes	Data quality	Estimated penetration of test (m)	Depth to 1st anom re TL (m)	Suspected nature of 1st anomaly	Corroboration	Certainty / likely significance of 1st anomaly	Depth to 2nd anom re TL (m)	Suspected nature of 2nd anomaly	prroboration	Certainty / likely significance of 2nd anomaly	Suggested Actions
Site Area Surveyed:			**Low Level**											
New	Piles													
289	OK	1.2		med	8.0									
290	OK	1.2		med	8.0									
291	OK	1.2		med	8.0									
292	OK	1.2		med	8.0									
297	OK	1.2		med	8.0									
298	OK	1.2		med	8.0									
299	OK	1.2		med	8.0									
300	OK	1.2		med	8.0									
428	OK	1.2		med	8.0									
429	OK	1.2		med	8.0									
432	OK	1.2		med	8.0									
433	OK	1.2		med	6.0									
515	OK	1.2		med	8.0									
516	OK	1.2		med	8.0									
Total No. of	New	piles	with	OK		status in this site area is:-			14					
Total tests in this area									14					

Summary and Conclusions

Pile Integrity Evaluation Survey Visit No. 6

Piles retested 0

Pile No.	Acoustic Status	TL re PPL (m)	Notes	Data quality	Estimated penetration of test (m)	Depth to 1st anom re TL (m)	Suspected nature of 1st anomaly	Corroboration	Certainty / likely significance of 1st anomaly		Depth to 2nd anom re TL (m)	Suspected nature of 2nd anomaly	orroboration	Certainty / likely significance of 2nd anomaly		Suggested Actions
120	ANOMALOUS	0.7		med	6.5	6m	fracture	other piles in this area confirmed to contain fractures at this level.	high	?						Undertake an engineering review of the pile construction details to establish the likely nature and significance (if any) of the anomaly.
122	ANOMALOUS	0.7		med	8.5	8m	fracture	other piles in this area confirmed to contain fractures at this level.	high	?						Undertake an engineering review of the pile construction details to establish the likely nature and significance (if any) of the anomaly.
139	ANOMALOUS	0.0		med	6.5	5.5m	fracture	other piles in this area confirmed to contain fractures at this level.	high	?						Undertake an engineering review of the pile construction details to establish the likely nature and significance (if any) of the anomaly.
149	ANOMALOUS	0.7		med	13.0	12m	fracture	other piles in this area confirmed to contain fractures at this level.	high	?						Undertake an engineering review of the pile construction details to establish the likely nature and significance (if any) of the anomaly.
157	ANOMALOUS	0.7		med	13.0	11.5m	fracture	other piles in this area confirmed to contain fractures at this level.	high	?						Undertake an engineering review of the pile construction details to establish the likely nature and significance (if any) of the anomaly.
Total No. of	New	piles	with	ANOMALOUS		status in this site area is:-			7							
156	OK	0.7		med	16.0											
158	OK	0.7		med	14.0											
159	OK	0.7		med	16.0											
160	OK	0.7		med	16.5											
Total No. of	New	piles	with	OK		status in this site area is:-			4							
Total tests in this area									11							

Job No. 6381 **Client Ref.** 7508PilR

Site Name

Site Area Retaining Wall **Pile No.** 157

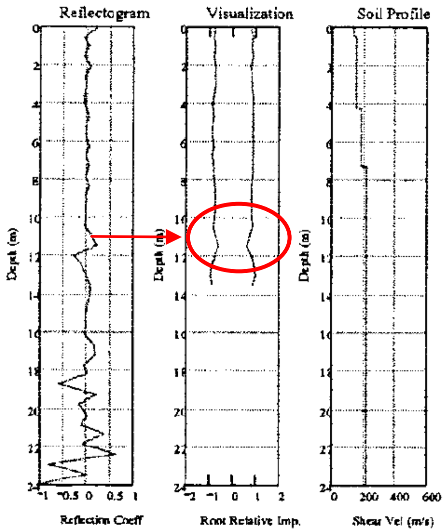
Pile Details

Type	CFA
Bored Length (m)	15 6
Diameter (mm)	600
Steel	6T20 x 5m
Concrete	?

Strata - all levels re PPL

Depth to base (m)	Type	SPT	Vs(m/s)
1.2	made	10	136
5	clay	20	152
8	clay	30	186
	clay	40	215

Test Data



Test Details

Site Visit	7	
Test date	02/05/2007	
Time	13.36	
Engineer		
Test I.D.	35	
Notes	New	
Test level	0.7	(m) below PPL
Data Quality	med	
Pile Age	>7 days	approx.
Pile Bar Vel	4000	(m/s) assumed
Penetration	13	(m) below test level
Pile head Stiffness	0.88	(MN/mm) dynamic

Acoustic Assessment

ANOMALOUS

Engineering Evaluation

Anomaly	Depth	Expected Nature	Corroboration	Certainty	Significance
1	11.5m	fracture	other piles in this area confirmed to contain fractures at this level.	high	?
2					

Suggested Actions

Undertake an engineering review of the pile construction details to establish the likely nature and significance (if any) of the anomaly.

Checked by. N A Pulford 03/05/2007

Job No. 6381 **Client Ref.** 7508PilR

Site Name

Site Area Retaining Wall **Pile No.** 166

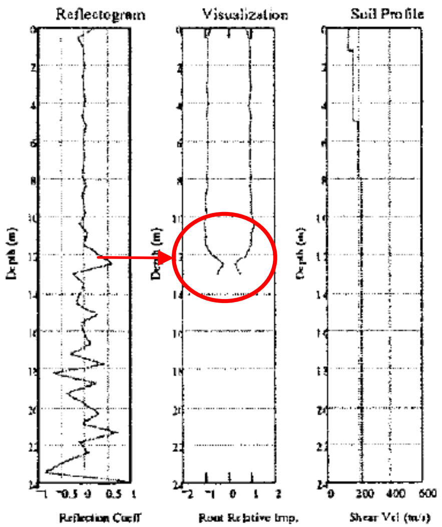
Pile Details

Type	CFA
Bored Length (m)	15 6
Diameter (mm)	600
Steel	6T20 x 6m
Concrete	?

Strata - all levels re PPL

Depth to base (m)	Type	SPT	Vs(m/s)
1.2	made	10	136
5	clay	20	185
8	clay	30	205
	clay	40	215

Test Data



Test Details

Site Visit	2	
Test date	13/04/2007	
Time	11.47	
Engineer		
Test I.D.	46	
Notes	New	
Test level	0.0	(m) below PPL
Data Quality	med	
Pile Age	>7 days	approx.
Pile Bar Vel	4000	(m/s) assumed
Penetration	12.5	(m) below test level
Pile head Stiffness	1.26	(MN/mm) dynamic

Acoustic Assessment

ANOMALOUS

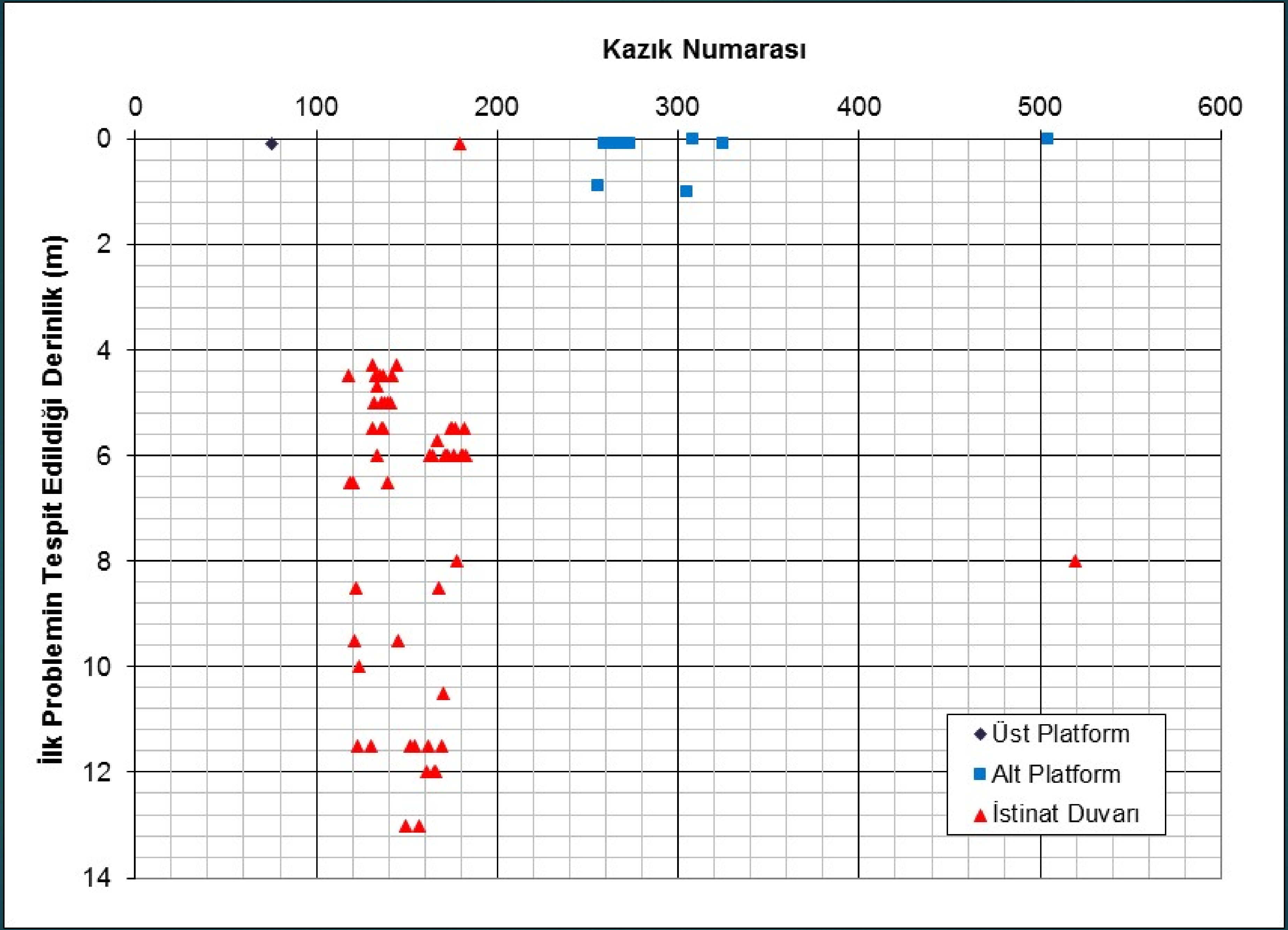
Engineering Evaluation

Anomaly	Depth	Expected Nature	Corroboration	Certainty	Significance
1	12m	mechanical damage fracture	anomaly within clay bore and below base of reinforcing cage	med	?
2					

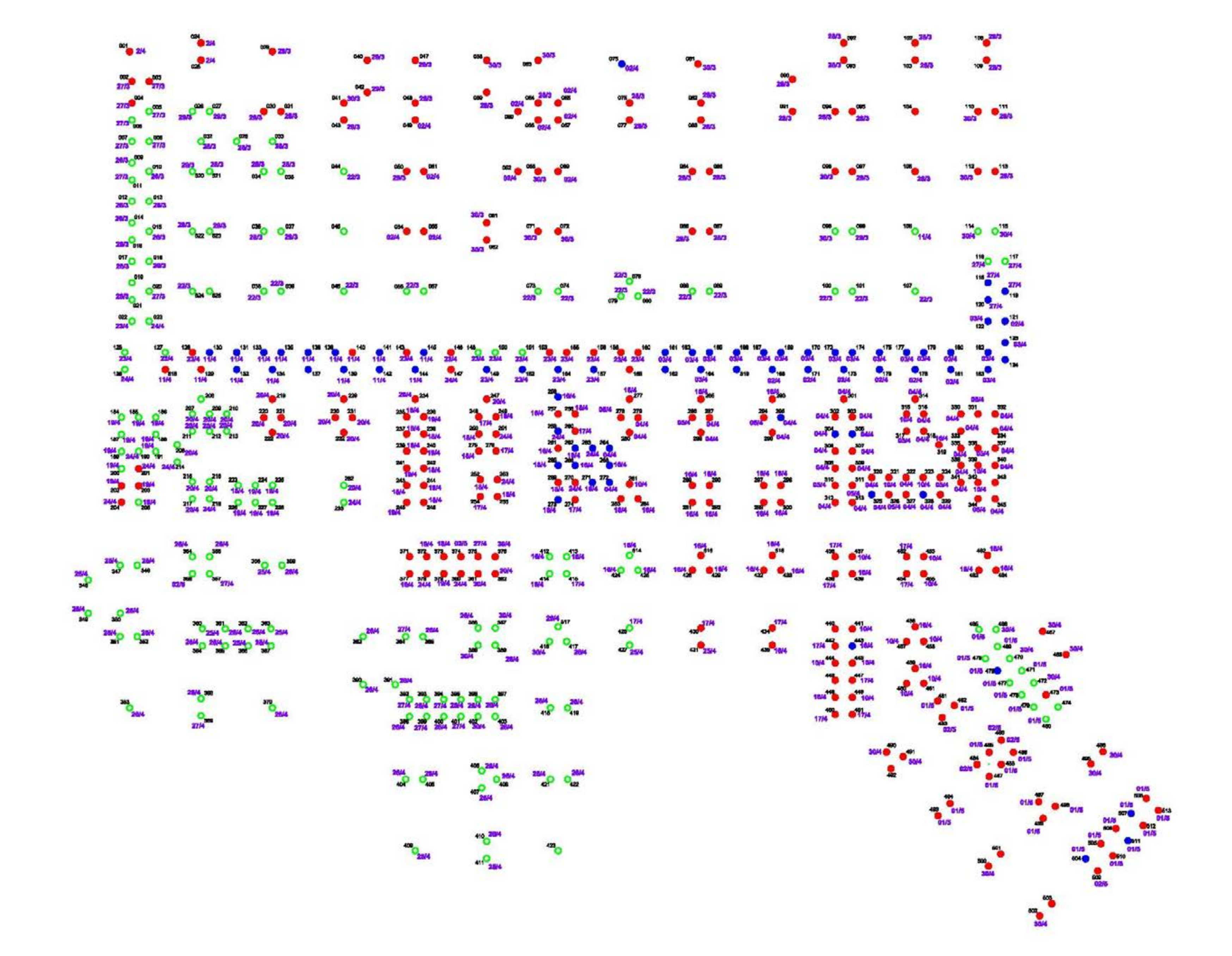
Suggested Actions

Undertake an engineering review of the pile.

Checked by. N A Pulford 13/04/2007



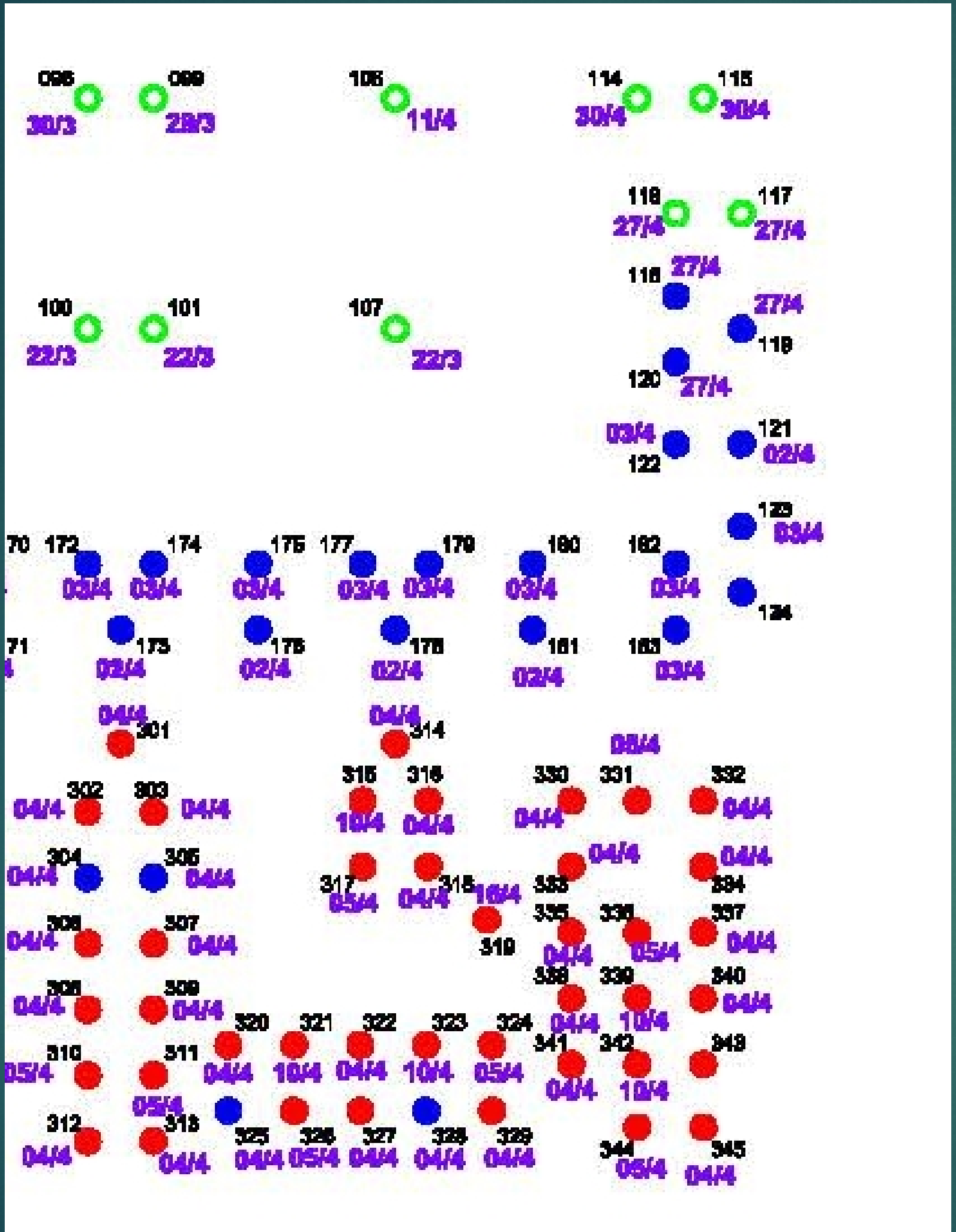
Kazık Numarası
0
100
200
300
400
500
600
0
2
4
6
8
10
12
14
İlk Problemin Tespit Edildiği Derinlik (m)
Üst Platform
Alt Platform
İstinat Duvarı



Problemli Kazıklı Temeller

Problemsiz Kazıklı Temeller

Test Yapılmayan Kazıklar




Problemli Kazıklı Temeller
Problemsiz Kazıklı Temeller
Test Yapılmayan Kazıklar

B.1 Muhafaza borulu veya desteklenmemiş kazılı delme kazıkların inşaası : Genel veri

Müteahhit ________________________________

Kazık tipi ve metodu ______________________

Şantiye ________________________________

Pafta no ________________________

Muhafazalı borulu kazık

Desteksiz kazı __________________

1. Kazık verileri
a) Çap ______________________________ m
b) Dış muhafaza borusu çapı ______________ m
c) Kesme pabucu çapı __________________ m
d) Sondaj matkapı çapı __________________ m
e) Su altında kazı

e) Agrega (En büyük tane büyüklüğü) _________

f) Su çimento oranı W/C ____________________
W = Suyun kütlesi C = Çimentonun kütlesi
g) Beton kimyasal katkılar __________________
% olarak çimento kütlesi __________________
h) Geçiktirici kimyasal katkılar
İşlenebilirlik süresi_______________________

2. Donatı
Pafta no ______________________________
a) Donatı kafesinin yerleştirilmesi
-Betonlamadan önce
-Betonlamadan sonra
b) Aralık verici takoz
-Tip____________________________________
-Adet/ Boyuna aralık m

3. Beton
a) Anma dayanımı ____________________
Kıvam: F/S/superplastisikleştirici
b) Hazır beton
Şantiyede yapılmış beton
c) Çimento tipi (Tedarikçi adı) _____________
d) Çimento miktarı __________________ kg/m^3

4. Betonlama
a) Su altı şartlarında
Kuru şartlarda
b) Betonlama metodu
-Oluklu boru ∅ ________ m
-Pompa hortumu ∅ ________m
-Farklı betonlama metodu
-Tarif _____________________________

c) Kazık tabanının temizlenmesi _____________

d) Betonlamaya başlarken sudan betonun ayrılması
İçin alınan önlemler.

5. Yorumlar/Gözlemler ____

Uygun olanı işaretle

B.2 Muhafaza borulu veya desteksiz kazılarla Delme kazık yapımı: Özel veriler

Delme kazık numarası ____________________

Basınç kazığı

Çekme kazığı

Eğik kazık ____________________________

1. Zemin tabakaları

M Çalışma Seviyesi Altında	m Deniz Seviyesin den yüksekliği	Zemin tanımı	Yer altı suyu	Sondaj aletleri muhafaza borusu
	±0	çalışma seviyesi		den…… E kadar ……m

Ölçek 1:

2. Uygulama süresi

1 İşlem	2 Çevre sıcaklığı °C	3 Zamanlar den	4 E kadar	5 Tarih
Kazı				
Delme				
Kesinti				
Taban Formasyon				
Betonlama				

3. Kazık verileri
a) Kazıdan sonra derinlik ölçümü

__________ m çalışma seviyesi altında

b) Delme

______ m e ______ m çalışma seviyesi altı

c) Çalışma seviyesinde aks sapması

Eksen : ________ cm Eksen ________ cm

4. Donatı
Projeden sapma ____________________

Uzunluk boyunca sapma ________________

Değişiklikler _______________

5. Beton
Özel olaylar ________________________

6. Betonlama
a) Betonlama başlangıcında delik içerisinde su seviyesi,

çalışma seviyesinin altında _____________ m

b) Beton tüketimi
Teorik ________ m^3 Gerçek ________ m^3

7. Yorumlar / Gözlemler
Genel verilerden sapma __________________

8. İmzalar / Tarih
Formen / İdareci ____________________
Müteahhit temsilcisi ____________________
Müşteri temsilcisi ____________________

Uygun olanı işaretle

65

TÜRK STANDARDI
TURKISH STANDARD

TS 3168 EN 1536
Kasım 2001

ICS 93.020

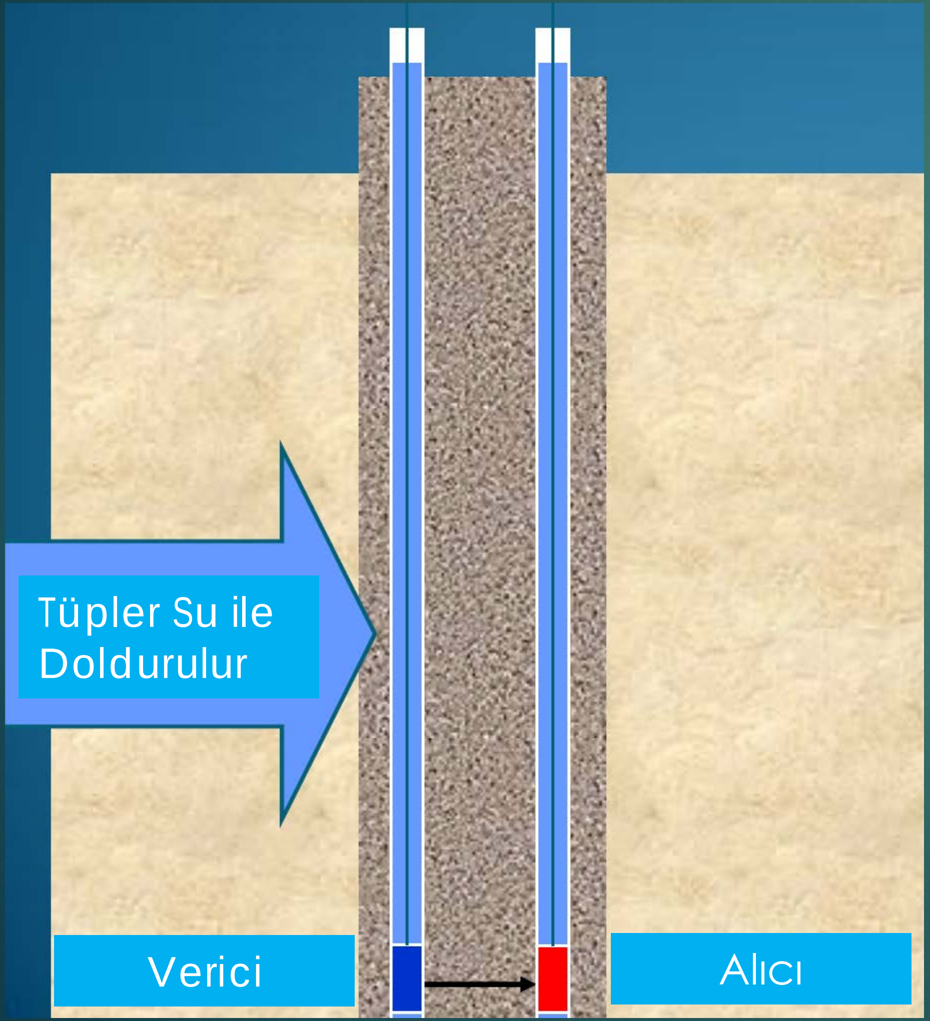
1. Baskı

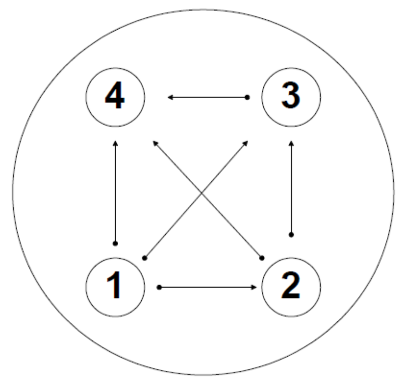
ÖZEL JEOTEKNİK UYGULAMALAR DELME (FORE)-KAZIKLAR- (YERİNDE DÖKME BETONARME KAZIKLAR)

Execution of special geotechnical work- Bored piles

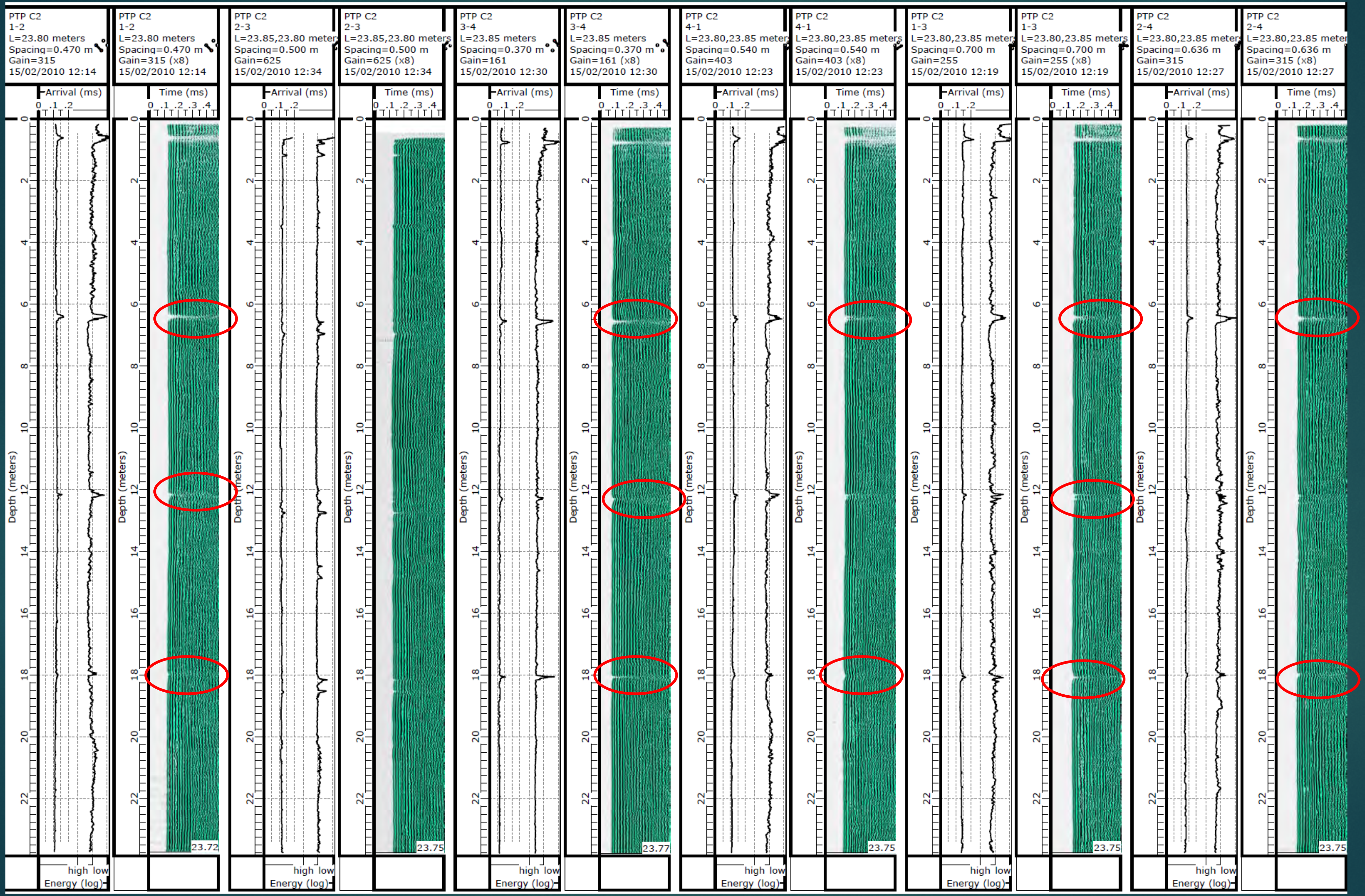
TÜRK STANDARDLARI ENSTİTÜSÜ
Necatibey Caddesi No.112 Bakanlıklar/ANKARA

Karşı Kuyu Sonik Log Deneyi
Cross Hole Sonic Logging Test (CSL)





Gözlem Tüplerinin Yerleştirilmesi


PTP C2
1-2
L=23.80 meters
Spacing=0.470 m
Gain=315
15/02/2010 12:14
Arrival (ms)
Depth (meters)
high low
Energy (log)
PTP C2
1-2
L=23.80 meters
Spacing=0.470 m
Gain=315 (x8)
15/02/2010 12:14
Time (ms)
23.72
PTP C2
2-3
L=23.85,23.80 meters
Spacing=0.500 m
Gain=625
15/02/2010 12:34
PTP C2
2-3
L=23.85,23.80 meters
Spacing=0.500 m
Gain=625 (x8)
15/02/2010 12:34
23.75
PTP C2
3-4
L=23.85 meters
Spacing=0.370 m
Gain=161
15/02/2010 12:30
PTP C2
3-4
L=23.85 meters
Spacing=0.370 m
Gain=161 (x8)
15/02/2010 12:30
23.77
PTP C2
4-1
L=23.80,23.85 meters
Spacing=0.540 m
Gain=403
15/02/2010 12:23
PTP C2
4-1
L=23.80,23.85 meters
Spacing=0.540 m
Gain=403 (x8)
15/02/2010 12:23
23.75
PTP C2
1-3
L=23.80,23.85 meters
Spacing=0.700 m
Gain=255
15/02/2010 12:19
PTP C2
1-3
L=23.80,23.85 meters
Spacing=0.700 m
Gain=255 (x8)
15/02/2010 12:19
23.75
PTP C2
2-4
L=23.80,23.85 meters
Spacing=0.636 m
Gain=315
15/02/2010 12:27
PTP C2
2-4
L=23.80,23.85 meters
Spacing=0.636 m
Gain=315 (x8)
15/02/2010 12:27
23.75

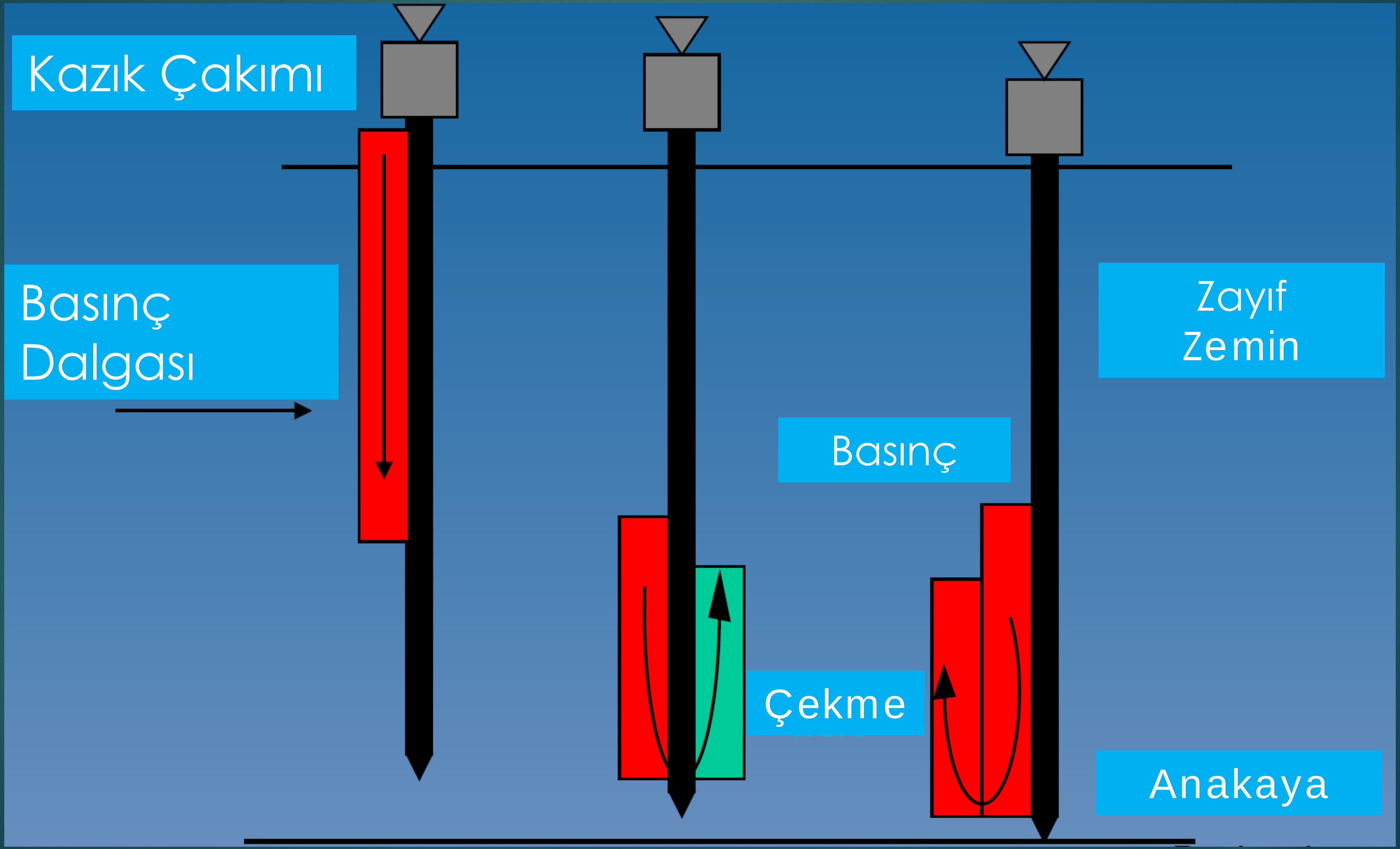
Avantajları:

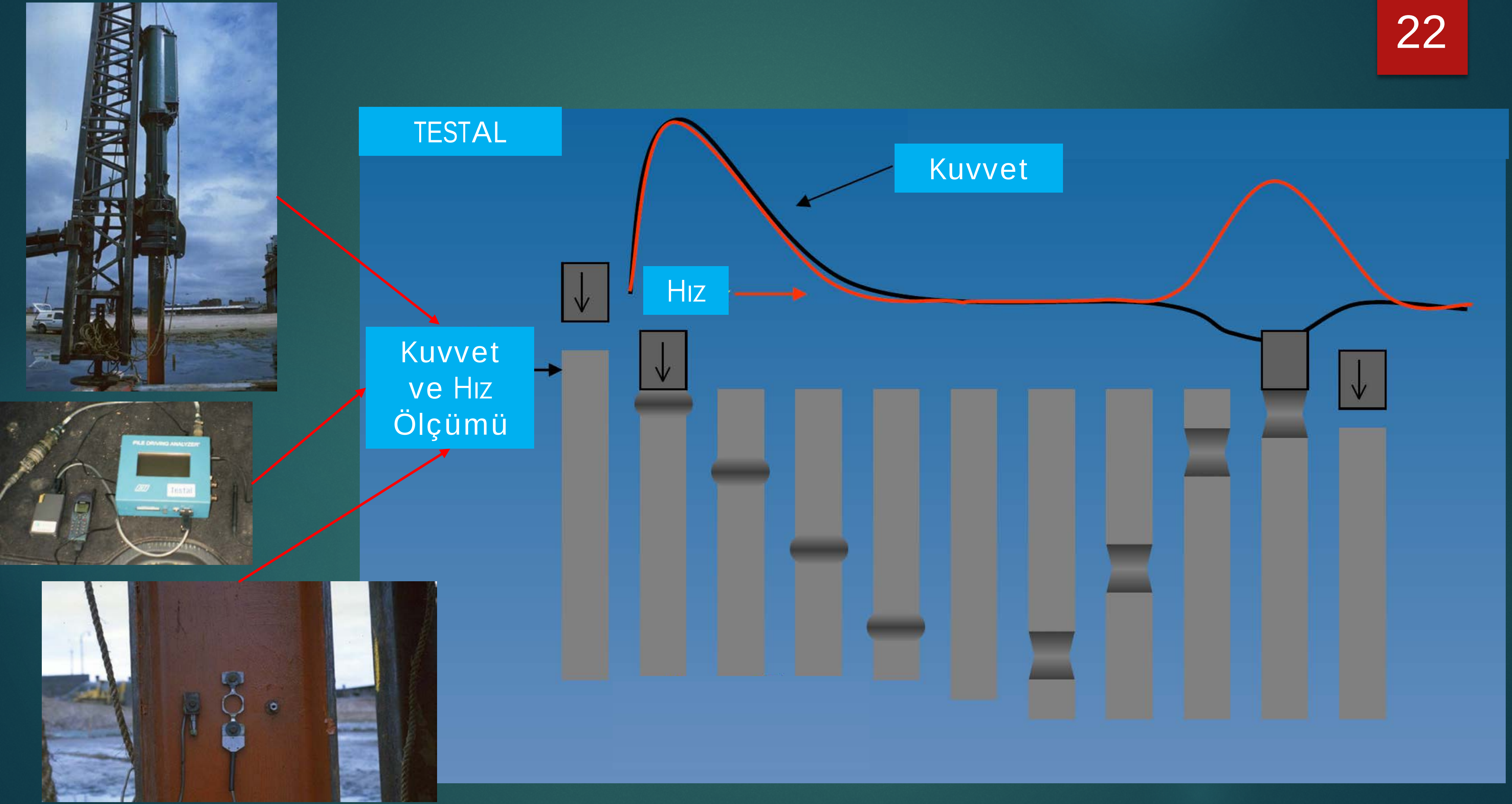
- ✓ PIT kullanılamayan çakışan kazık (iksa?) projelerinde kullanılabilir.
- ✓ Donatı kafesi içersindeki betonun kalitesini kontrol etme imkanı tanır.
- ✓ Kompleks durumlarda kazığın bir nevi tomografisini çıkartır.

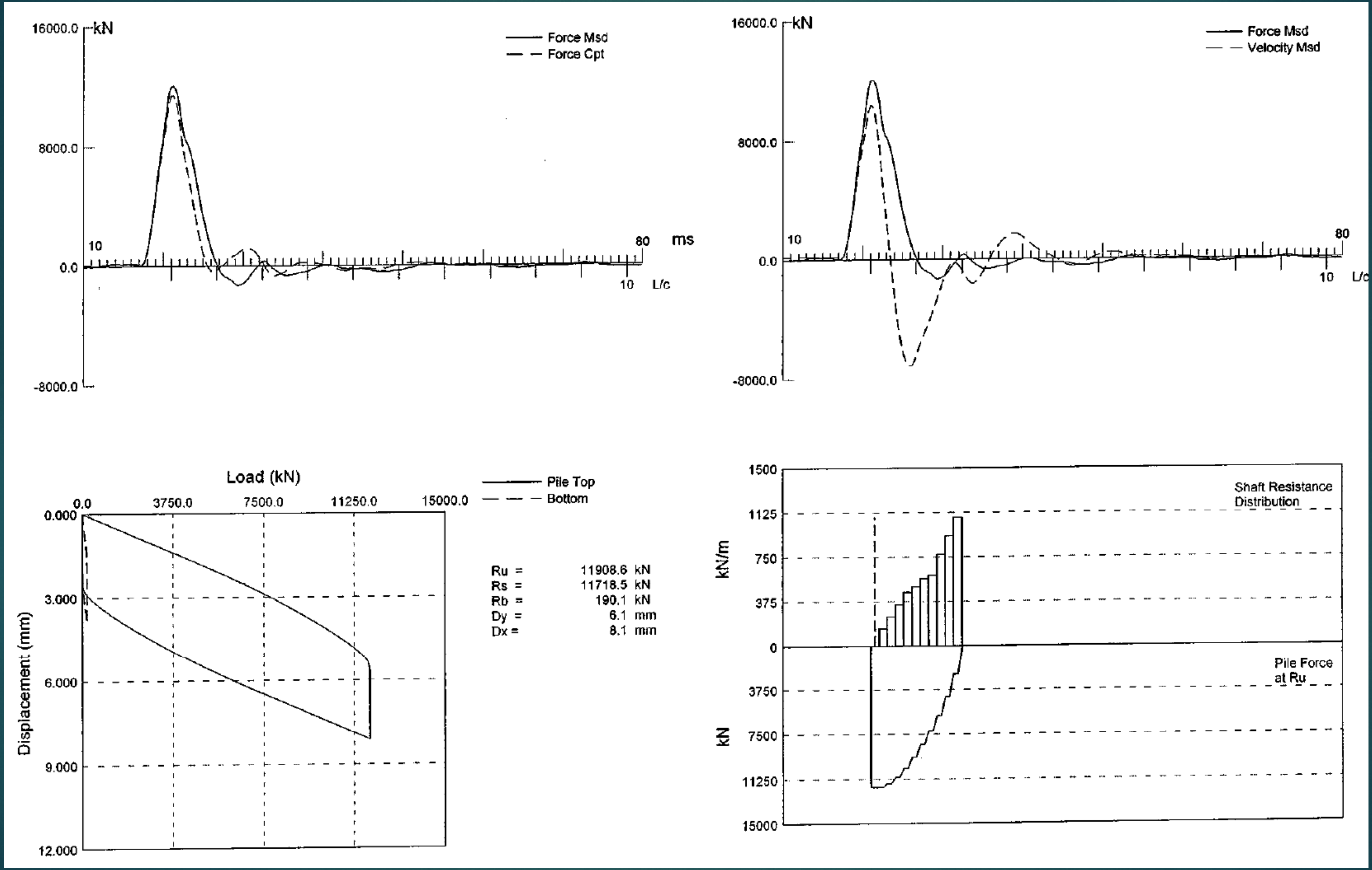
Dezavantajları:

- ➢ Küçük çaplı kazıklarda kullanımı sınırlıdır (min. 600mm?).
- ➢ Deneyin yapılması için tercihen çelik tüpler kullanılmalıdır. dolayısıyla maliyeti PIT'ye göre nispeten yüksektir.
- ➢ Deney başlamadan en az yedi gün kür süresini beklemek gerekir.
- ➢ Donatı kafesi çevresindeki beton paspayını bu metodla değerlendiremeyiz.

Yüksek Şekil Değiştirmeli Deneyler
CAse Pile Wave Analysis Program (CAPWAP)




TESTAL
Kuvvet
Hız
Kuvvet ve Hız Ölçümü


16000.0 kN
8000.0
0.0
-8000.0
10
80
ms
10
L/c
Force Msd
Force Cpt
16000.0 kN
8000.0
0.0
-8000.0
10
80
10
L/c
Force Msd
Velocity Msd
Load (kN)
0.0
3750.0
7500.0
11250.0
15000.0
Displacement (mm)
0.000
3.000
6.000
9.000
12.000
Pile Top
Bottom
Ru = 11908.6 kN
Rs = 11718.5 kN
Rb = 190.1 kN
Dy = 6.1 mm
Dx = 8.1 mm
1500
1125
750
375
0
kN/m
Shaft Resistance
Distribution
3750
7500
11250
15000
kN
Pile Force
at Ru

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 11908.6; along Shaft 11718.5; at Toe 190.1 kN

Soil Sgmnt No.	Dist. Below Gages m	Depth Below Grade m	Ru kN	Force in Pile kN	Sum of Ru kN	Unit Resist. (Depth) kN/m	Unit Resist. (Area) kPa	Smith Damping Factor s/m	Quake mm
				11908.6					
1	2.1	0.6	0.0	11908.6	0.0	0.00	0.00	0.000	1.471
2	4.1	2.6	311.6	11597.0	311.6	150.33	39.88	1.846	1.471
3	6.2	4.7	519.1	11077.9	830.7	250.44	66.43	1.846	1.471
4	8.3	6.8	726.7	10351.2	1557.4	350.60	93.00	1.846	1.471
5	10.4	8.9	934.4	9416.8	2491.8	450.81	119.58	1.846	1.471
6	12.4	10.9	1038.2	8378.6	3530.0	500.89	132.86	1.846	1.471
7	14.5	13.0	1181.8	7196.8	4711.8	570.17	151.24	1.846	1.396
8	16.6	15.1	1242.2	5954.6	5954.0	599.31	158.97	1.846	1.258
9	18.7	17.2	1597.5	4357.1	7551.5	770.72	204.44	1.846	1.132
10	20.7	19.2	1924.1	2433.0	9475.6	928.29	246.24	1.846	1.060
11	22.8	21.3	2242.9	190.1	11718.5	1082.10	287.04	1.846	0.988
Avg. Shaft			1065.3			550.16	145.94	1.846	1.235
Toe			190.1				168.09	0.145	1.451

Soil Model Parameters/Extensions		Shaft	Toe
Case Damping Factor		1.876	0.002
Unloading Quake	(% of loading quake)	87	51
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	40	
Resistance Gap (included in Toe Quake) (mm)			0.437
Soil Plug Weight	(kN)		11.51
Soil Support Dashpot		1.574	3.000
Soil Support Weight	(kN)	39.07	39.07

```
CAPWAP match quality     =   8.06        (Wave Up Match) ; RSA = 0
Observed: final set      =  2.000 mm;    blow count     =    500 b/m
Computed: final set      =  0.616 mm;    blow count     =   1622 b/m

max. Top Comp. Stress    =   10.2 MPa    (T=  21.8 ms, max= 1.070 x Top)
max. Comp. Stress        =   11.0 MPa    (Z=   4.1 m, T=  22.5 ms)
max. Tens. Stress        =  -1.51 MPa    (Z=  12.4 m, T=  30.1 ms)
max. Energy (EMX)        =  28.41 kJ;    max. Measured Top Displ. (DMX)= 3.07 mm
```

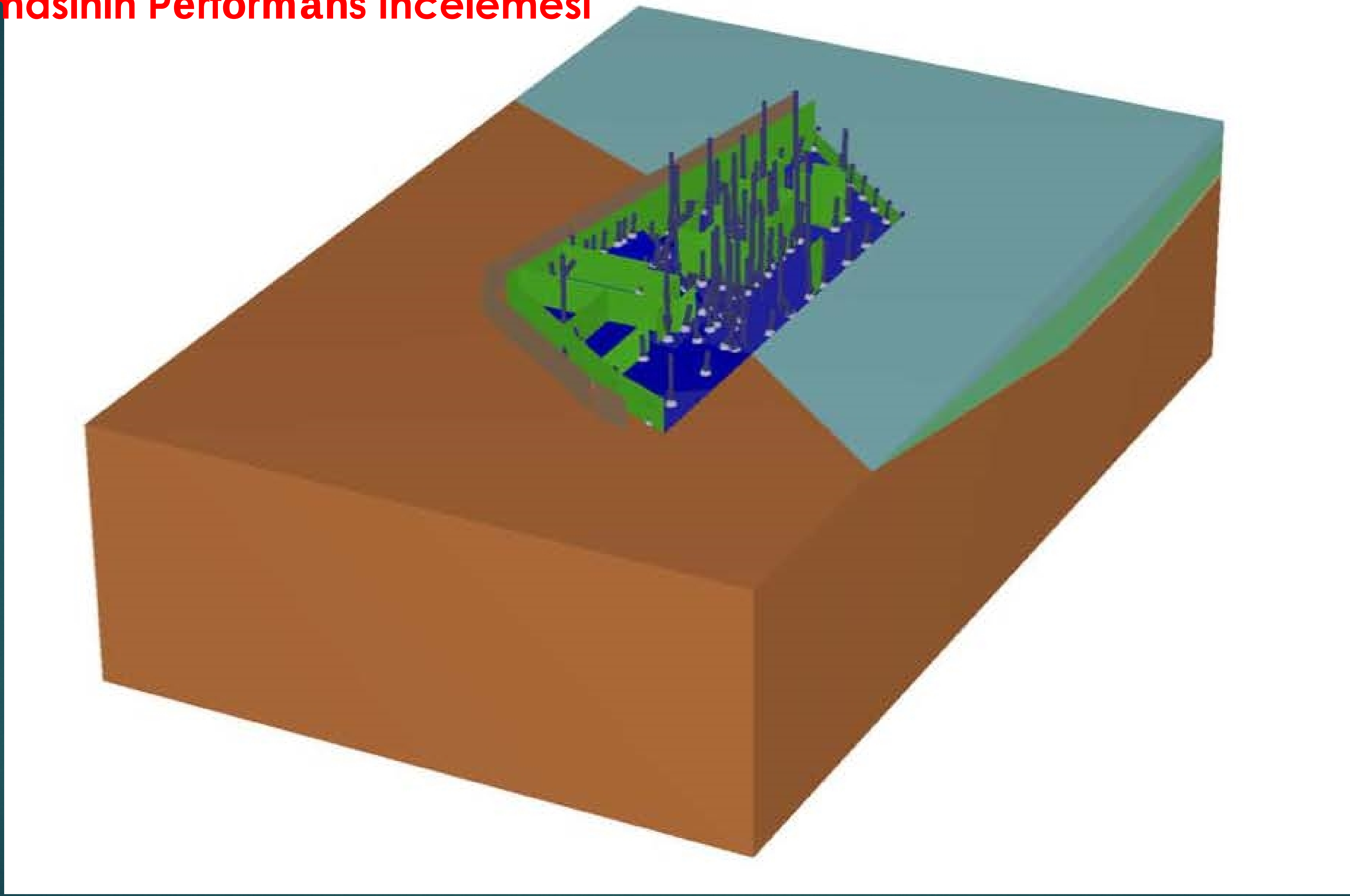
Avantajları:

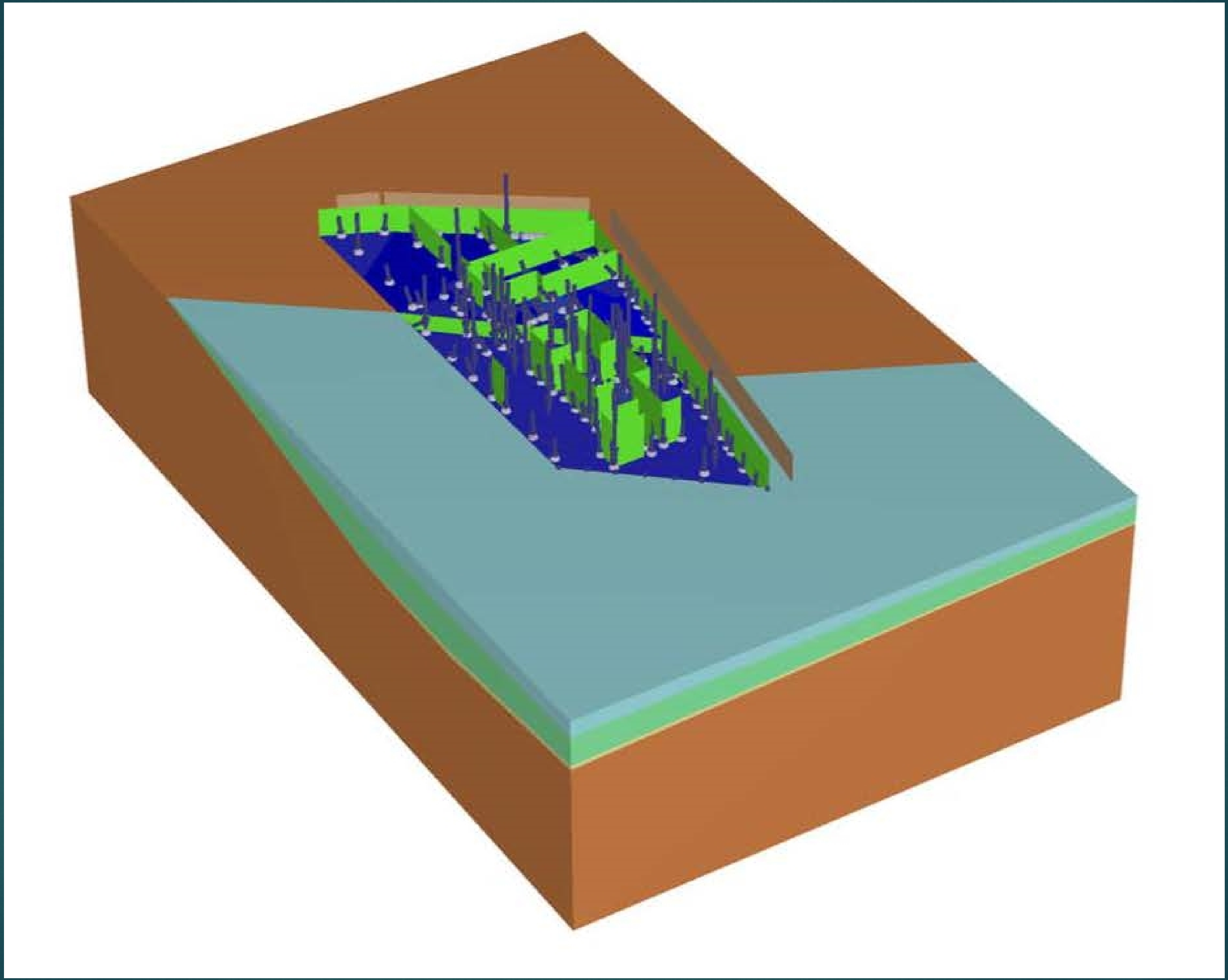
- ✓ Çok sayıda kazık üzerinde hızlı bir şekilde yapılabilir.
- ✓ Yükleme deneyleri ile kalibre edilirse yapılacak yükleme deneylerinin sayısını azaltabilir.
- ✓ Yüksek şekil değiştirme içerdiğinden muhtemel kazık oturmaları hakkında bilgi verir.
- ✓ Çakma kazıklarda kazık boyunca iletilen enerjiyi ölçme imkanı tanır.

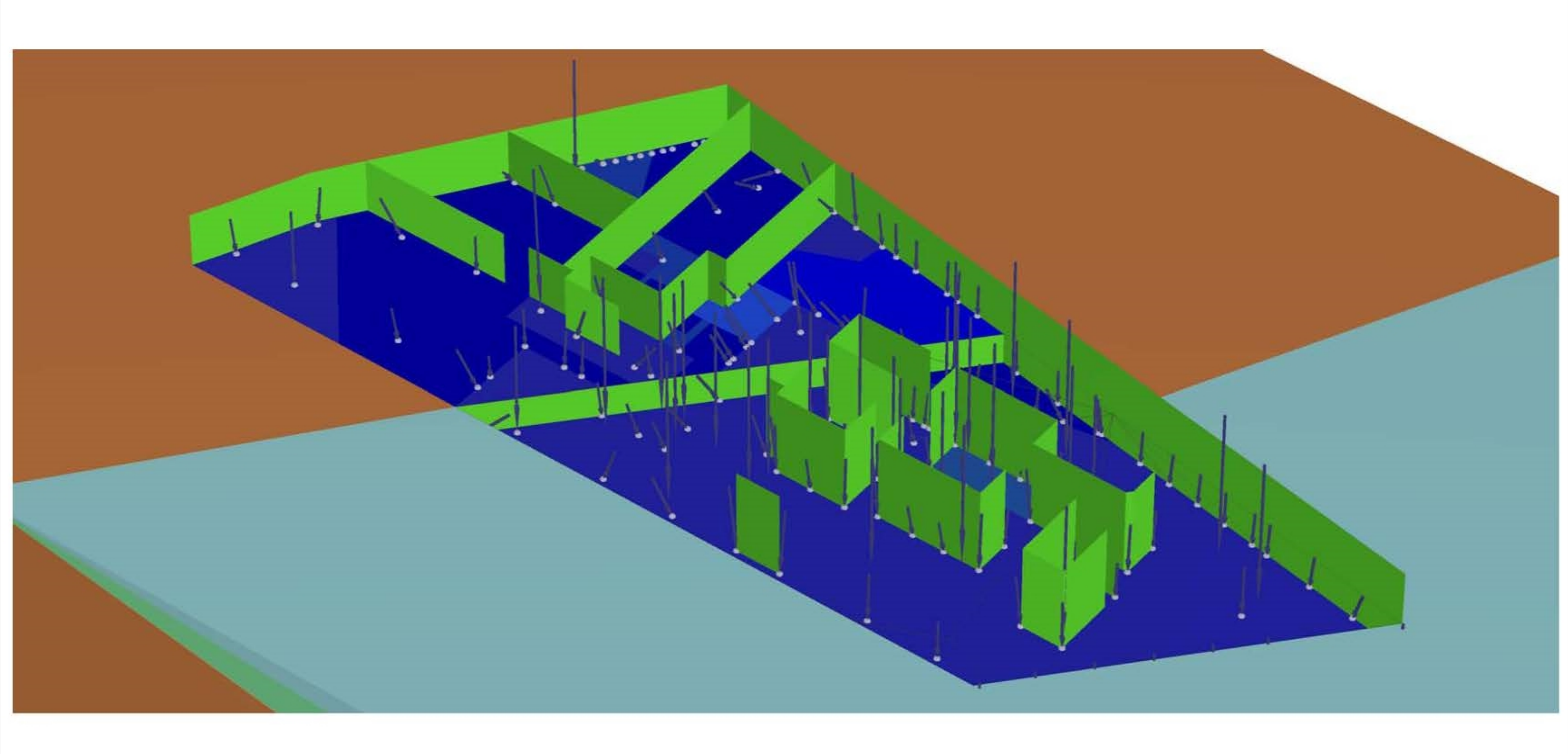
Dezavantajları:

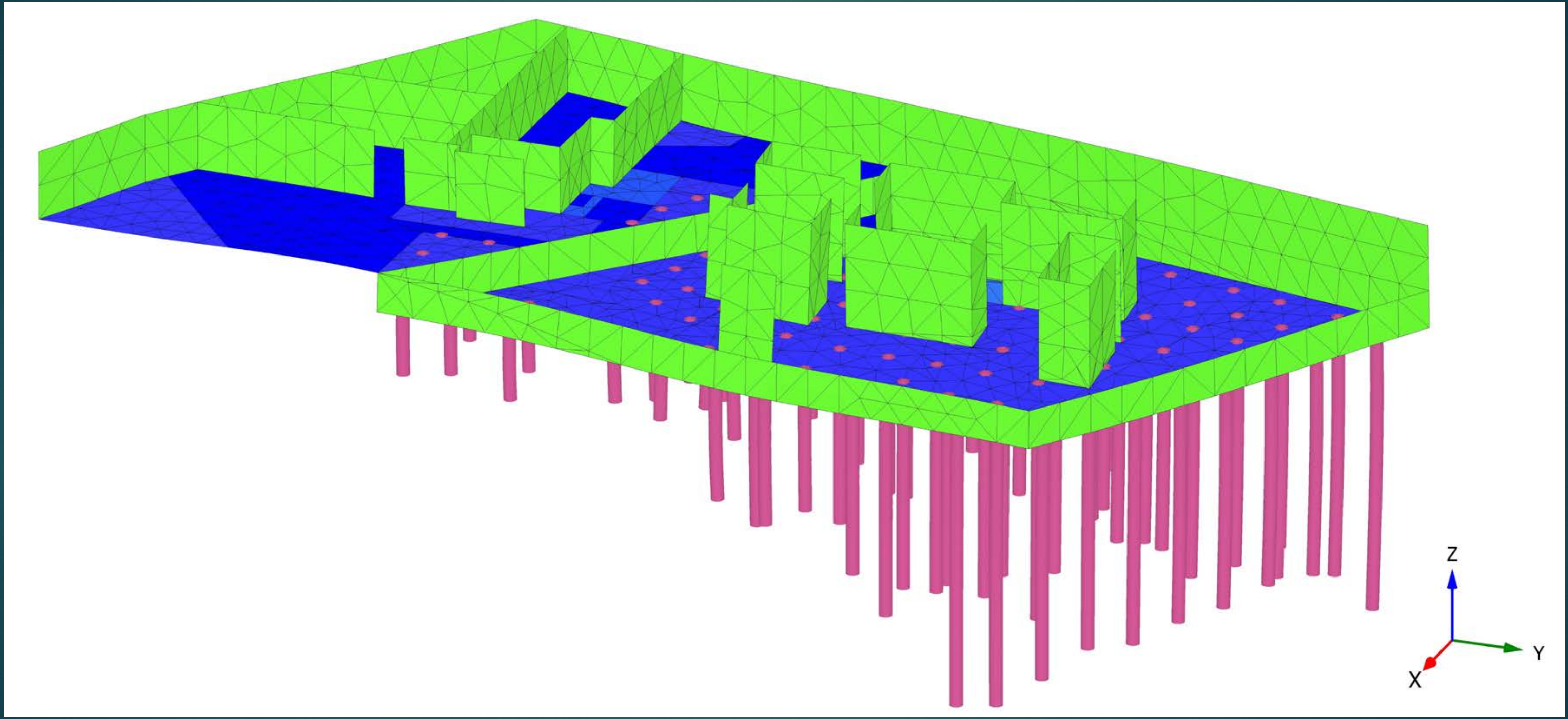
- ➢ Mobilize olan statik zemin mukavemeti nihai zemin mukavemeti olmayabilir.
- ➢ Efektif sonuç elde edilebilmesi için tam kapsamlı bir yükleme deneyi sonucu ile kalibre edilmelidir.
- ➢ Akma (creep) ve konsolidasyon etkilerini dikkate almaz bu yüzden yük-şekil değiştirme grafiği her zaman efektif olmayabilir.

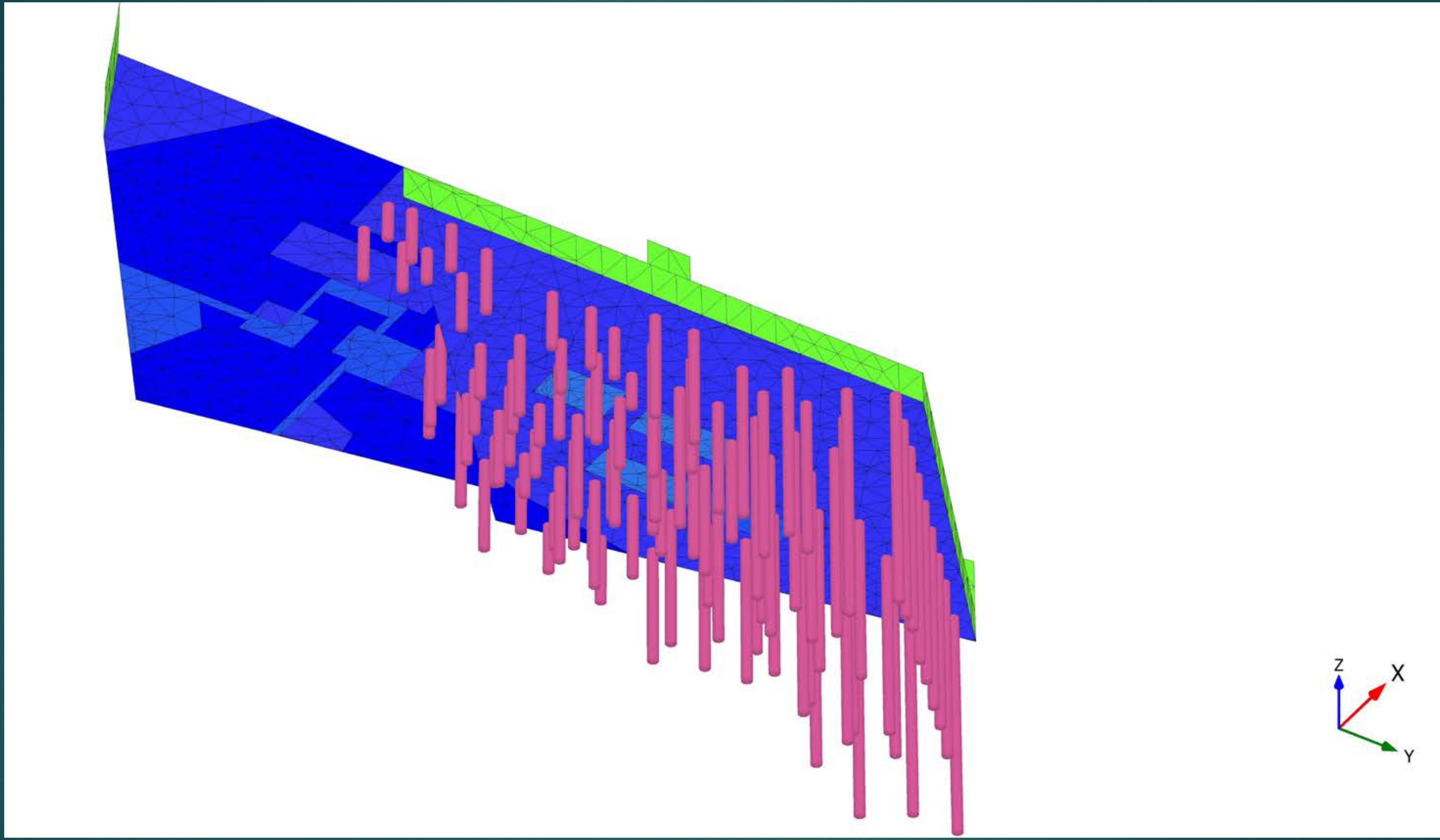
Durum Analizi 2 - Bir Kazıklı Radye Uygulamasının Performans İncelemesi

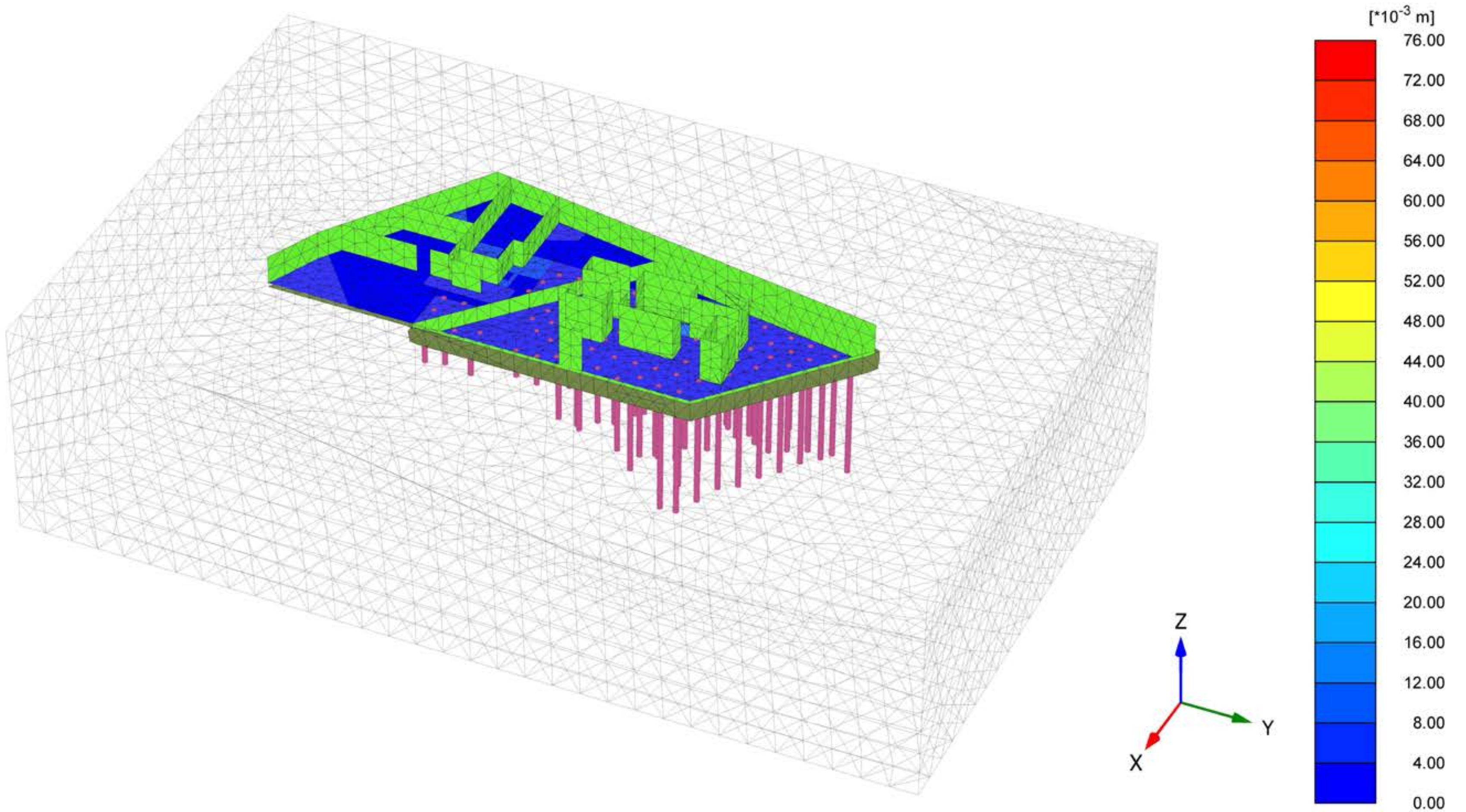






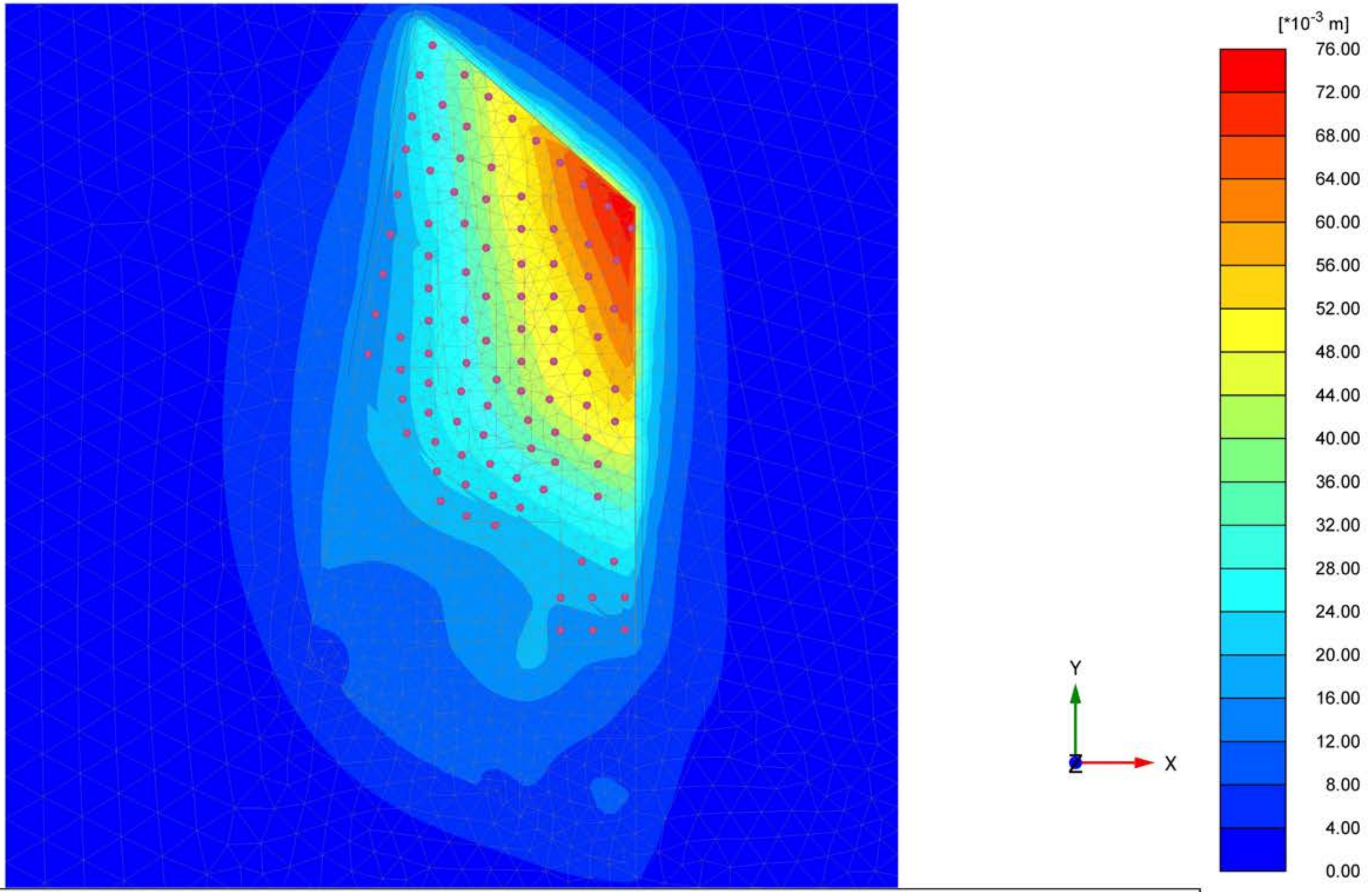

Z
Y
X


Z
X
Y



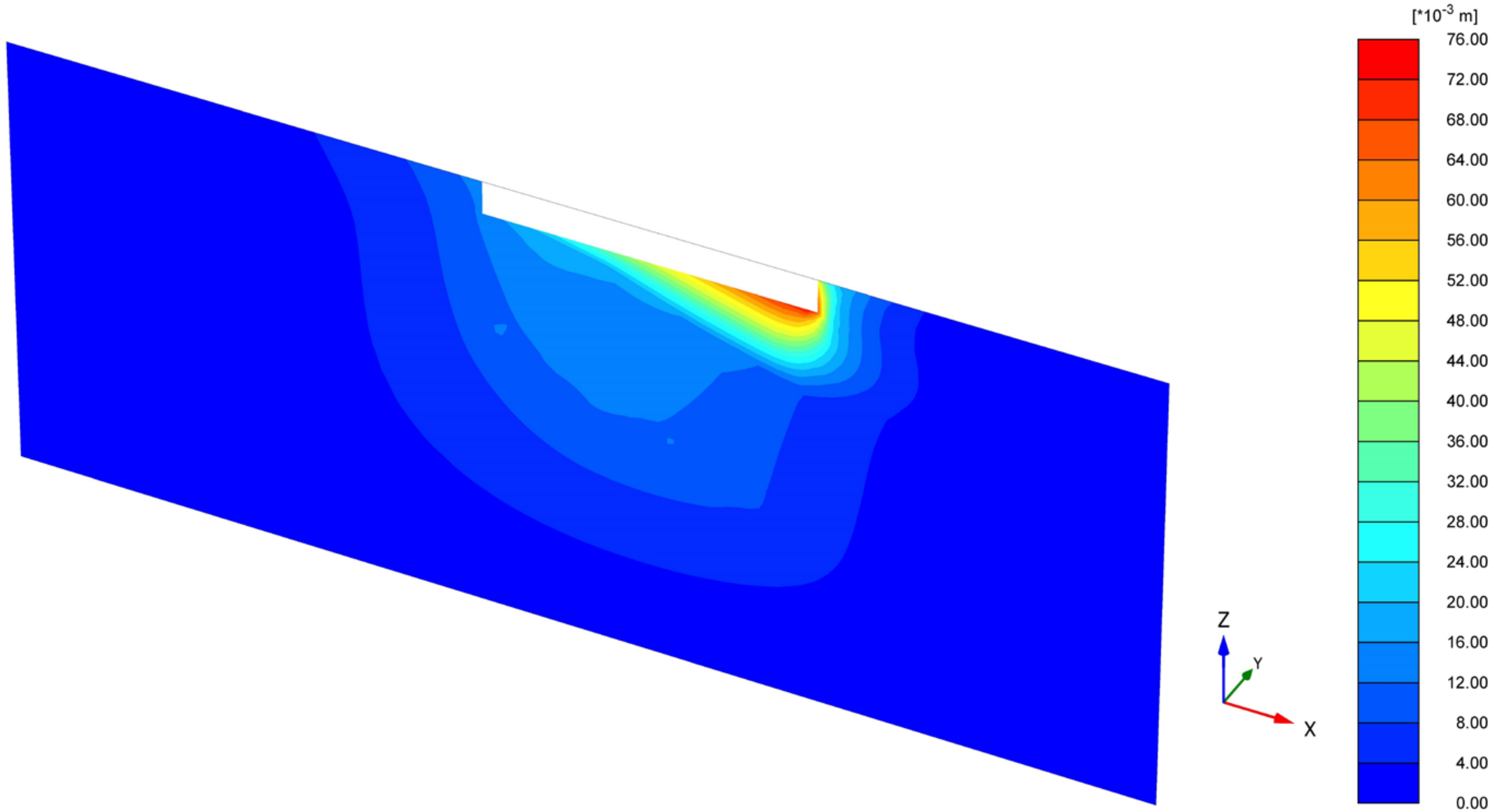
Total displacements |u|

Maximum value = 0.07485 m (Element 2145 at Node 106485)



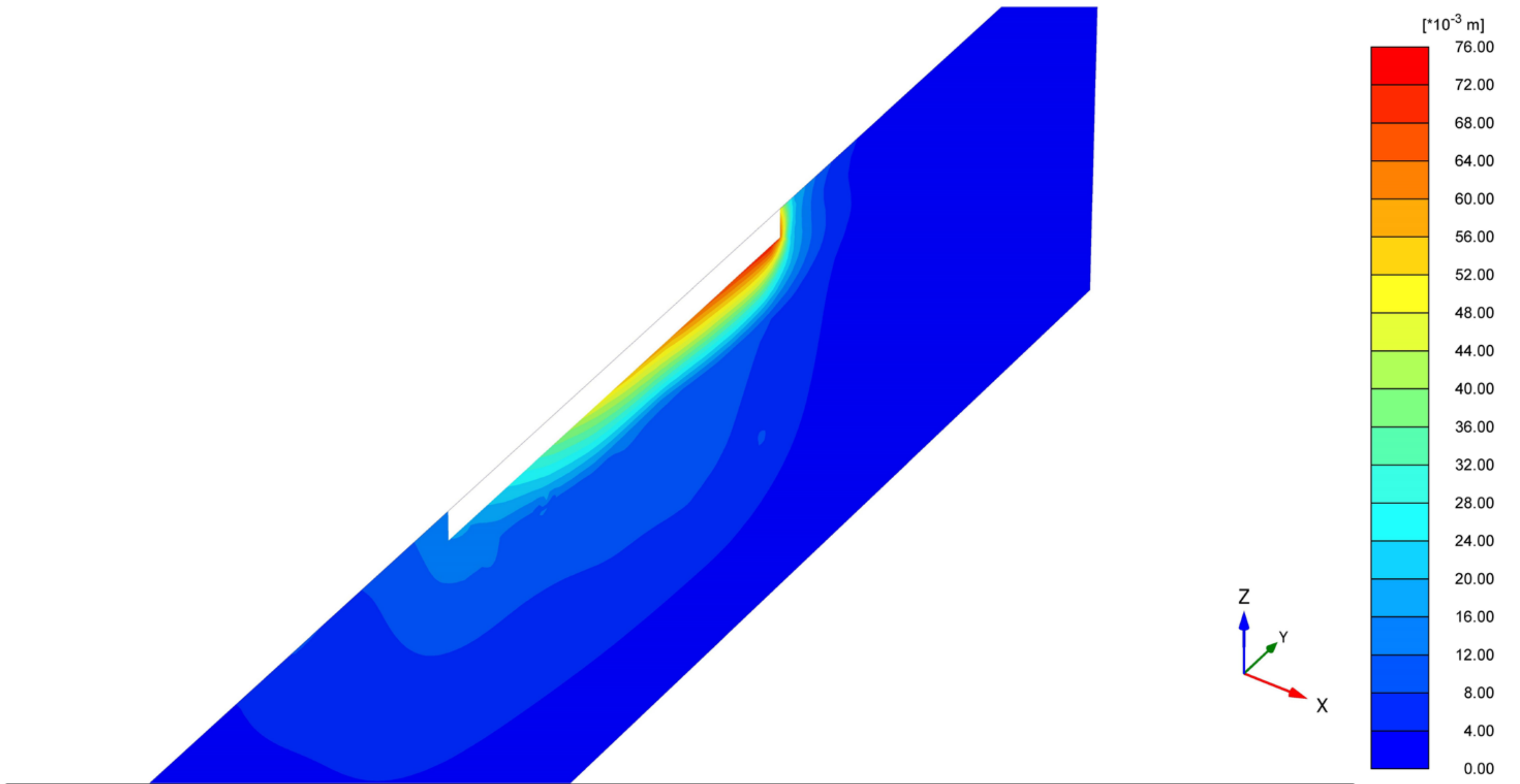
Total displacements |u|

Maximum value = 0.07485 m (Element 2145 at Node 106485)



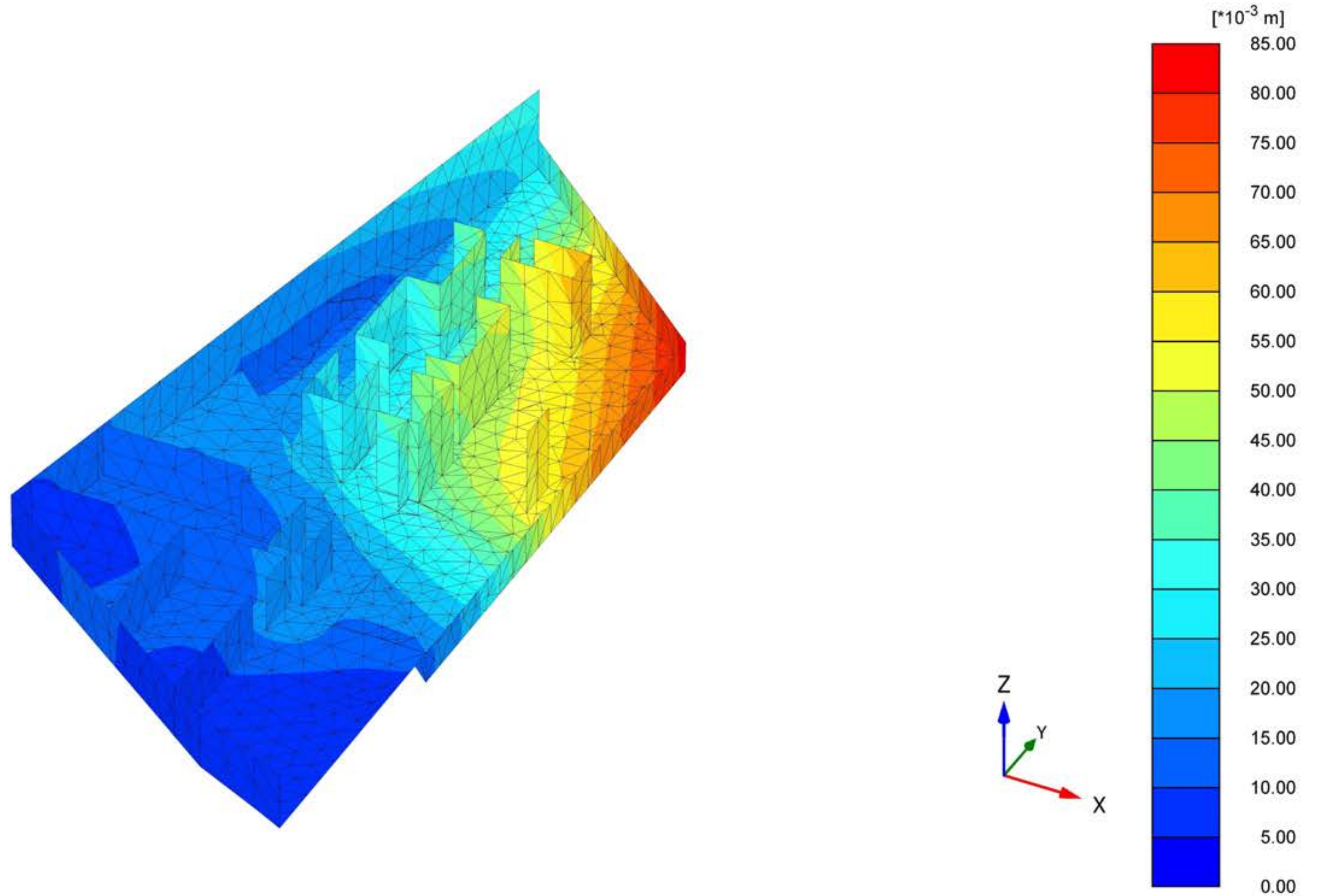
Total displacements |u|

Maximum value = 0.07321 m



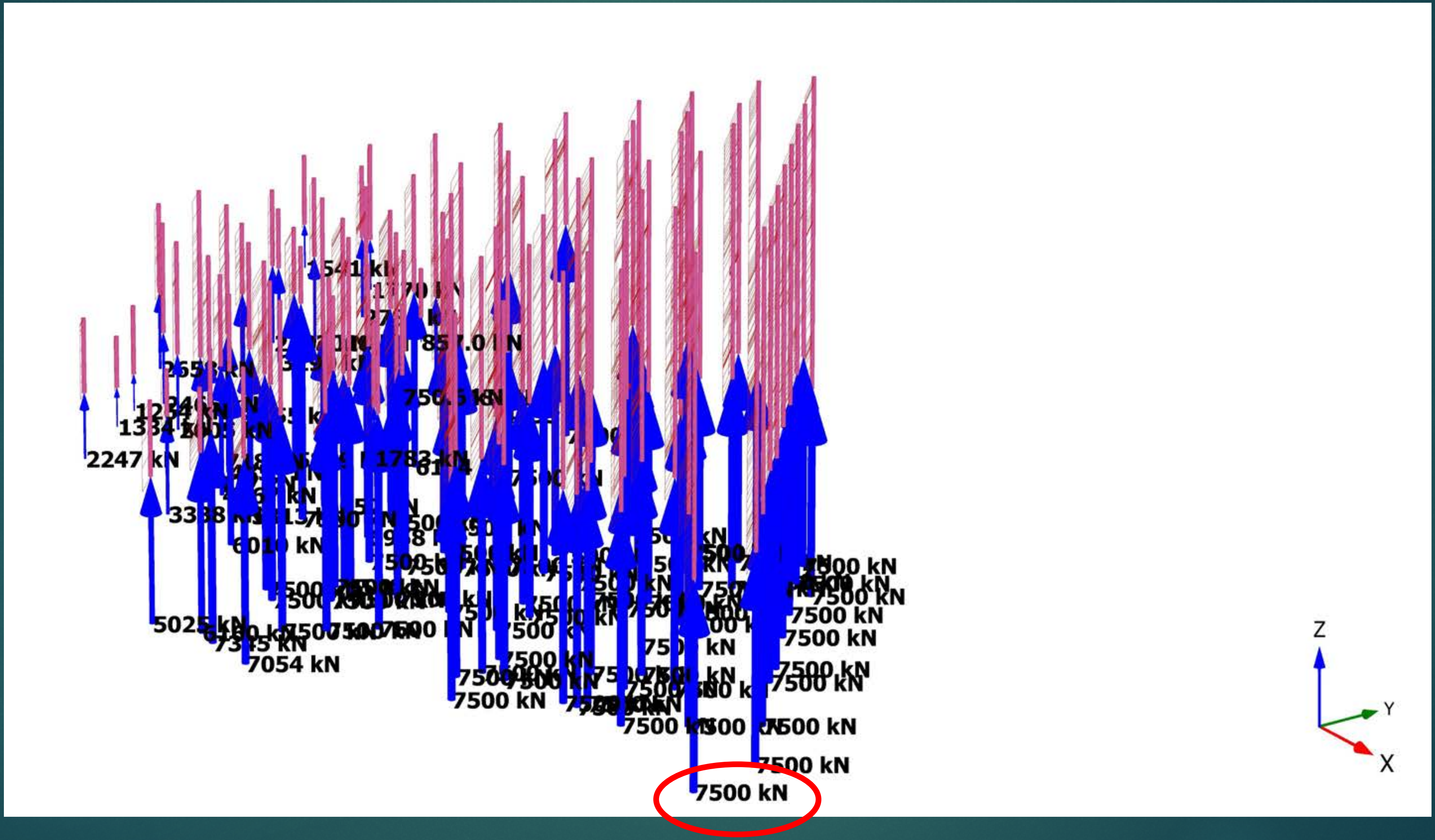
Total displacements |u|

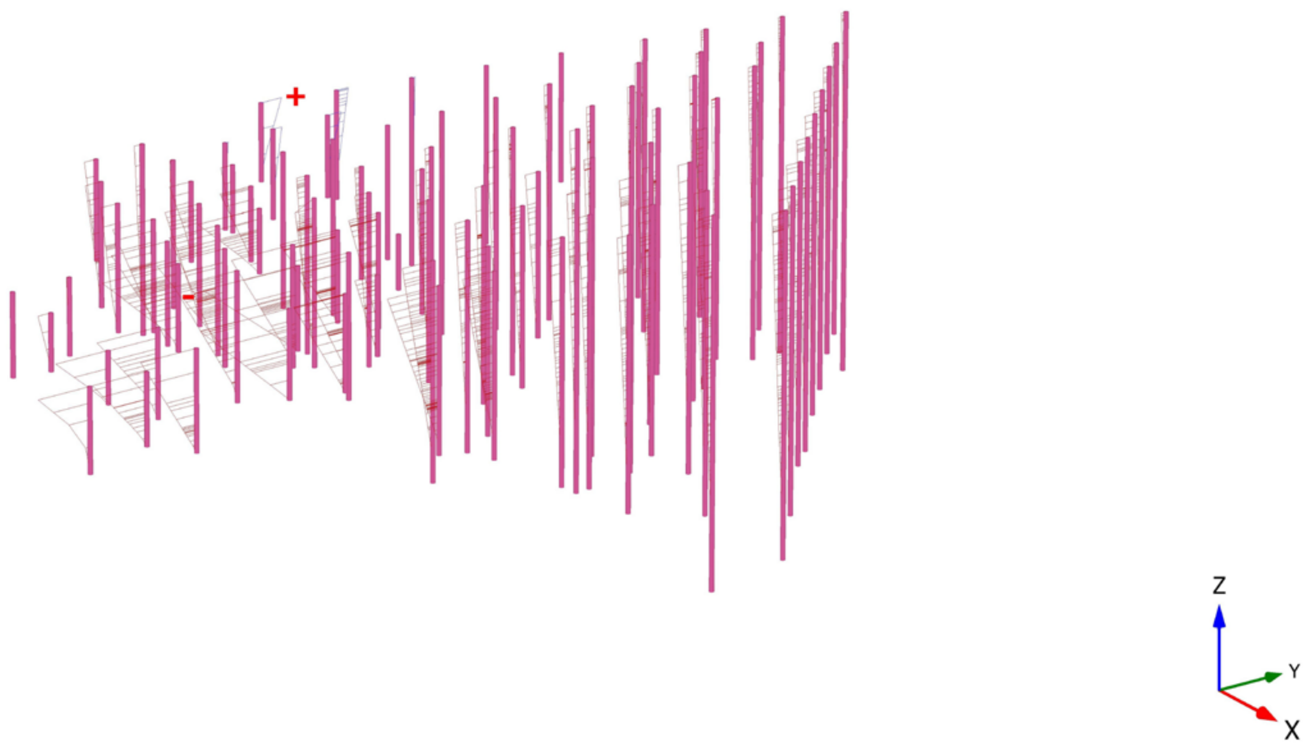
Maximum value = 0.07283 m



Total displacements |u|

Maximum value = 0.08181 m (Element 1371 at Node 117587)

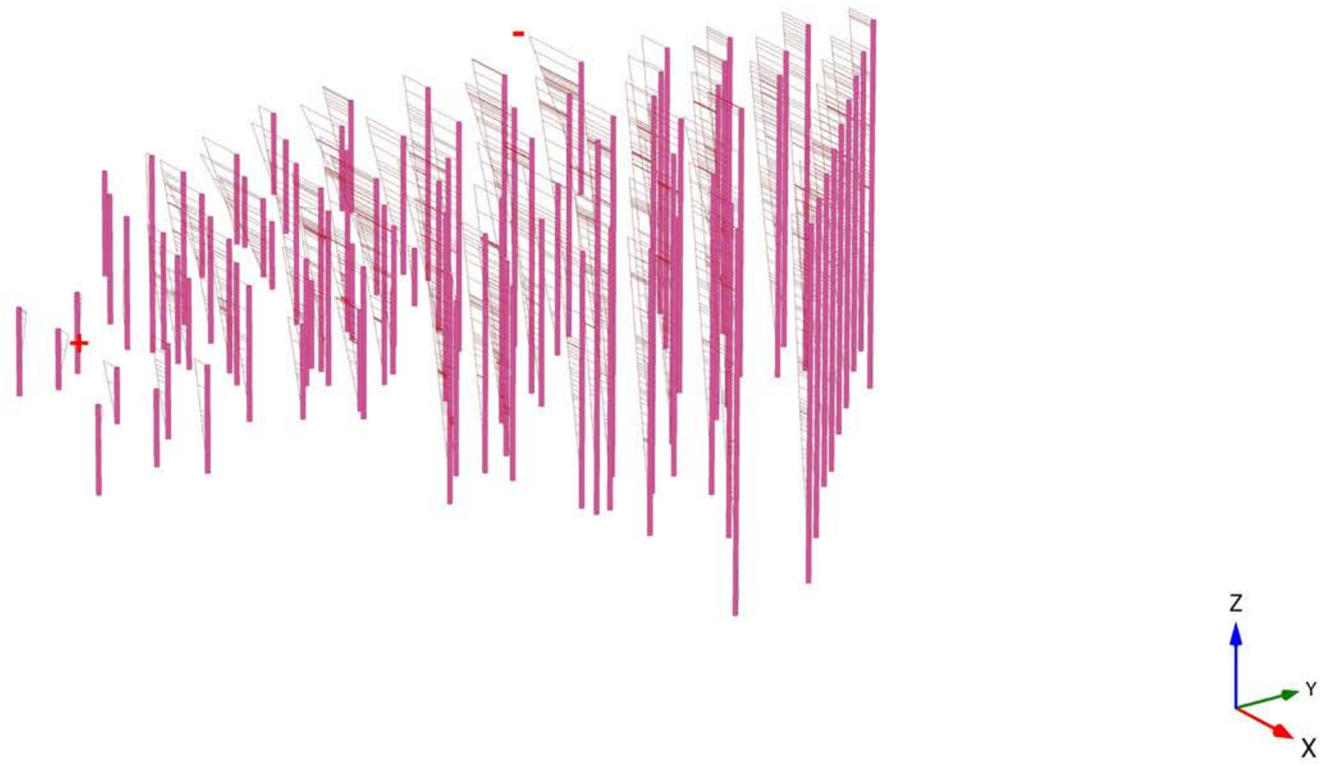

2247 kN
5025 kN
7054 kN
7500 kN
Z
Y
X



Bending moments M_2 (scaled up $2.00*10^{-3}$ times)

Maximum value = 684.0 kN m (Element 1456 at Node 158082)

Minimum value = -3077 kN m (Element 1434 at Node 158034)



Bending moments M_3 (scaled up $2.00*10^{-3}$ times)

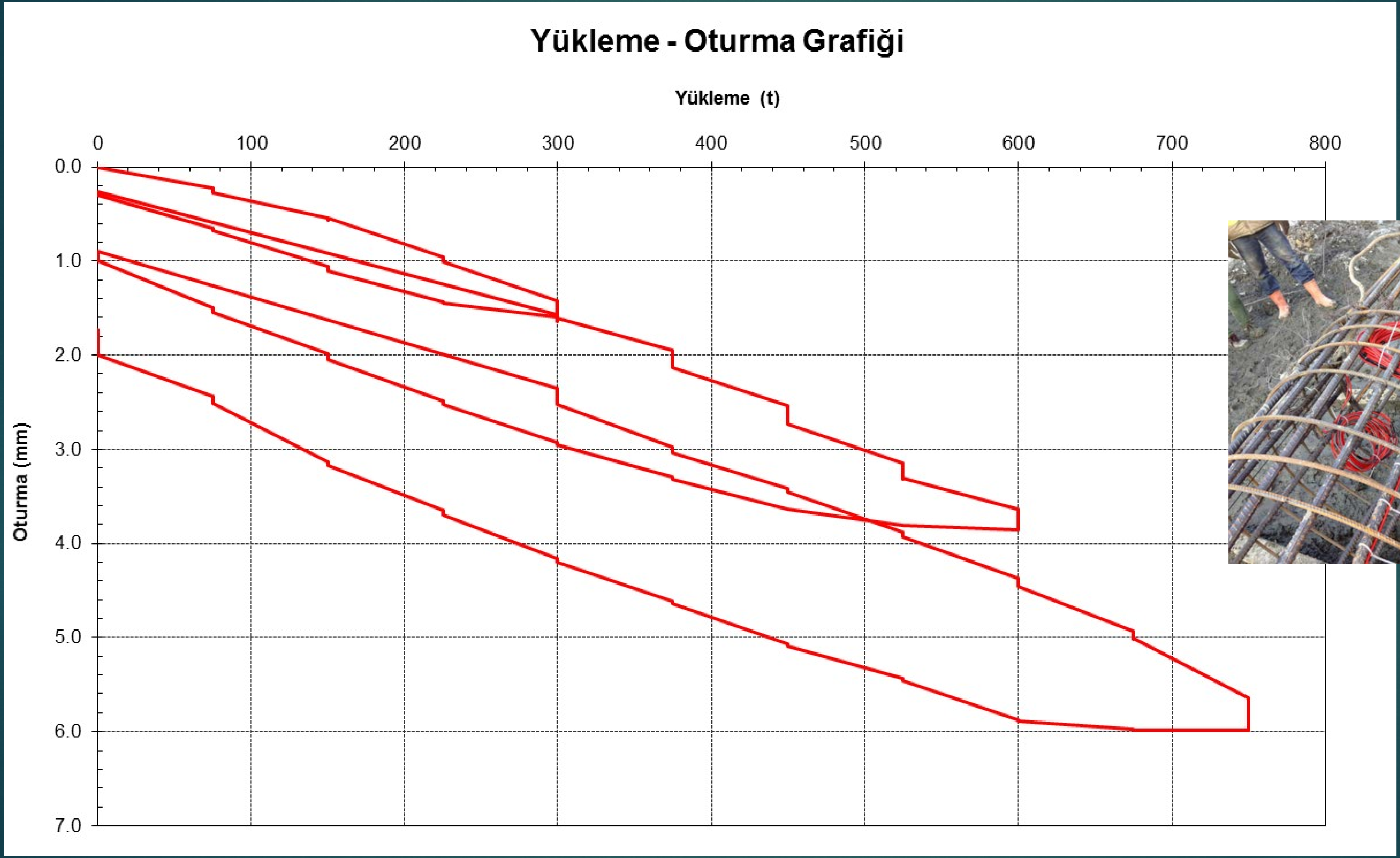
Maximum value = 486.4 kN m (Element 1512 at Node 158206)

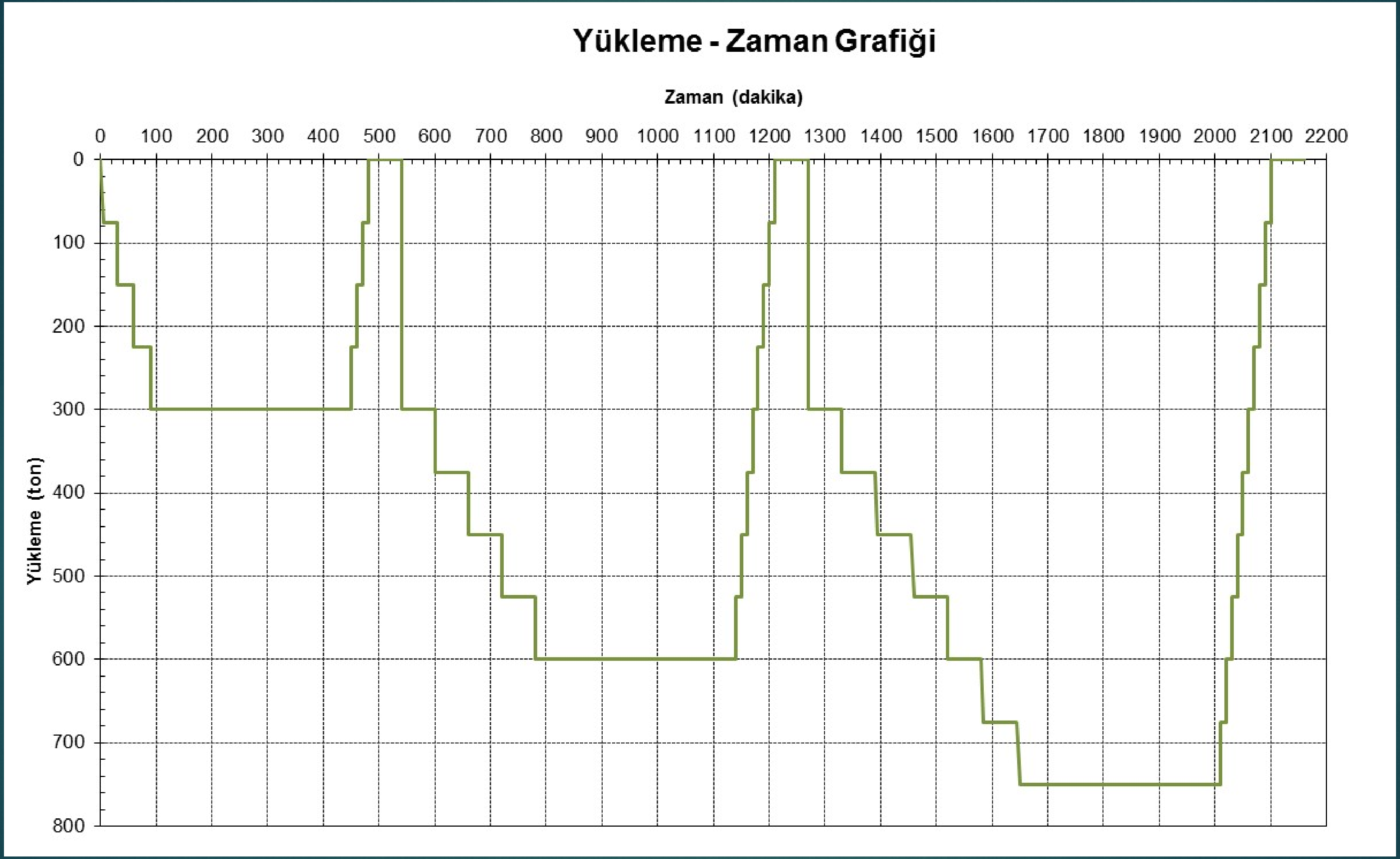
Minimum value = -2447 kN m (Element 1251 at Node 157647)

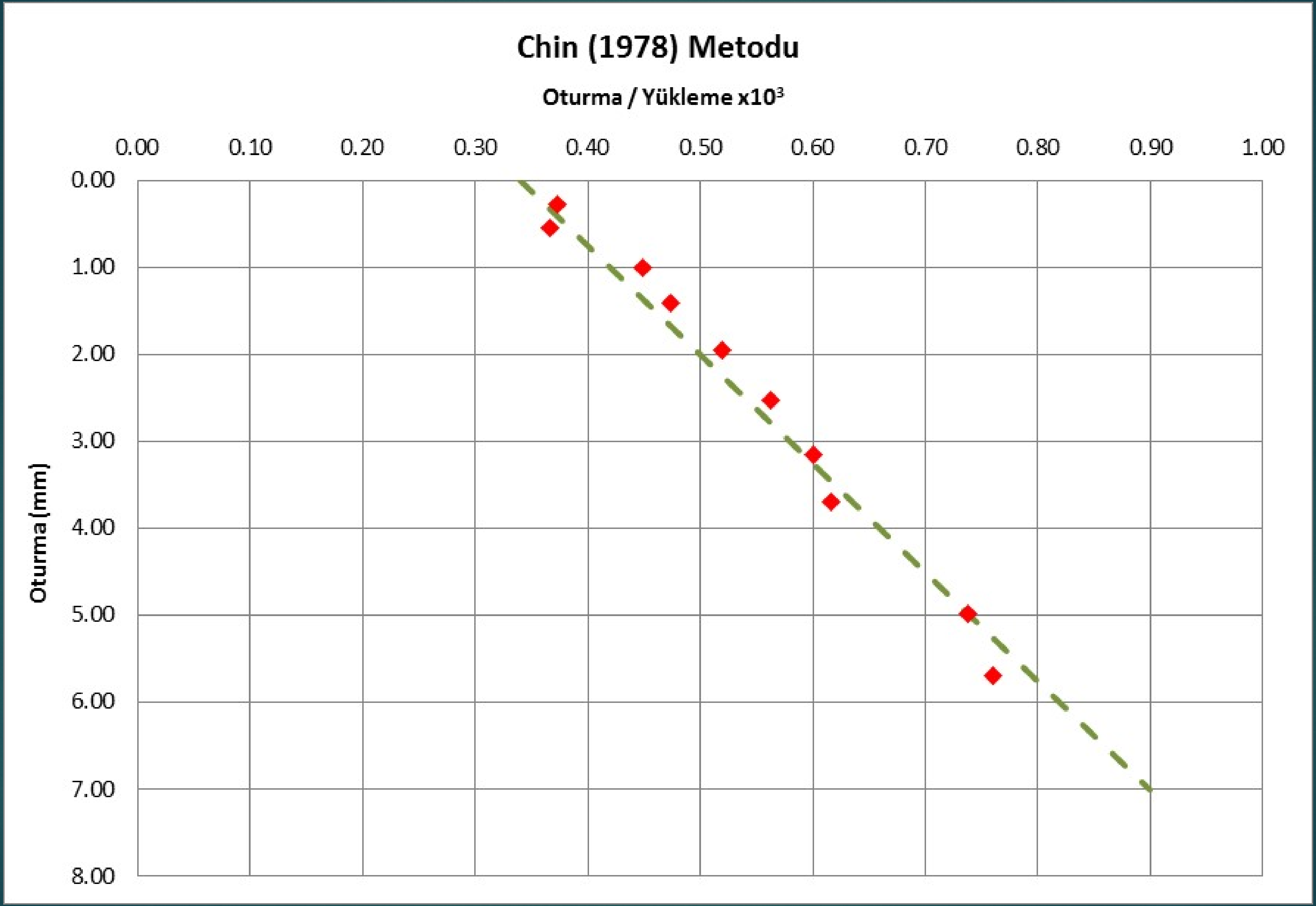
Yüksek Katlı Binalar İçin Tavsiye Edilen Servis Oturması Kriterleri (Zhang and Ng, 2006)

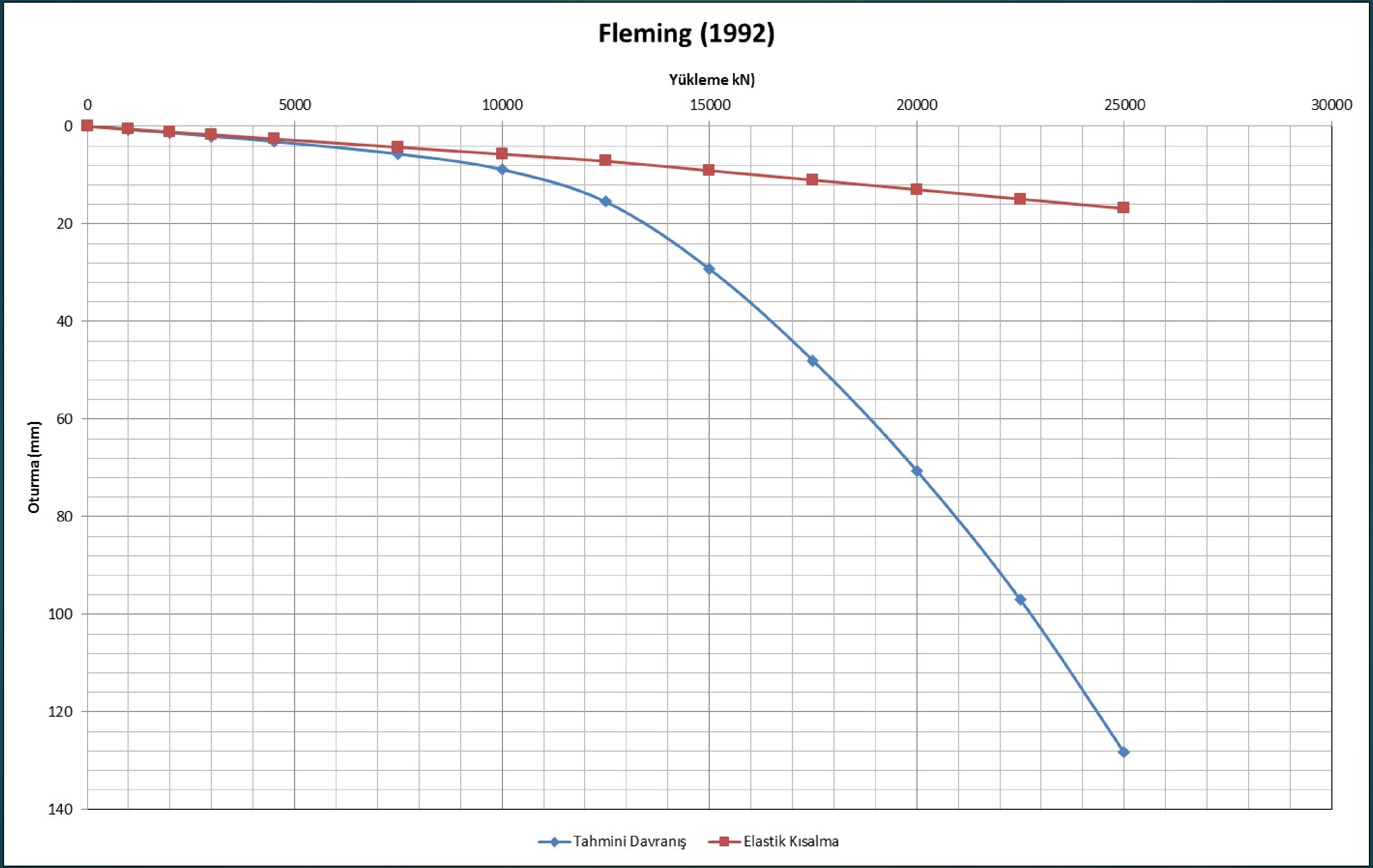
Miktar	Değer	Yorum
Tolere Edilebilir Limit Deplasman (mm)	106	Derin temeller üzerinde yapılmış 52 durum çalışması sonucu
Gözlemlenen Tolere Edilemeyecek Deplasman(mm)	349	Derin temeller üzerinde yapılmış 52 durum çalışması sonucu
Tolere Edilebilir Limit Diferansiyel Oturma (rad)	1/500 1/250 (H<24m) 1/1,000 (H>100m)	Derin temeller üzerinde yapılmış 52 durum çalışması sonucu Çin Yönetmeliği H: Bina Yüksekliği
Gözlemlenen Tolere Edilemeyecek Diferansiyel Oturma (rad)	1/125	Derin temeller üzerinde yapılmış 57 durum çalışması sonucu

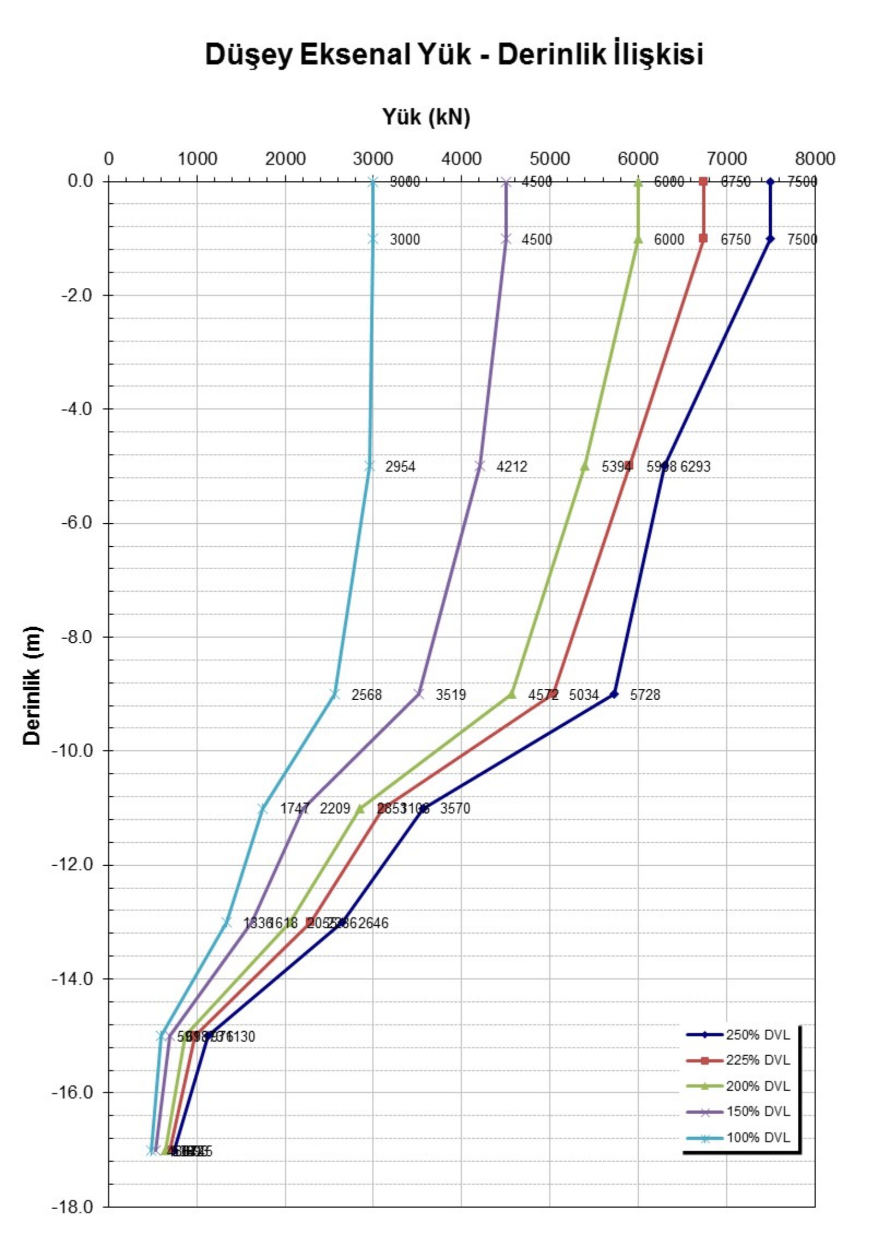
Durum Analizi 3 - Yüksek Kapasiteli Kazık Yükleme Deneylerine Bir Örnek

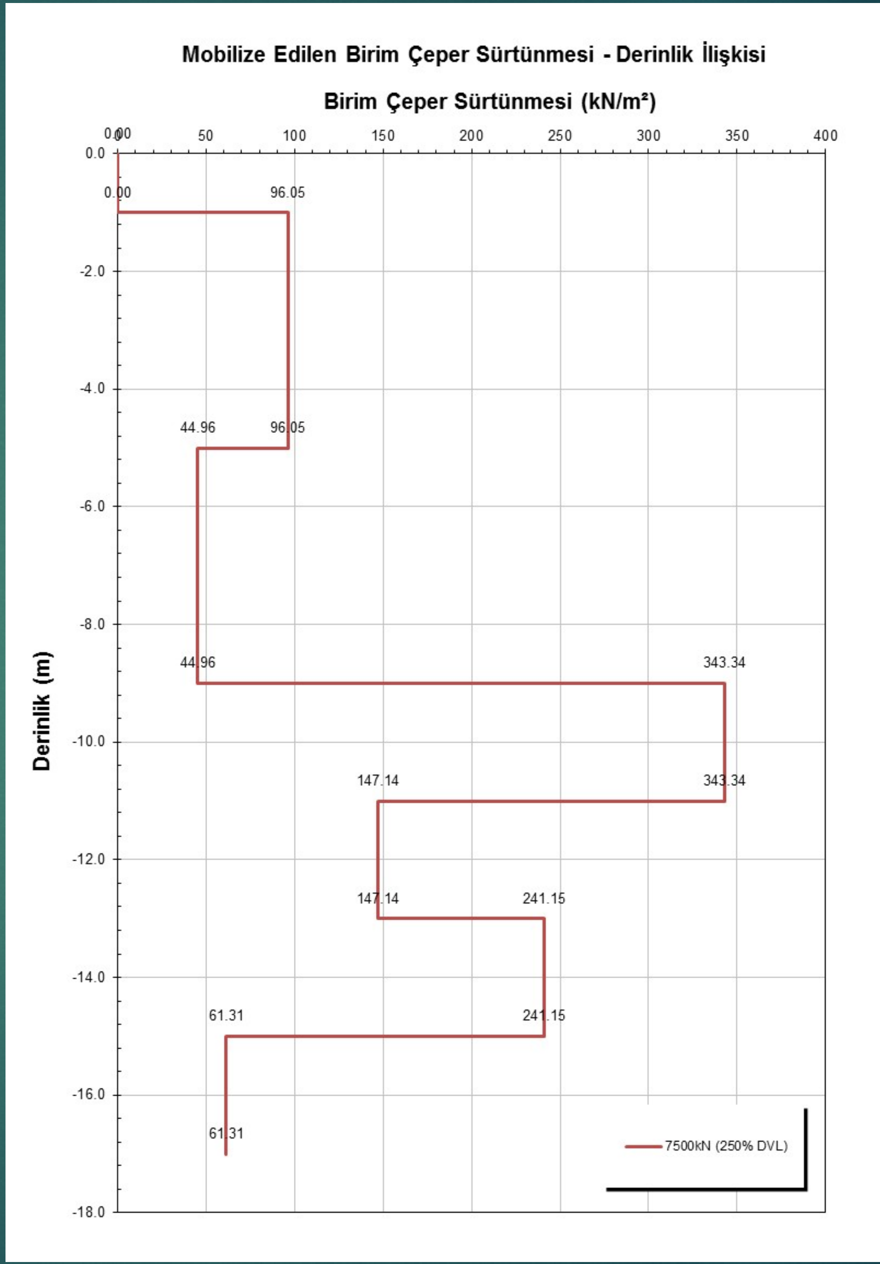

Yükleme - Oturma Grafiği
Yükleme (t)
0
100
200
300
400
500
600
700
800
Oturma (mm)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

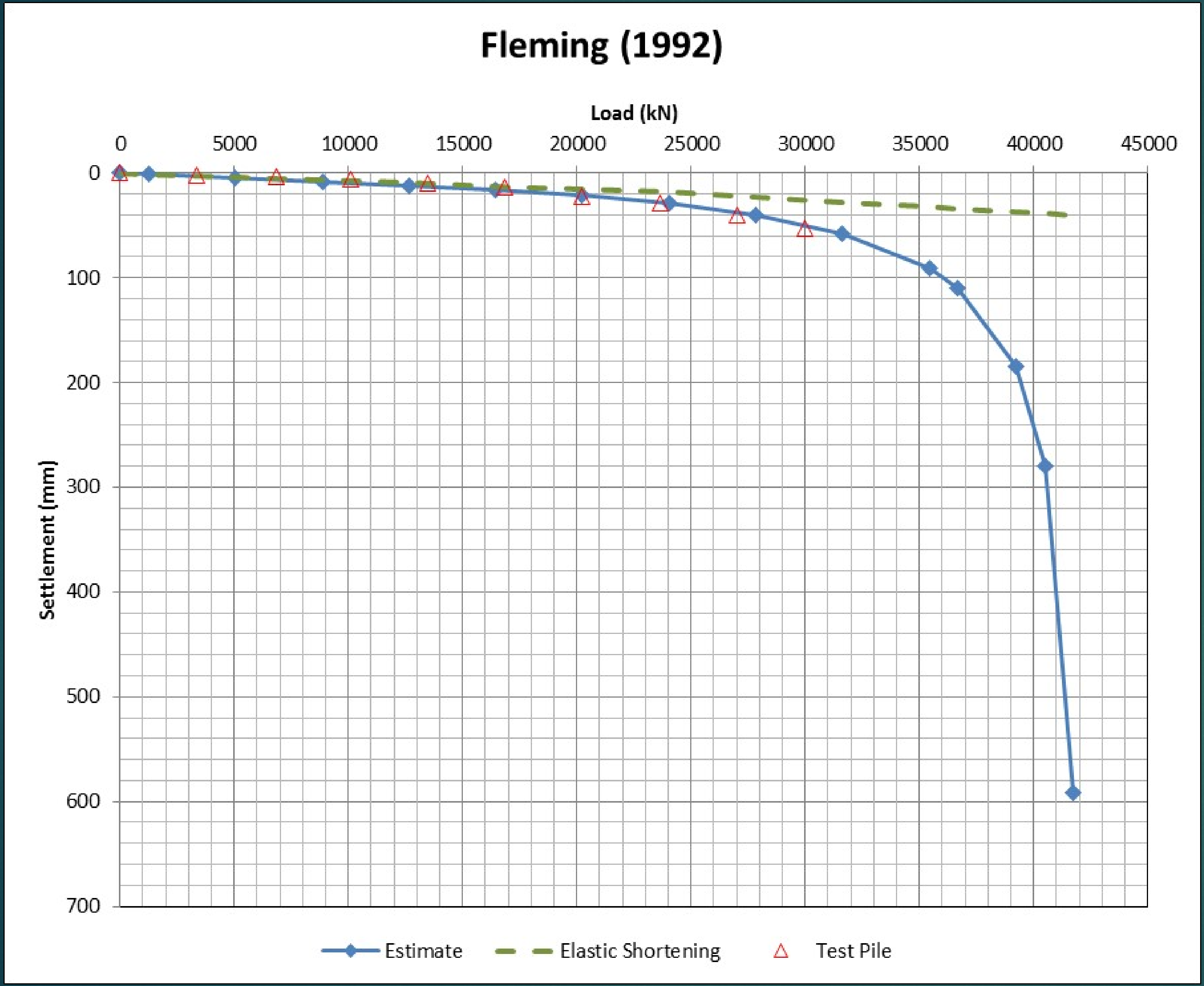

Yükleme - Zaman Grafiği
Zaman (dakika)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200
0 100 200 300 400 500 600 700 800
Yükleme (ton)

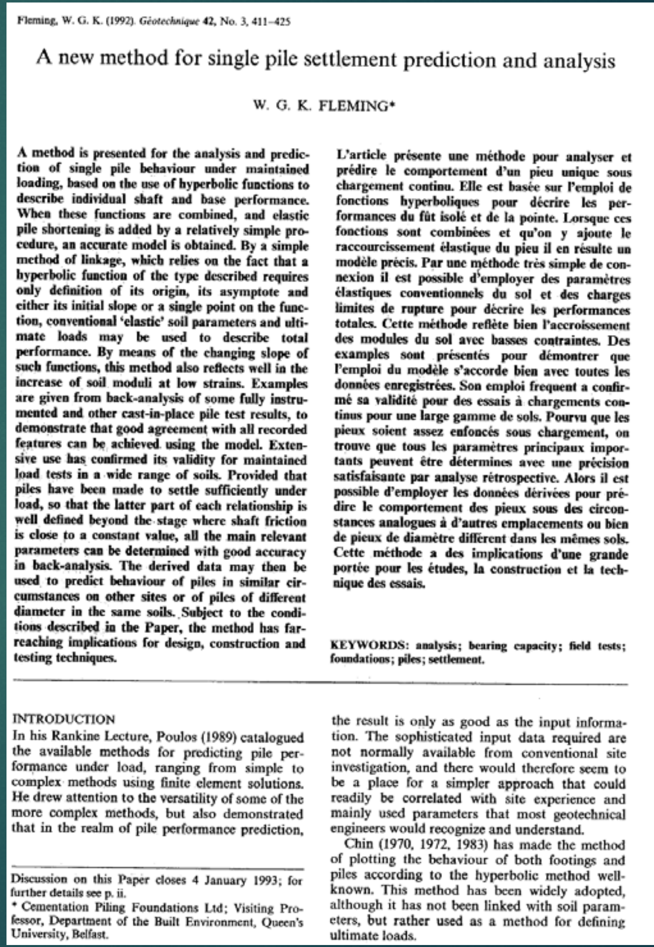

Chin (1978) Metodu
Oturma / Yükleme x10³
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
Oturma (mm)


Fleming (1992)
Yükleme kN)
0
5000
10000
15000
20000
25000
30000
Oturma (mm)
0
20
40
60
80
100
120
140
Tahmini Davranış
Elastik Kısalma


Düşey Eksenal Yük - Derinlik İlişkisi
Yük (kN)
Derinlik (m)
250% DVL
225% DVL
200% DVL
150% DVL
100% DVL


Mobilize Edilen Birim Çeper Sürtünmesi - Derinlik İlişkisi
Birim Çeper Sürtünmesi (kN/m²)
Derinlik (m)
7500kN (250% DVL)





Fleming, W. G. K. (1992). *Géotechnique* **42**, No. 3, 411–425

A new method for single pile settlement prediction and analysis

W. G. K. FLEMING*

A method is presented for the analysis and prediction of single pile behaviour under maintained loading, based on the use of hyperbolic functions to describe individual shaft and base performance. When these functions are combined, and elastic pile shortening is added by a relatively simple procedure, an accurate model is obtained. By a simple method of linkage, which relies on the fact that a hyperbolic function of the type described requires only definition of its origin, its asymptote and either its initial slope or a single point on the function, conventional 'elastic' soil parameters and ultimate loads may be used to describe total performance. By means of the changing slope of such functions, this method also reflects well in the increase of soil moduli at low strains. Examples are given from back-analysis of some fully instrumented and other cast-in-place pile test results, to demonstrate that good agreement with all recorded features can be achieved using the model. Extensive use has confirmed its validity for maintained load tests in a wide range of soils. Provided that piles have been made to settle sufficiently under load, so that the latter part of each relationship is well defined beyond the stage where shaft friction is close to a constant value, all the main relevant parameters can be determined with good accuracy in back-analysis. The derived data may then be used to predict behaviour of piles in similar circumstances on other sites or of piles of different diameter in the same soils. Subject to the conditions described in the Paper, the method has far-reaching implications for design, construction and testing techniques.

L'article présente une méthode pour analyser et prédire le comportement d'un pieu unique sous chargement continu. Elle est basée sur l'emploi de fonctions hyperboliques pour décrire les performances du fût isolé et de la pointe. Lorsque ces fonctions sont combinées et qu'on y ajoute le raccourcissement élastique du pieu il en résulte un modèle précis. Par une méthode très simple de connexion il est possible d'employer des paramètres élastiques conventionnels du sol et des charges limites de rupture pour décrire les performances totales. Cette méthode reflète bien l'accroissement des modules du sol avec basses contraintes. Des examples sont présentés pour démontrer que l'emploi du modèle s'accorde bien avec toutes les données enregistrées. Son emploi frequent a confirmé sa validité pour des essais à chargements continus pour une large gamme de sols. Pourvu que les pieux soient assez enfoncés sous chargement, on trouve que tous les paramètres principaux importants peuvent être détermines avec une précision satisfaisante par analyse rétrospective. Alors il est possible d'employer les données dérivées pour prédire le comportement des pieux sous des circonstances analogues à d'autres emplacements ou bien de pieux de diamètre différent dans les mêmes sols. Cette méthode a des implications d'une grande portée pour les études, la construction et la technique des essais.

KEYWORDS: analysis; bearing capacity; field tests; foundations; piles; settlement.

INTRODUCTION

In his Rankine Lecture, Poulos (1989) catalogued the available methods for predicting pile performance under load, ranging from simple to complex methods using finite element solutions. He drew attention to the versatility of some of the more complex methods, but also demonstrated that in the realm of pile performance prediction, the result is only as good as the input information. The sophisticated input data required are not normally available from conventional site investigation, and there would therefore seem to be a place for a simpler approach that could readily be correlated with site experience and mainly used parameters that most geotechnical engineers would recognize and understand.

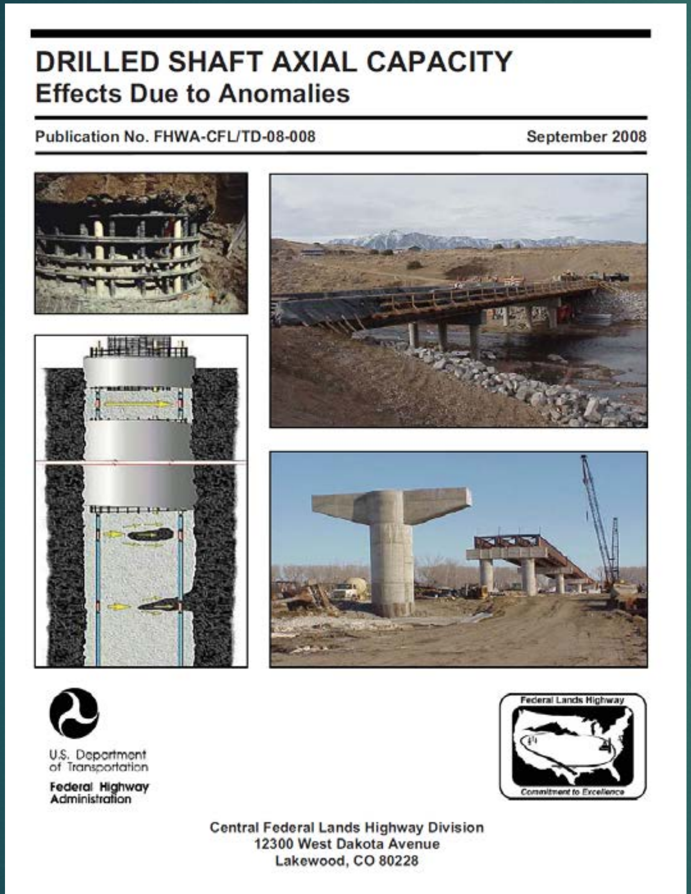
Chin (1970, 1972, 1983) has made the method of plotting the behaviour of both footings and piles according to the hyperbolic method well-known. This method has been widely adopted, although it has not been linked with soil parameters, but rather used as a method for defining ultimate loads.

Discussion on this Paper closes 4 January 1993; for further details see p. ii.

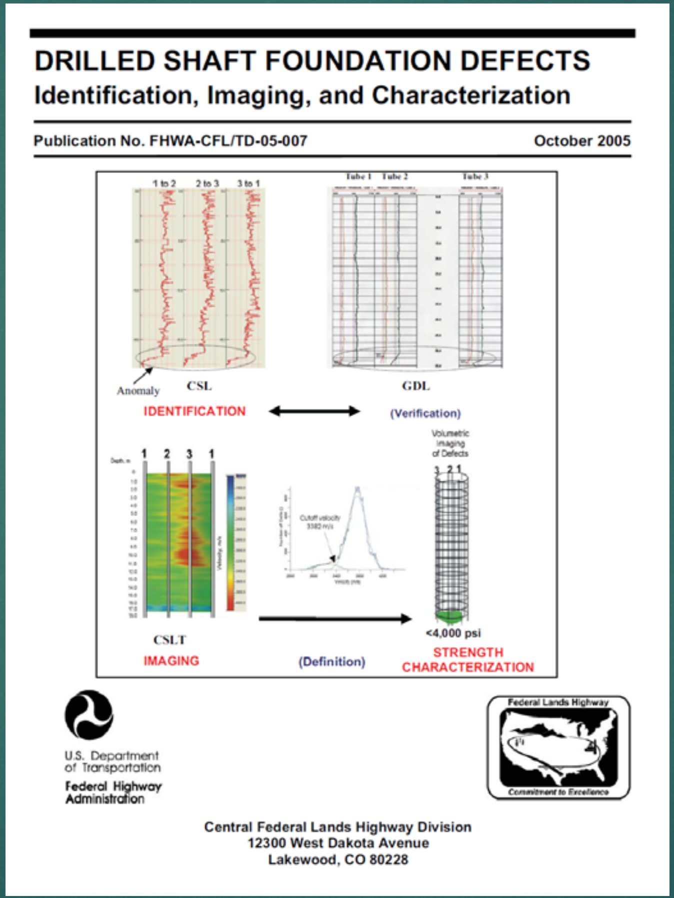
* Cementation Piling Foundations Ltd; Visiting Professor, Department of the Built Environment, Queen's University, Belfast.

Problem Karşısında Alınabilecek Kararlar

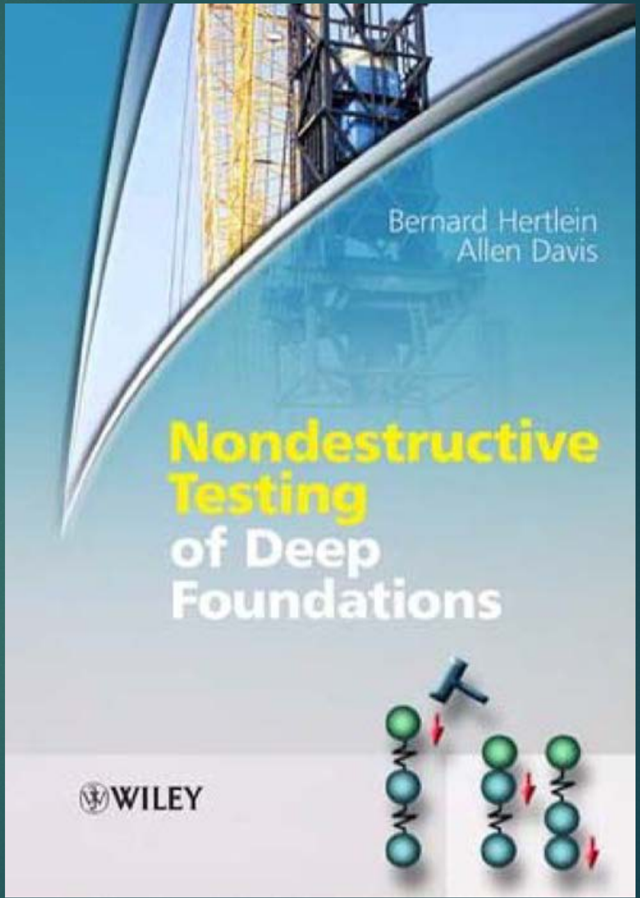
- Problem ne kadar geç farkedilirse makul bir çözüm bulma olasılığı bir o kadar azalır. En doğru yaklaşım proje aşamasında muhtemel sorunları ve riskleri tespit edip bunların tasarım aşamasında çözümlenmesi ve bütçelendirilmesidir.
- Şayet inşaat aşamasında problem farkedilirse bina içinden veya çevresinden derin temel uygulamasına gidilip gidilemeyeceğine bakılır ama yeni kazıklar gerilimi alana kadar deformasyonlar daha da ilerleyebilir.
- Ekonomik açıdan makul görülürse yük hafifletmek için kat adeti sayısında azaltmaya gidilebilir.
- Servis yüklerini azaltmak için daha hafif inşaat malzemesi kullanımına gidilebilir.
- İleri analiz yöntemleri ile sorunun uzun vadede sürüp sürmeyeceği araştırılır gerekiyorsa ilave sondajlar yapılır.
- Façade, asansör ve mekanik sistemlerde ileride doğabilecek muhtemel problemlerin sorumlularca düzeltilmesi kabul edilir.
- Nihai kazık kapasitesi yapısal ve geoteknik kapasite hesaplarından çıkan sonuçların minimum değerine karşılık gelir. Yapısal kapasitenin daha düşük çıkabileceği unutulmamalıdır.



DRILLED SHAFT AXIAL CAPACITY
Effects Due to Anomalies
Publication No. FHWA-CFL/TD-08-008
September 2008
U.S. Department of Transportation
Federal Highway Administration
Federal Lands Highway
Commitment to Excellence
Central Federal Lands Highway Division
12300 West Dakota Avenue
Lakewood, CO 80228



DRILLED SHAFT FOUNDATION DEFECTS
Identification, Imaging, and Characterization
Publication No. FHWA-CFL/TD-05-007
October 2005
Anomaly
CSL
GDL
IDENTIFICATION
(Verification)
CSLT
IMAGING
(Definition)
<4,000 psi
STRENGTH CHARACTERIZATION
U.S. Department of Transportation
Federal Highway Administration
Federal Lands Highway
Commitment to Excellence
Central Federal Lands Highway Division
12300 West Dakota Avenue
Lakewood, CO 80228



Bernard Hertlein
Allen Davis
Nondestructive Testing of Deep Foundations
WILEY