

# NİSSİBİ KÖPRÜSÜ YAPISAL İZLEME SİSTEMİ VE YÜKLEME TESTLERİ



*Altok KURŞUN   Arif ERDİŞ   Alemdar BAYRAKTAR  
Gülsan Holding A.Ş.*

# İÇERİK

- Köprü ve Taşıyıcı Sistemi Bilgileri
- Köprü İzleme Sistemi Bilgileri
- Statik ve Dinamik Yükleme Testleri
- Köprü İzleme Sistemi Örnek Ölçüm Sonuçları
- **2 Mart 2017 Samsat-Adıyaman Depremi ( $M_w=5.5$ ) Sırasında Köprü Davranışı**

# KÖPRÜ VE TAŞIYICI SİSTEMİ BİLGİLERİ



İdare/ Investor:

T.C. ULAŞTIRMA DENİZCİLİK VE HABERLEŞME BAKANLIĞI  
KARAYOLLARI GENEL MÜDÜRLÜĞÜ - 9. BÖLGE MÜDÜRLÜĞÜ

Republic of Turkey: Ministry of transport, maritime affairs and communications  
General Directorate of Highways – 9th Regional Directorate

Proje/Designer:

(İhale Dökümantasyonu)  
**YÜKSEL PROJE** **ponting**  
mostovi

(Uygulama ve Detay)  
**GÜLSAN** **wiecon**

Yüklenici/Contractor:

GÜLSAN AŞ



Başlangıç Tarihi/Beginning date: 25.01.2012

Bitiş Tarihi/Finishing date: 14.05.2015

İhale Bedeli / Tender Cost: 81.757.513 TL

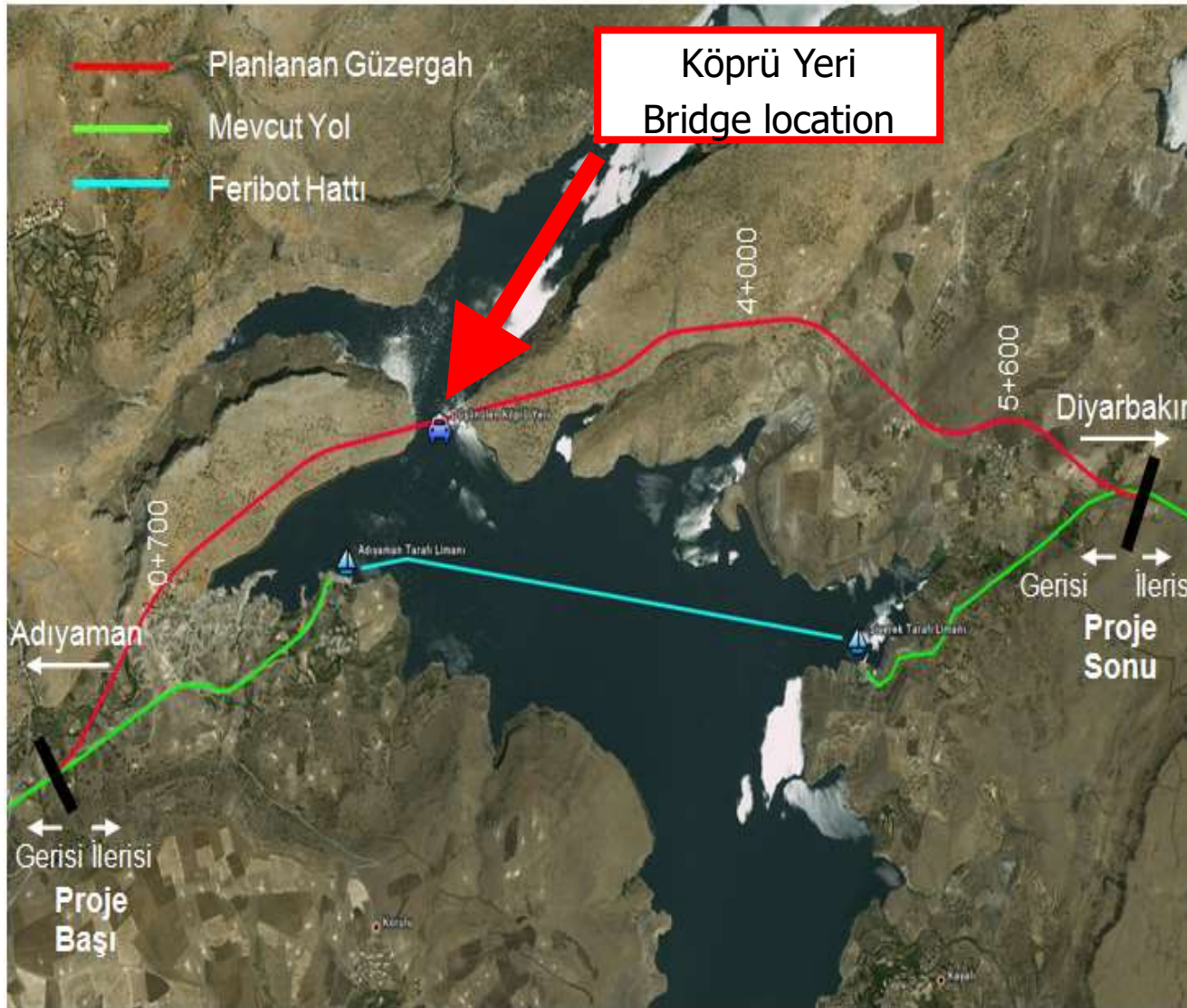
Danışman/Supervision:

EMAY AŞ



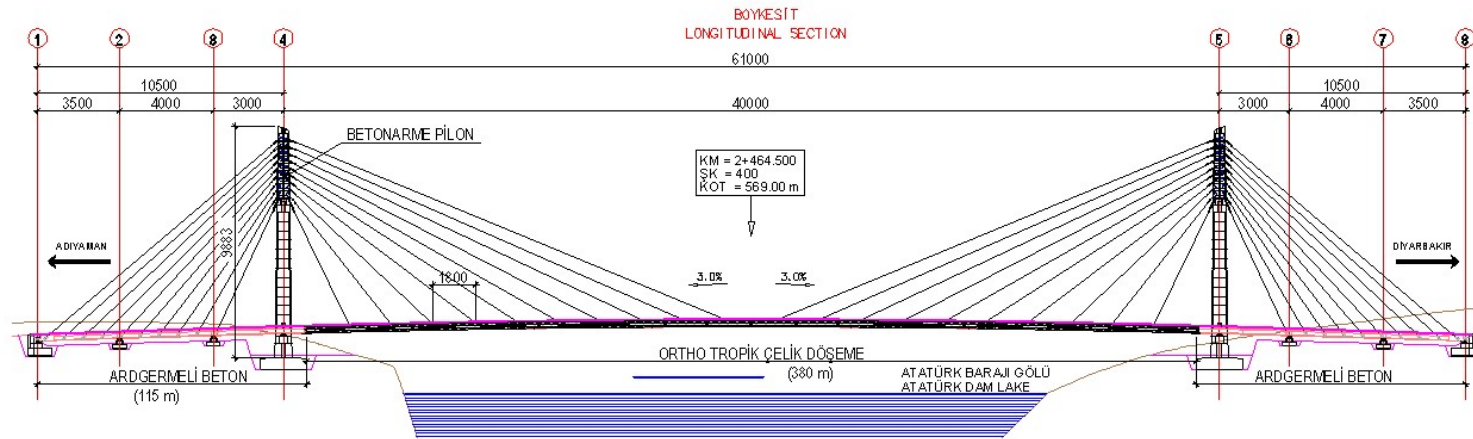


# KÖPRÜ VE TAŞIYICI SİSTEMİ BİLGİLERİ



HAREKET SAATLERİ/TimeTable	
<b>Kahta'dan</b> From Kahta To Siverek	<b>Siverek'ten</b> From Siverek To Kahta
07:00	8:00
08:30	09:30
10:30	11:30
12:30	13:30
14:30	15:30
16:30	17:30
Kış:18:30	Kış:19:30
Yaz:20:30	Yaz:21:30

# KÖPRÜ VE TAŞIYICI SİSTEMİ BİLGİLERİ



## Beton

Pilon: C50/60

Pilon Temeli, Orta ve Kenarayaklar: C30/37

Mesnet Blokları: C50/60

Ardgermeli Beton: C40/50

## Çelik

Yapısal Çelik : S355

Betonarme Çeliği: BÇ-IVa ( $f_y = 500$  Mpa)

## Kablolar

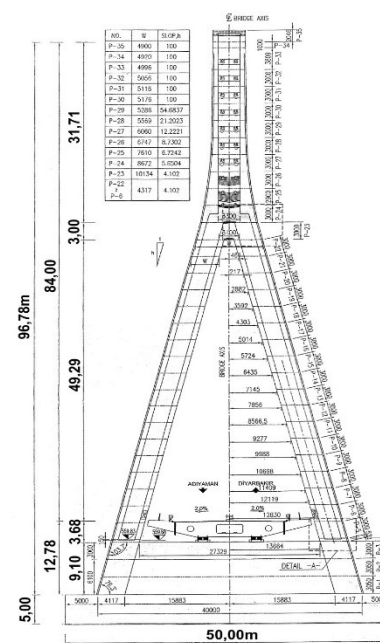
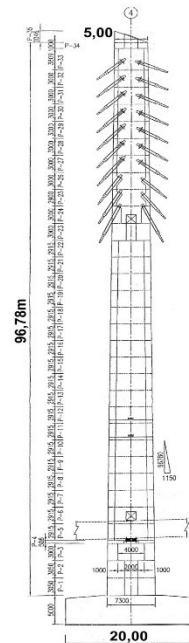
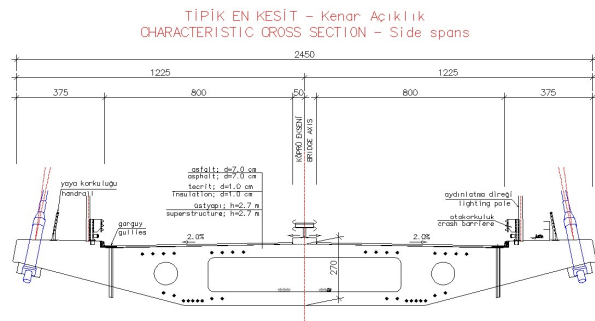
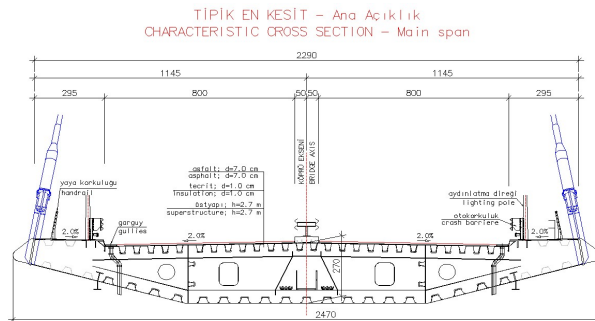
Gr 1600 / 1860  $\phi$  15.7mm Düşük Gevşemeli

Kopma Dayanımı : 1860 MPa

Akma Dayanımı : 1600 MPa

Kesit Alanı : 150 mm<sup>2</sup>

Elastisite Modülü : 195000 MPa

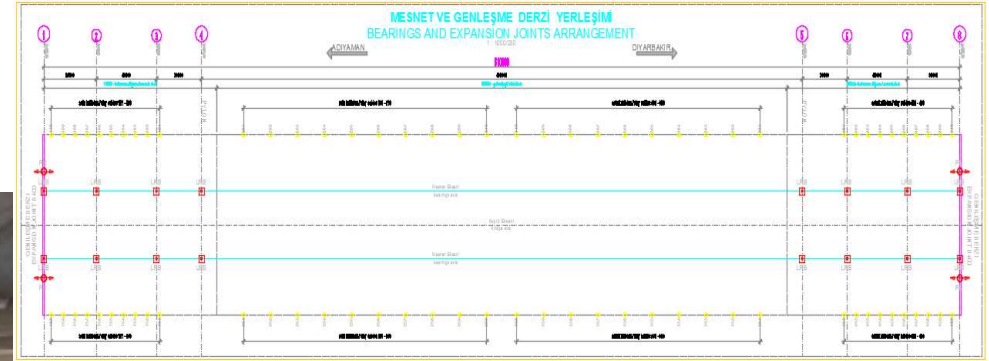
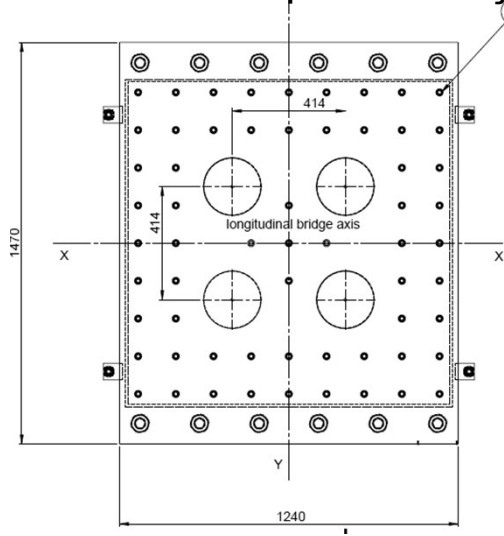


- Zemin: Gaziantep formasyonu
- Pilon temel: (50m x20m x5m)  
dikdörtgen yüzeysel temel
- Tipik ayak temeli: (13.3m x6m x1.5m)  
yüzeysel temel
- Kenarayak temeli: (28.7m x12.2m  
x1.5m) yüzeysel temel
- Köprü yan açıklık ayakları ve  
kenarayak: betonarme yapı

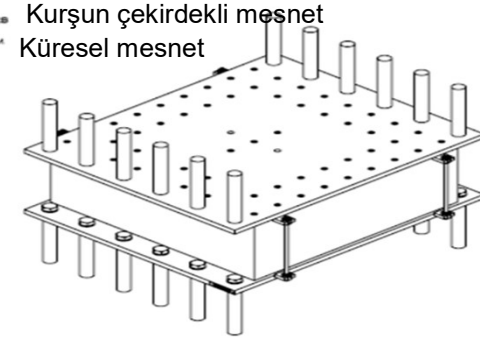


# KÖPRÜ VE TAŞIYICI SİSTEMİ BİLGİLERİ

Köprü Üst Döşemesi LRB Mesnetler



Kurşun çekirdekli mesnet  
Küresel mesnet



ASKI KABLOSU / CABLE STAYS 101 - 110   151 - 160		
Cable Stay Sign Askı Kablosu No	Internal Hydraulic Damper Dahili Hidrolik Sönümleyici	Σ Piece Σ Adet
101, 151	-	-
102, 152	-	-
103, 153	-	-
104, 154	-	-
105, 155	-	-
106, 156	-	-
107, 157	-	-
108, 158	1	2
109, 159	1	2
110, 160	1	2
TOTAL / TOPLAM		6

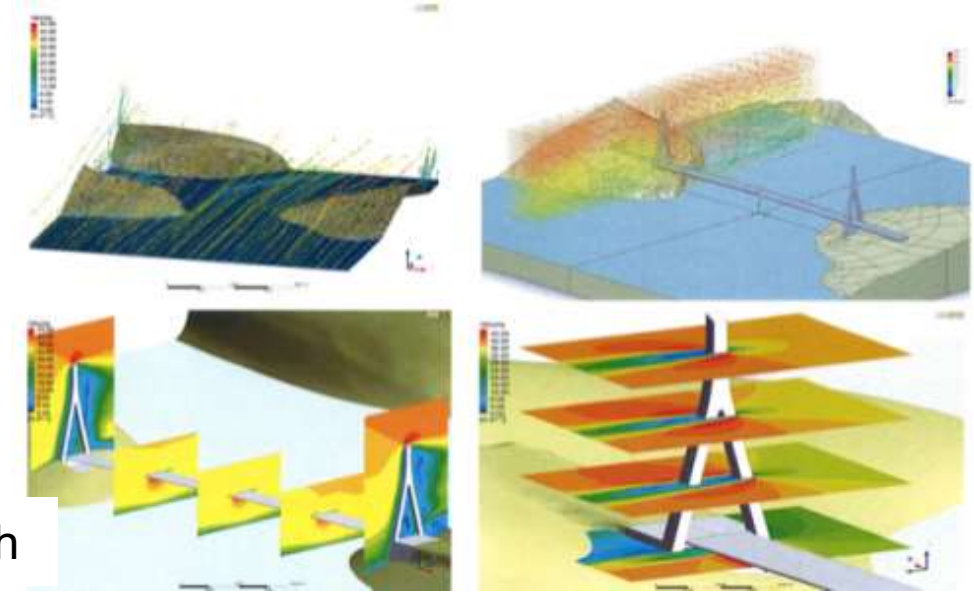
Kablo Sönümleyicileri (36 adet)



ASKI KABLOSU / CABLE STAYS 201 - 210   251 - 260		
Cable Stay Sign Askı Kablosu No	Internal Hydraulic Damper Dahili Hidrolik Sönümleyici	Σ Piece Σ Adet
201, 251	-	-
202, 252	-	-
203, 253	-	-
204, 254	-	-
205, 255	1	2
206, 256	1	2
207, 257	1	2
208, 258	1	2
209, 259	1	2
210, 260	1	2
TOTAL / TOPLAM		12

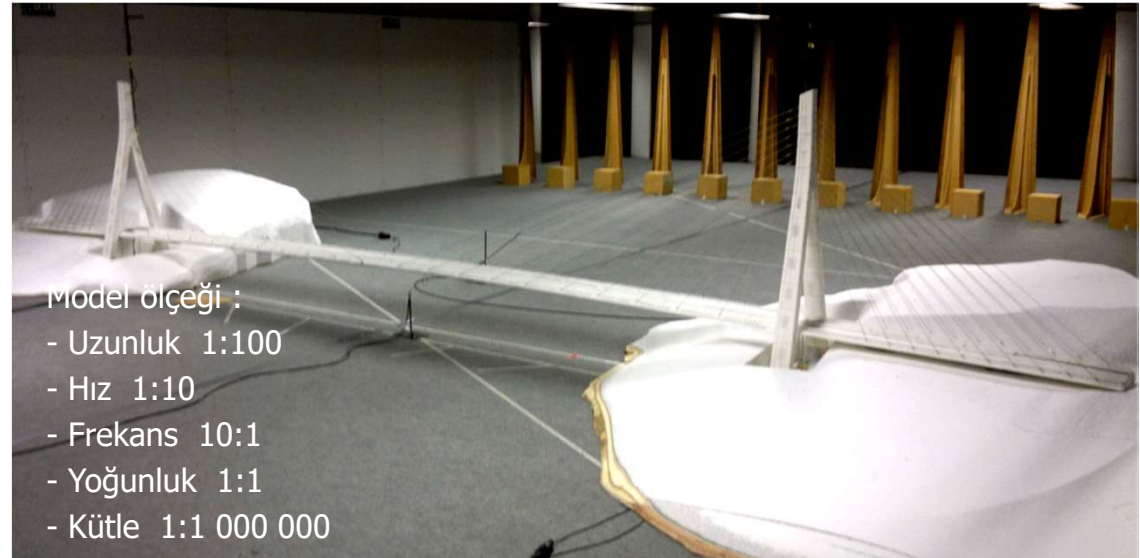
# KÖPRÜ VE TAŞIYICI SİSTEMİ BİLGİLERİ

❑ Nissibi köprüsünün tasarımında kesitin aerodinamik özellikleri CFD (Computational Fluid Dynamics) yöntemiyle belirlenmiştir.



❑ Tasarım rüzgar hızı:  $33.6 \text{ m/s} = 120 \text{ km/h}$

❑ Tüzgar tüneli testi yapılmıştır.



Model ölçeği :  
- Uzunluk 1:100  
- Hız 1:10  
- Frekans 10:1  
- Yoğunluk 1:1  
- Kütle 1:1 000 000

# KÖPRÜ VE TAŞIYICI SİSTEMİ BİLGİLERİ

Zemin sınıfı: B

Spektrum eğrilerinin elde edilmesi ( Her deprem seviyesi için )

Boylam = 39.00

Enlem = 37.90

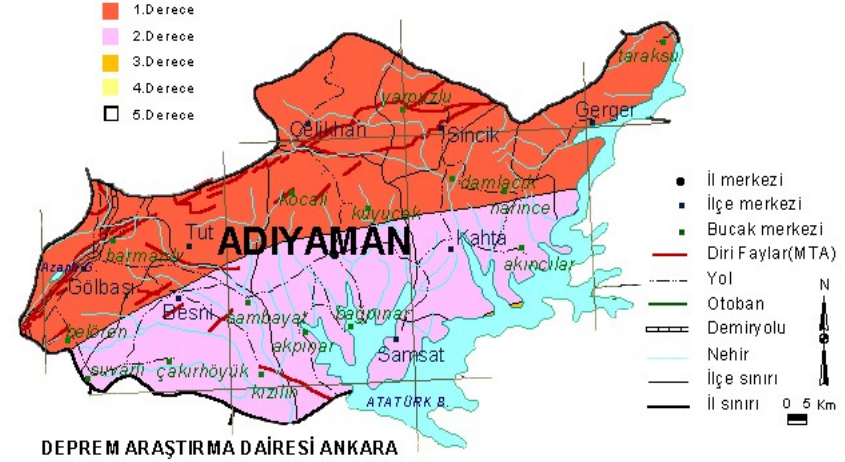
Spektral ivme değerleri : ( EK-A' ya göre )

**$S_s$  değerleri ;**

50 yılda aşılma olasılığı %50	=	0.33	( $D_1$ depremi , 75 yıllık deprem )
50 yılda aşılma olasılığı %10	=	0.66	( $D_2$ depremi , 475 yıllık deprem )
50 yılda aşılma olasılığı %02	=	1.04	( $D_3$ depremi , 2475 yıllık deprem )

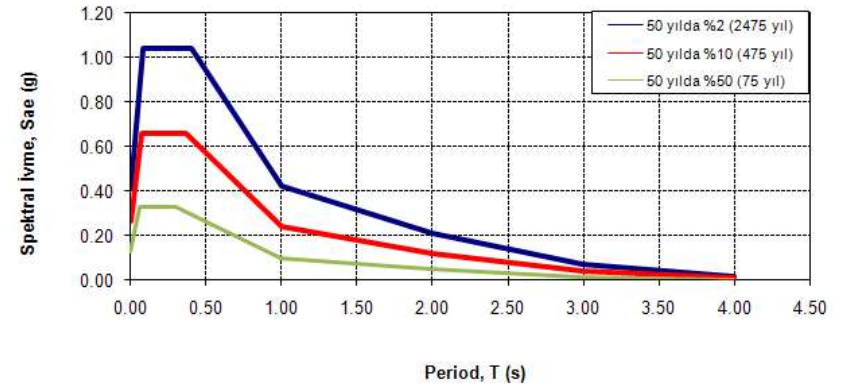
**$S_1$  değerleri ;**

50 yılda aşılma olasılığı %50	=	0.10	( $D_1$ depremi , 75 yıllık deprem )
50 yılda aşılma olasılığı %10	=	0.24	( $D_2$ depremi , 475 yıllık deprem )
50 yılda aşılma olasılığı %02	=	0.42	( $D_3$ depremi , 2475 yıllık deprem )



DEPREM ARAŞTIRMA DAİRESİ ANKARA

**NEHRP Tasarım Spektrumu**  
(Nissibi Köprüsü)





# KÖPRÜ İZLEME SİSTEMİ BİLGİLERİ

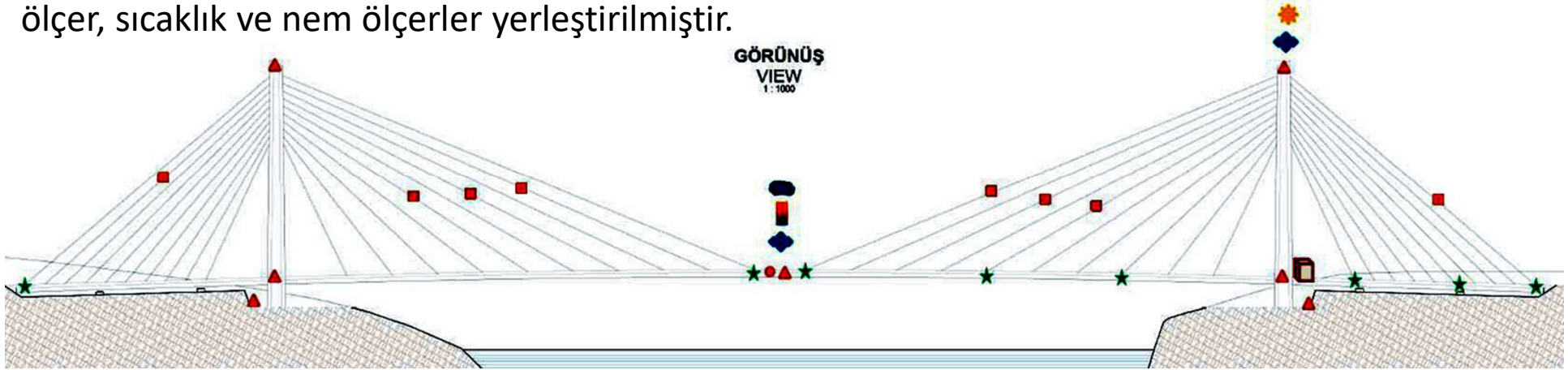
Mühendislik yapılarında yapısal sağlık izlemelerinin hem aletsel hem de gözlemsel olarak yapılması sonucu;

- Hasara yönelik erken teşhis,
- Onarım ve bakım maliyetinin azalması,
- Toptan ani göçmenin önlenmesi,
- Mühendislik yapılarının davranışlarının belirlenmesine yönelik teorik bilgilerin iyileştirilmesi

sağlanır.

# KÖPRÜ İZLEME SİSTEMİ BİLGİLERİ

Köprüye sabit izleme sensörleri olarak kablo kuvvet ölçer, ivme ölçer, rüzgar hız ve yön ölçer, sıcaklık ve nem ölçerler yerleştirilmiştir.



★ Cable load cells to be provided by the cable supplier (8 stay cables): Final distribution by bridge desingner

▲ 3d-Accelerometers (total 4)

● 1d-Accelerometer (total 1)

■ 2d-Cable-Accelerometers (total 8): Final distribu

◆ Wind Sensors 3d ultrasonic (total 2)

☀ Solar radiation (Luminosity) (total 1)

◌ Air Humidity (total 1)

▬ Air Temperature (total 1)

MASTER-STATION

Pos.	Sensorgroup	Abbr.	Nos. of Sensors	Nos. of Channels
1	Ultrasonic wind 3D	UW	2	6
2	Air Temperature/Humidity	AT_H	1	2
3	Solar Radiation	SOL	1	1
4	Accelerometer 3D	A3	7	21
5	Accelerometer 1D	A1	1	1
6	Cable Accelerometer 2D	CA	8	16
7	Transmitter for Cable Load Cell	T-LC	8	8
Sum:			28	55

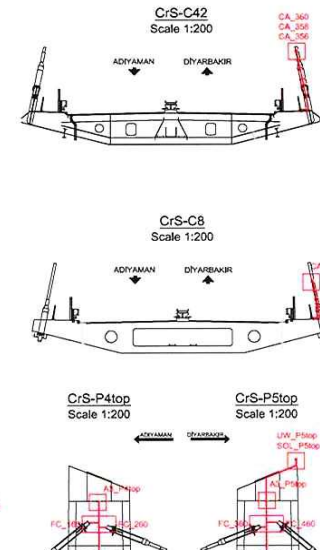
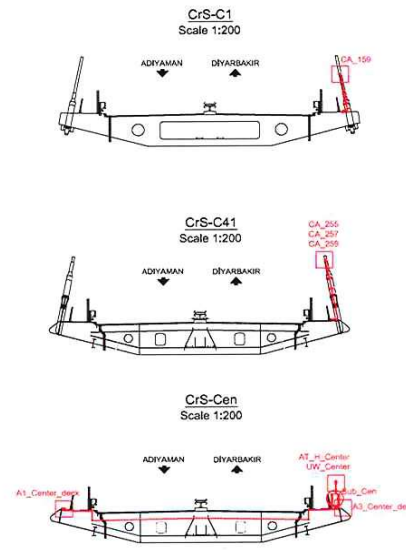
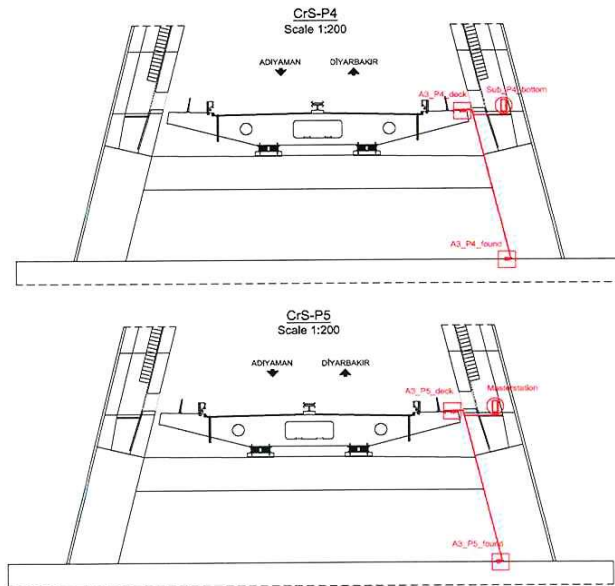
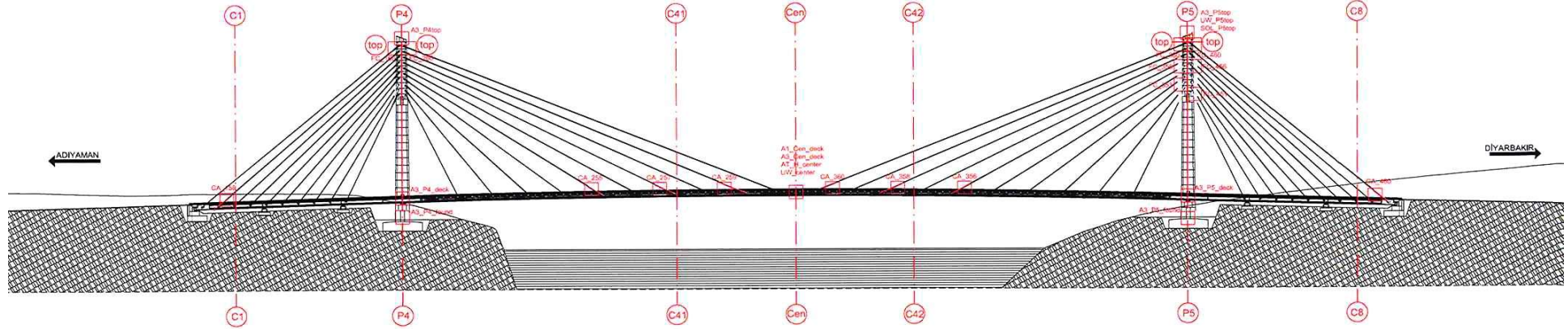
# KÖPRÜ İZLEME SİSTEMİ BİLGİLERİ

Pos	Sensor short name	Sensor long name	Type	Number of Channels	Cross Section
1	FC_160	Force Cable 160	T-LC	1	CrS-C1
2	CA_159	Acceleration Cable 159	CA	2	CrS-C1
3	A3_P4top	Acceleration 3D P4top	A3	3	CrS-P4top
4	A3_P4_found	Acceleration 3D P4 foundation	A3	3	CrS-P4
5	A3_P4_deck	Acceleration 3D P4 deck	A3	3	CrS-P4
6	CA_255	Acceleration Cable 255	CA	2	CrS-C41
7	CA_257	Acceleration Cable 257	CA	2	CrS-C41
8	CA_259	Acceleration Cable 259	CA	2	CrS-C41
9	FC_260	Force Cable 260	T-LC	1	CrS-Center
10	UW_center	Ultrasonic Wind 3D Main Span Center	W	0	CrS-Center
11	AT_H_center	Air Temperature and Humidity Center	AT_H	2	CrS-Center
12	A1_center_deck	Acceleration 1D Main Span Center deck	A1	1	CrS-Center
13	A3_center_deck	Acceleration 3D Main Span Center deck	A3	3	CrS-Center
14	FC_360	Force Cable 360	T-LC	1	CrS-Center
15	CA_360	Acceleration Cable 360	CA	2	CrS-C42
16	CA_358	Acceleration Cable 358	CA	2	CrS-C42
17	CA_356	Acceleration Cable 356	CA	2	CrS-C42
18	FC_356	Force Cable 356	T-LC	1	CrS-C42
19	FC_353	Force Cable 353	T-LC	1	CrS-P5
20	UW_P5top	Ultrasonic Wind P5top	W	1	CrS-P5top
21	SOL_P5top	Solar Radiation P5top	S	1	CrS-P5top
22	A3_P5top	Acceleration 3D P5top	A3	3	CrS-P5top
23	A3_P5_found	Acceleration 3D P5 found	A3	3	CrS-P5
24	A3_P5_deck	Acceleration 3D P5 deck	A3	3	CrS-P5
25	FC_451	Force Cable 451	T-LC	1	CrS-P5
26	CA_460	Acceleration Cable 460	CA	2	CrS-C8
27	FC_456	Force Cable 456	T-LC	1	CrS-C8
28	FC_460	Force Cable 460	T-LC	1	CrS-C8

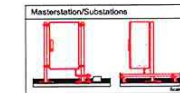
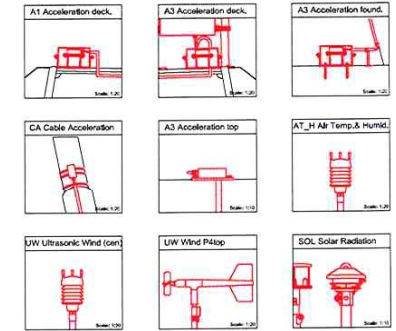


# KÖPRÜ İZLEME SİSTEMİ BİLGİLERİ

NISSIBI BRIDGE



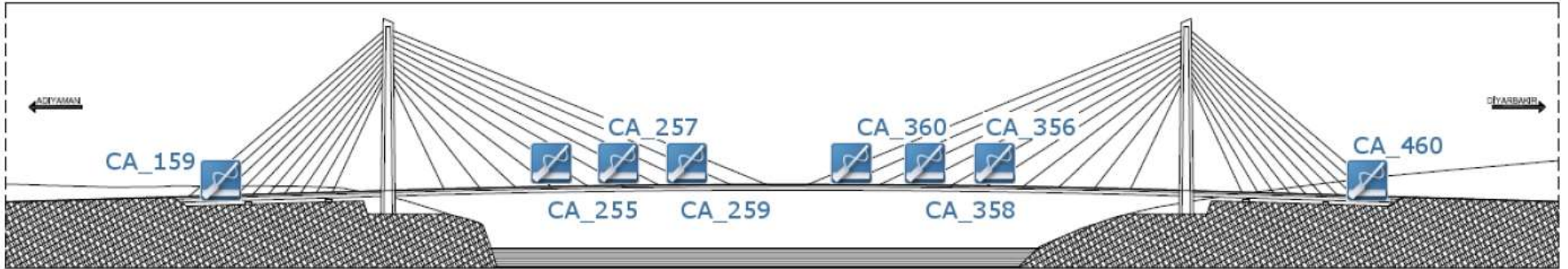
Sensortypes:



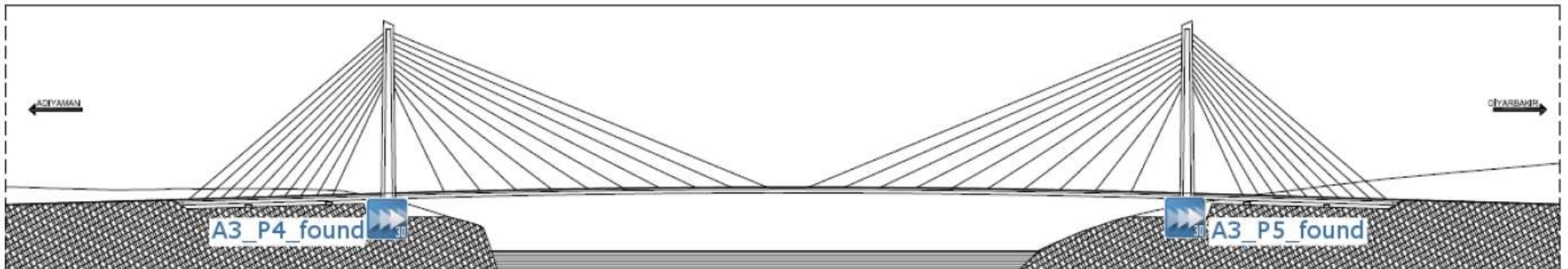
Station Name	Station Location
CrS-P4	Pier 4
CrS-P5	Pier 5
CrS-C1	Center Pier
CrS-C41	Center Pier
CrS-C42	Center Pier
CrS-C8	Center Pier
CrS-Cen	Center Pier
CrS-P4top	Pier 4 Top
CrS-P5top	Pier 5 Top
CrS-C1top	Center Pier Top
CrS-C41top	Center Pier Top
CrS-C42top	Center Pier Top
CrS-C8top	Center Pier Top
CrS-Centop	Center Pier Top
CrS-P4deck	Pier 4 Deck
CrS-P5deck	Pier 5 Deck
CrS-C1deck	Center Pier Deck
CrS-C41deck	Center Pier Deck
CrS-C42deck	Center Pier Deck
CrS-C8deck	Center Pier Deck
CrS-Centdeck	Center Pier Deck
CrS-P4foundation	Pier 4 Foundation
CrS-P5foundation	Pier 5 Foundation
CrS-C1foundation	Center Pier Foundation
CrS-C41foundation	Center Pier Foundation
CrS-C42foundation	Center Pier Foundation
CrS-C8foundation	Center Pier Foundation
CrS-Centfoundation	Center Pier Foundation

# KÖPRÜ İZLEME SİSTEMİ BİLGİLERİ

Cable 2D accelerometers location

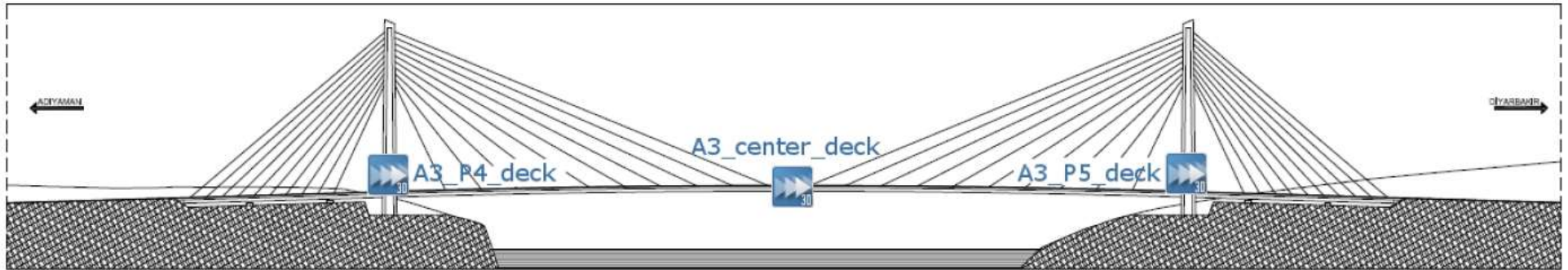


3D accelerometers location at foundation level

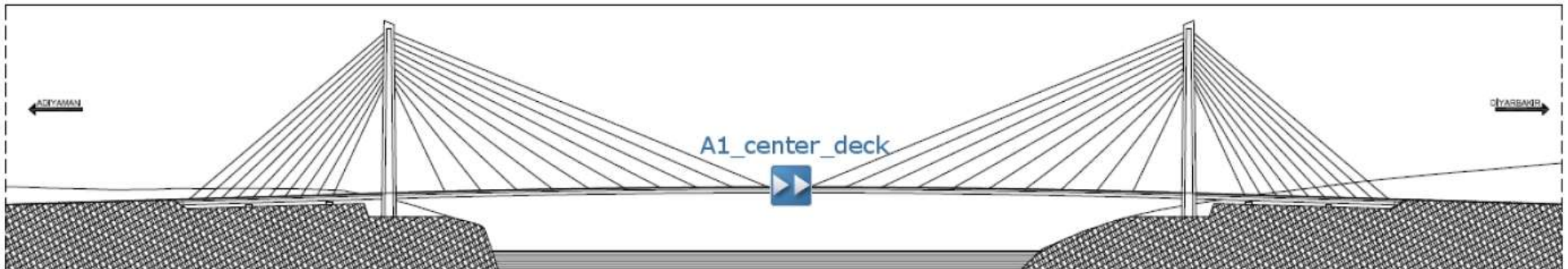


# KÖPRÜ İZLEME SİSTEMİ BİLGİLERİ

3D accelerometers location at deck level



1D accelerometers location at deck level





# KÖPRÜ İZLEME SİSTEMİ BİLGİLERİ

## Sensor types – Load cell



Parameter	Value
Measurement type	Static or dynamic
Global error	<0.5 kN
Span	160 kN
Material	Steel (the same material as the stay anchorages)
Operating temperature	-25°C to 75°C
Protection	Class IP67
Current conditioning system types	Isotension / voltage Isotension / current

# KÖPRÜ İZLEME SİSTEMİ BİLGİLERİ

## Sensor types – Cable Accelerometers



Parameter	Value
Measuring range	+/-2g
Use temperature	-20°C / +80°C
Shock	>1500g
Average life	10 years
Power consumption	<1,5 W
Protection index	IP65

# KÖPRÜ İZLEME SİSTEMİ BİLGİLERİ

## Sensor types - Accelerometers





# KÖPRÜ İZLEME SİSTEMİ BİLGİLERİ

## Sensor types – meteorological station



Ultrasonic Anemometer measures:

- wind speed
- wind direction
- air temperature
- air humidity

Parameter	Value
Wind speed measuring range	0-60m/s
Wind direction measuring range	0-360°
Air temperature measurement range	+/-50°C
Air relative humidity measurement range	0-100%
Luminosity measurement range	0-100W/m <sup>2</sup>
Sampling frequency	0 to 20Hz
Use temperature	-50°C / +50°C
Average life	10 years
Power consumption	<3 W
Protection index	IP65



Pyranometer measures solar radiation (Luminosity)

In the middle of the main span



# KÖPRÜ İZLEME SİSTEMİ BİLGİLERİ

Sensor types – meteorological station  
P5





# KÖPRÜ İZLEME SİSTEMİ BİLGİLERİ

Master station



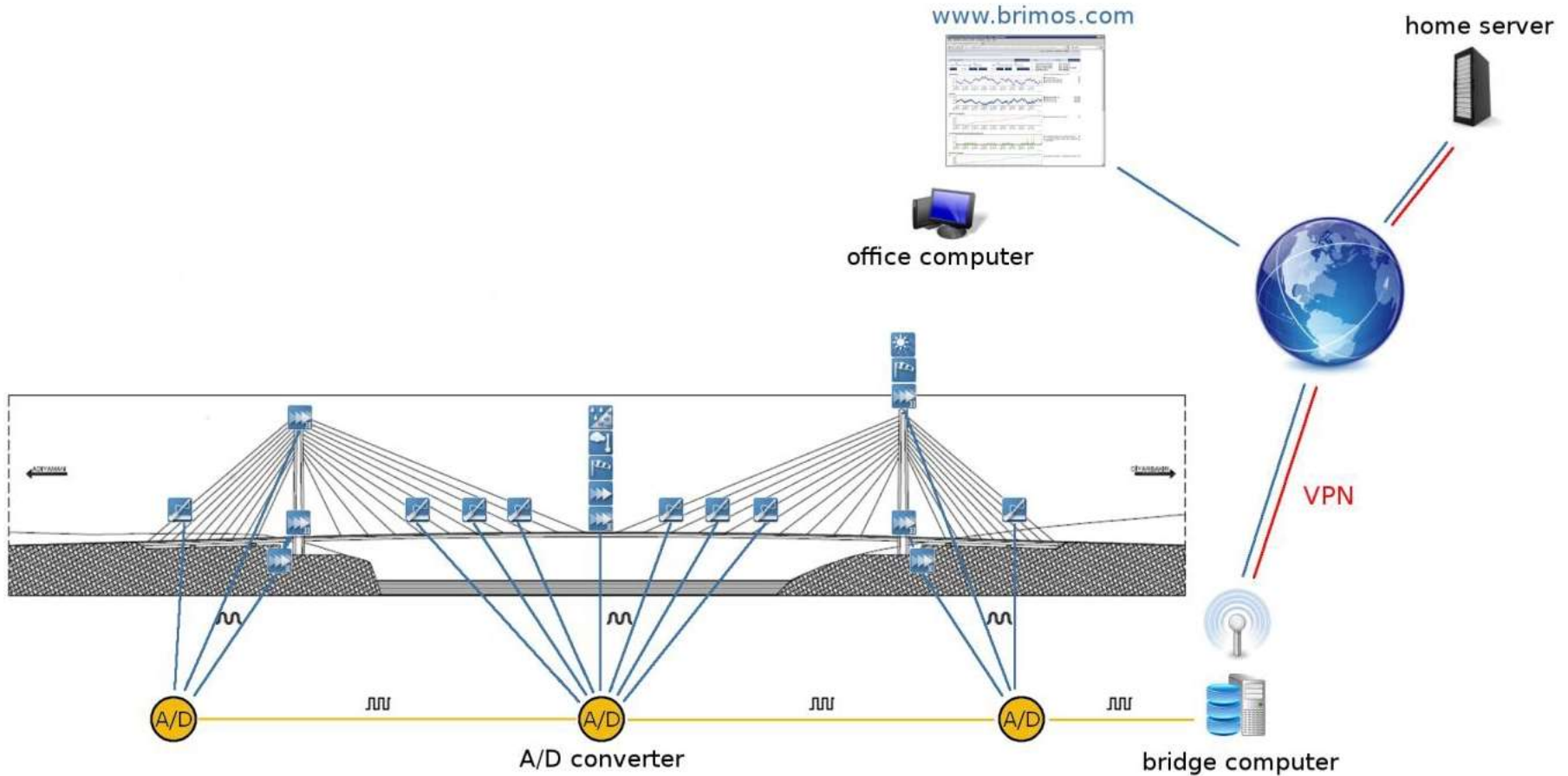
Inside pylon 4





# KÖPRÜ İZLEME SİSTEMİ BİLGİLERİ

## Bridge monitoring software



# KÖPRÜ İZLEME SİSTEMİ BİLGİLERİ

Welcome Nissibi Monitoring

• Login • **Overview** Logout

Permanent monitoring on Nissibi Köprüsü


About

Nissibi Köprüsü (Türkiye)

FilezoneTimebase: automzAlarmsAll data


**Project description:**

The Nissibi cable stayed road bridge project is to cross the upper reaches of the 817 km2 reservoir created by the Ataturk Dam across the Euphrates River in south eastern Anatolia. Nissibi cable stayed road bridge will connect Adiyaman City across the Euphrates River to the historic city of Diyarbakir on the banks of the Tigris River. ... [more](#)

**Image gallery:**

**Position of the bridge:**

Nissibi Köprüsü  
Coordinates: Lat. 37,893 - Long. 38,982



[Google Maps: Click here](#)

**Selected Monitoring Data:**

Cable Force

- Pylon 4 - Adiyaman
- Pylon 5 - Diyarbakir

Cable Acceleration

- Pylon 4 - Adiyaman
- Pylon 5 - Diyarbakir

Cable Acceleration Trendcards

- Pylon 4 - Adiyaman
- Pylon 5 - Diyarbakir

Acceleration 3D

- Pylon 4 - Adiyaman
- Center deck
- Pylon 5 - Diyarbakir

Acceleration 1D


- Center deck

Seismic Acceleration 3D

- Pylon 4 - Adiyaman
- Pylon 5 - Diyarbakir

Meteorological Conditions

- Meteorological Conditions

**Overview:**

Nissibi Köprüsü Yapısal İzleme Sistemi ve Yükleme Testleri

6. Çelik Köprüler ve Yapılar Çalıştayı, 15 Mayıs 2017, Ankara

# STARİK VE DİNAMİK YÜKLEME TESTLERİ

## Yükleme Deneylerinde Kullanılan Ölçüm Sistemleri

16-19 Mayıs 2015 tarihleri arasında köprüde çevresel titreşim deneyleri, farklı yüklemeye pozisyonları için statik ve dinamik yüklemeye deneyleri ile gözlemsel incelemeler gerçekleştirilmiştir.

## Köprü Sabit İzleme Ölçüm Sistemi

Köprüye sabit izleme sensörleri olarak kablo kuvvet ölçer, ivme ölçer, rüzgar hız ve yön ölçer, sıcaklık ve nem ölçerler yerleştirilmiştir.

## Jeodezik Ölçüm Sistemi

Köprünün yapım aşamalarında kullanılan sabit jeodezik ölçüm noktaları ve mobil aletleri, statik yüklemeye deneyleri sırasında da yerdeğiştirmeleri belirlemek için kullanılmıştır.

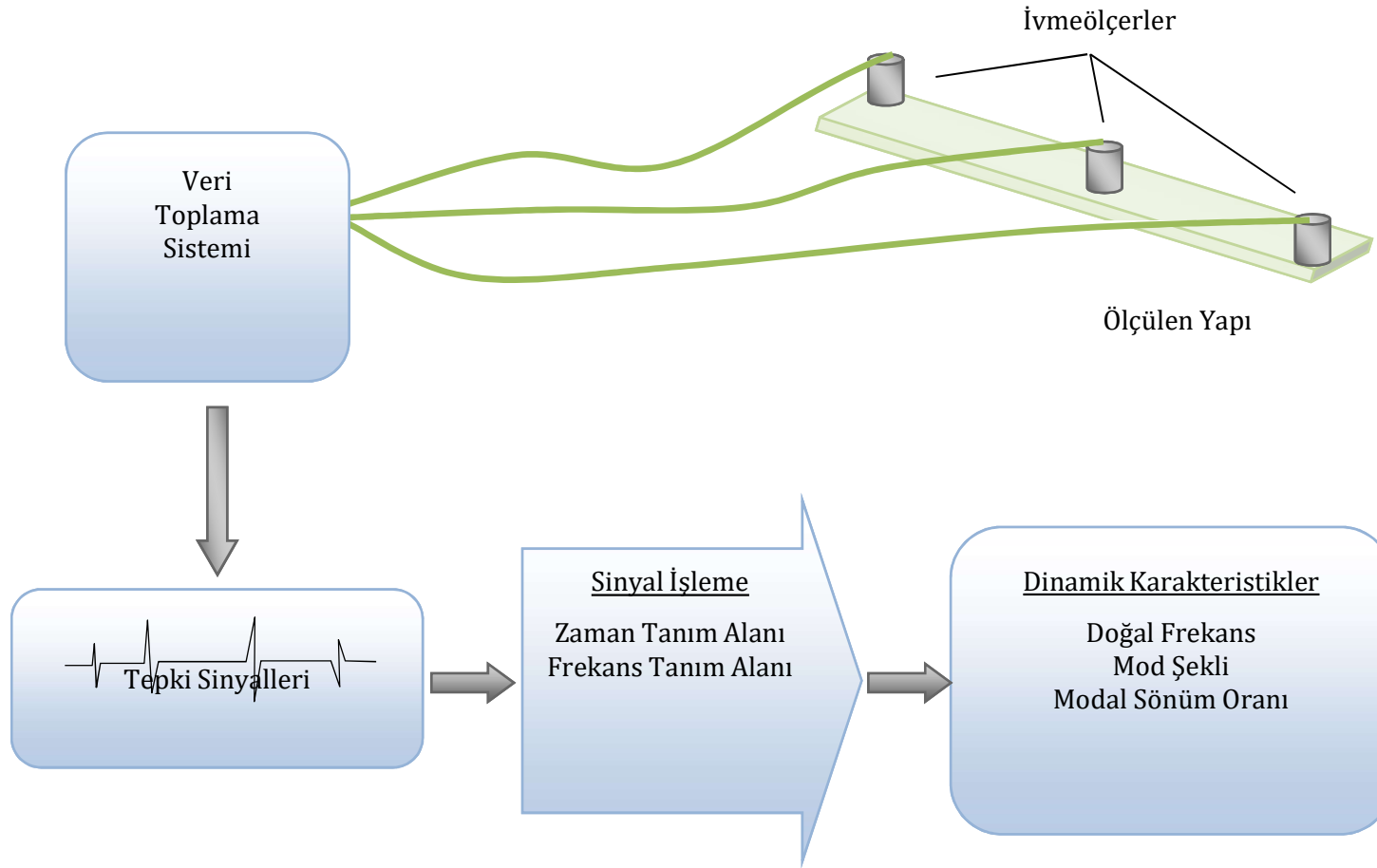
## Mobil Aletsel Ölçüm Sistemi

Köprüde yüklemeye deneyleri sırasında kablosuz mobil sistemlere göre daha hassas sonuçlar veren kablolu mobil ölçüm sistemi kullanılmıştır. Bu mobil ölçüm sistemi, kablolar, bir ve üç boyutlu hassas ivme ölçerler, datalogger ve bilgisayardan oluşmaktadır.



# ÇEVRESEL TİTREŞİM TESTLERİ

## Çevresel Titreşim Testi Yöntemi

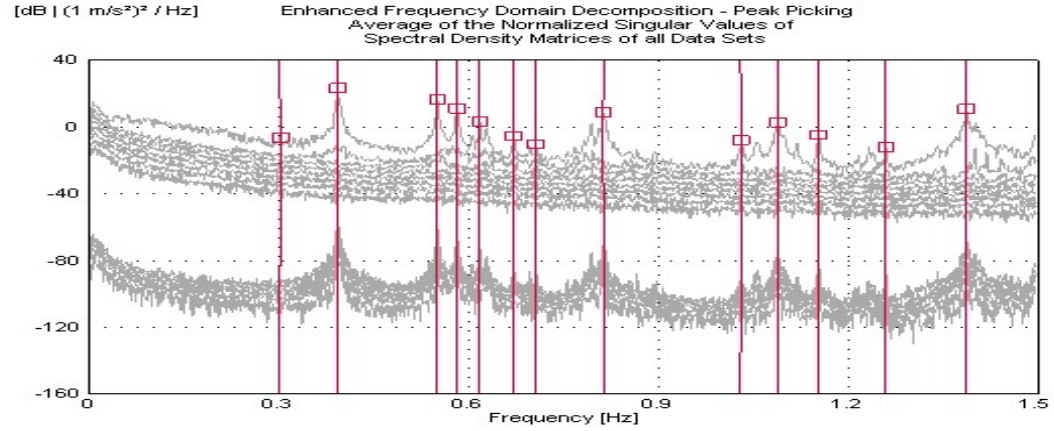




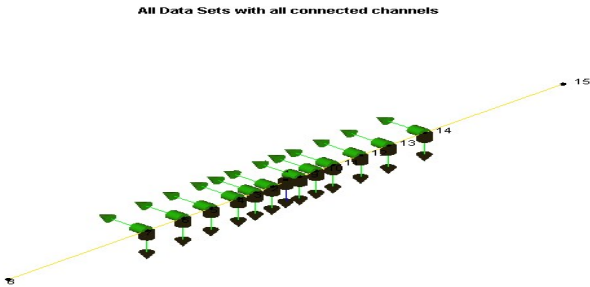
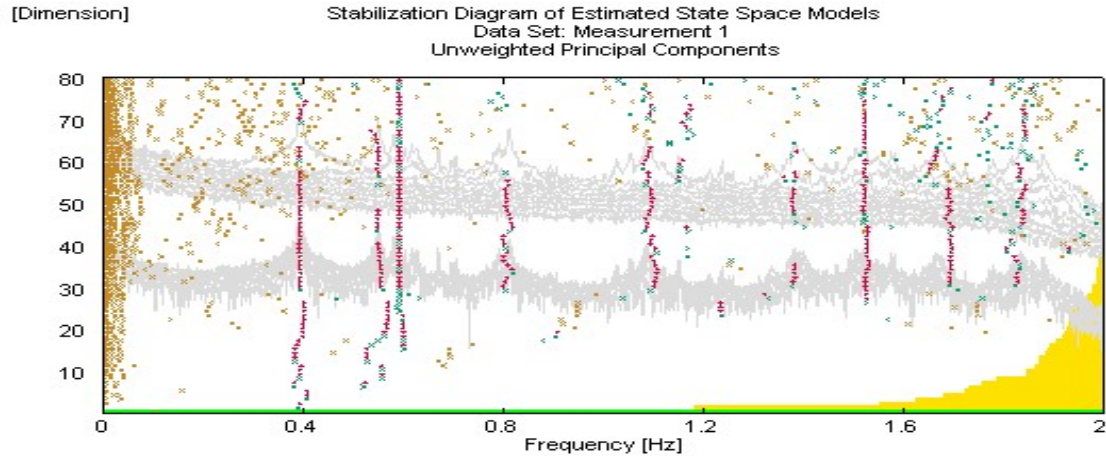
# ÇEVRESEL TİTREŞİM TESTLERİ

## Ölçüm Spektrumları

### GFTAA Yöntemine ait spektrum

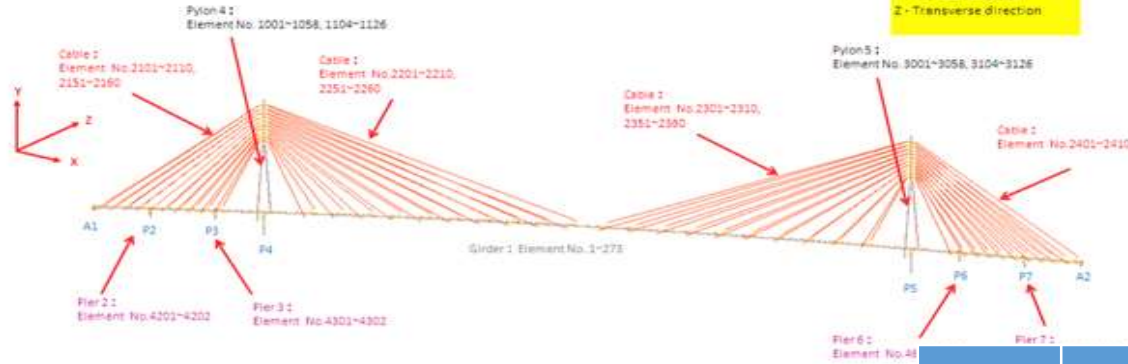


### SAB Yöntemine ait spektrum



# ÇEVRESEL TİTREŞİM TESTLERİ

## Köprü Frekansları



### MASS PARTICIPATION FACTORS [%]

MODE	$\phi_i \cdot M \cdot \phi_i$	X	Y	Z	SUM-X	SUM-Y	SUM-Z	HERTZ
1	0.5570E+04	0.00	0.00	15.72	0.00	0.00	15.72	0.263
2	0.2456E+04	0.00	5.76	0.00	0.00	5.76	15.72	0.389
3	0.3483E+05	47.46	0.00	0.00	47.46	5.76	15.72	0.395
4	0.1895E+05	0.00	0.00	0.00	47.46	5.76	15.72	0.401
5	0.1200E+05	0.00	0.00	25.47	47.46	5.76	41.19	0.419
6	0.3255E+04	2.35	0.00	0.00	49.82	5.76	41.19	0.549
7	0.8849E+04	0.00	0.00	0.00	49.82	5.76	41.19	0.694
8	0.3251E+04	0.00	1.59	0.00	49.82	7.34	41.19	0.798
9	0.3118E+04	0.24	0.00	0.00	50.06	7.34	41.19	1.062
10	0.6905E+04	0.00	0.00	0.00	50.06	7.34	41.19	1.193
11	0.3679E+05	0.00	0.00	0.12	50.06	7.34	41.31	1.320
12	0.3201E+04	0.00	0.58	0.00	50.06	7.92	41.31	1.363

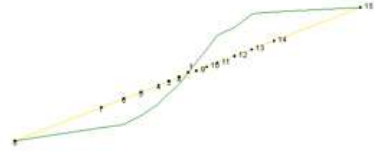
Mod Numarası	Frekans (Hz)	Sönüm Oranı (%)
1	0.303	0.666
2	0.394	0.264
3	0.552	0.131
4	0.583	0.259
5	0.619	0.179
6	0.673	0.167
7	0.707	0.092
8	0.815	0.167
9	1.031	0.149
10	1.089	0.184
11	1.154	0.134
12	1.260	0.076

# ÇEVRESEL TİTREŞİM TESTLERİ

## Mod Şekilleri

Elde edilemedi.  
1. Mod

EFDD - Enhanced Frequency Domain Decomposition



3. Mod (Düsey hareket)

EFDD - Enhanced Frequency Domain Decomposition



5. Mod (Yatay hareket)

EFDD - Enhanced Frequency Domain Decomposition



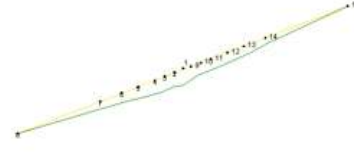
7. Mod (Yatay hareket)

EFDD - Enhanced Frequency Domain Decomposition



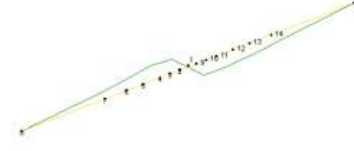
2. Mod (Düsey hareket)

EFDD - Enhanced Frequency Domain Decomposition



4. Mod (Yatay hareket)

EFDD - Enhanced Frequency Domain Decomposition



6. Mod (Yatay hareket)

EFDD - Enhanced Frequency Domain Decomposition



8. Mod (Düsey hareket)



a) 1.mod şekli



e) 5. mod şekli



b) 2.mod şekli



f) 6. mod şekli



c) 3.mod şekli



g) 7. mod şekli



d) 4.mod şekli



h) 8. mod şekli

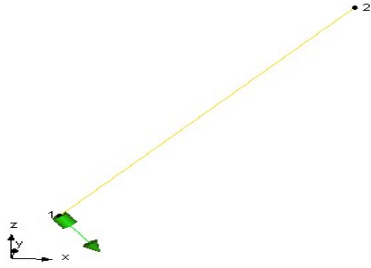




# ÇEVRESEL TİTREŞİM TESTLERİ

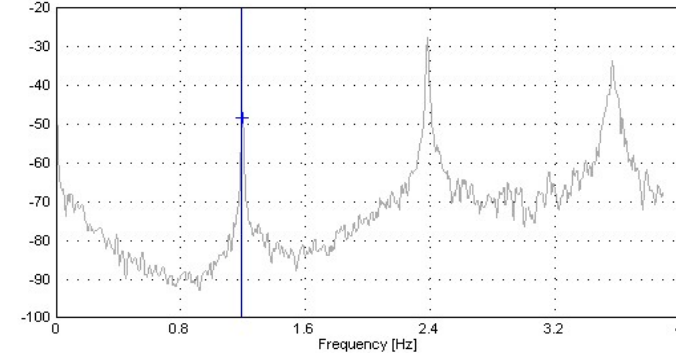
## Kablo Frekansları

All Data Sets with all connected channels



[dB | (1 m/s<sup>2</sup>)<sup>2</sup> / Hz]

Enhanced Frequency Domain Decomposition - Peak Picking  
Singular Values of Spectral Density Matrices  
of Data Set: Measurement 1



Cursor Values

Frequency = 1.2 Hz  
SVD Line = 1

Markers

Estimated Mode  
Selected Mode

Legend

Mode Marker  
SVD Line #1

Kablo Numarası	Yükleme Durumu	Birinci Frekans (Hz)
460	Kendi Ağırlığı	0.977
406	Kendi Ağırlığı	1.200
451	Kendi Ağırlığı	2.160
101	Kendi Ağırlığı	2.080
110	Kendi Ağırlığı	0.984
155	Kendi Ağırlığı	1.200

Kablo Numarası	Birim Kütle (m) (kg/m)	Kuvvet (F) (kN)	Uzunluk (L) (m)	Frekans (Hz)	
				Ölçülen	Hesaplanan
101	51.89	3179	62.81	2.080	1.970
110	76.25	4764	130.41	0.984	0.958
155	63.10	3561	90.91	1.200	1.306
406	69.72	3627	98.55	1.200	1.157
451	51.89	3179	62.81	2.160	1.970
460	76.25	4764	130.41	0.977	0.958

# STATİK YÜKLEME TESTLERİ

## Kamyon Özellikleri

### 3.5.1 Cab guiding and fastening zone

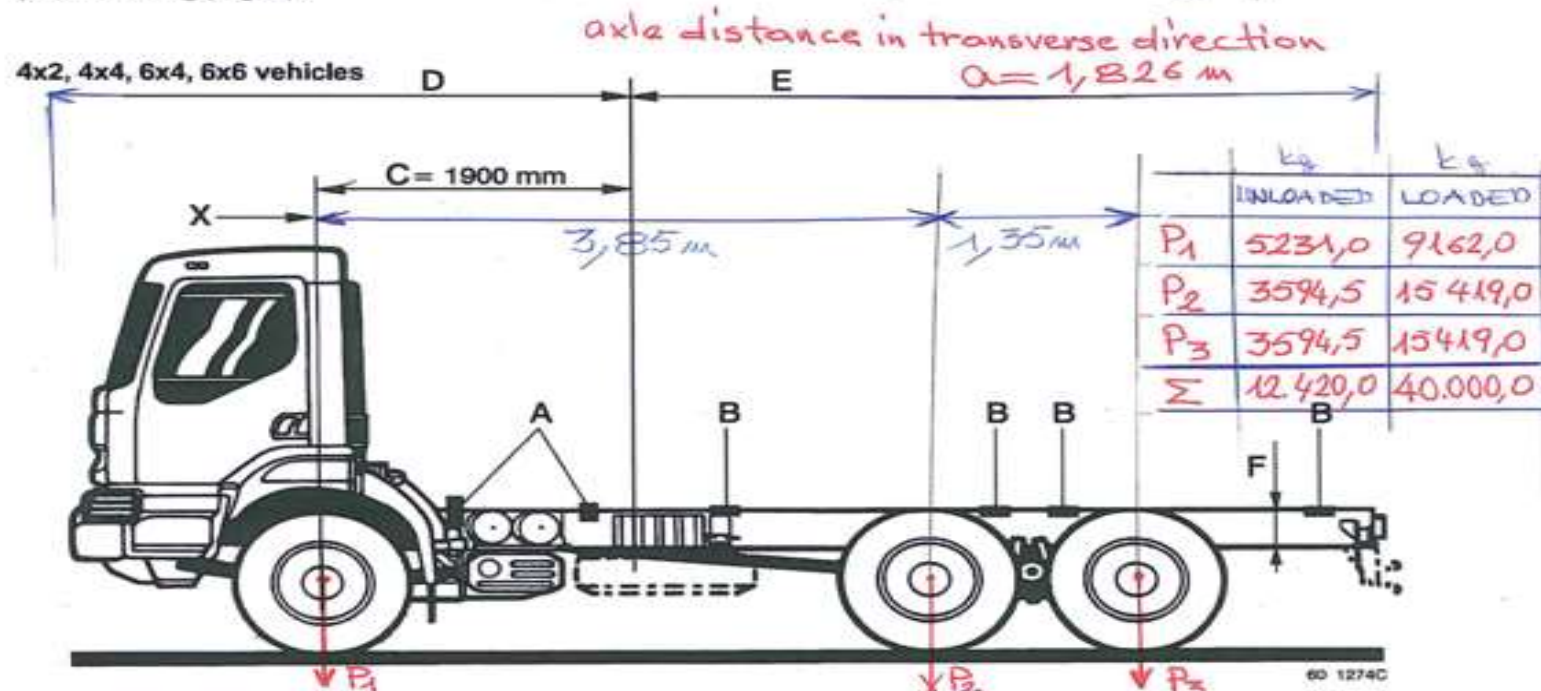
NISSIBI BRIDGE

- A - Semi-flexible attachment (first, second and/or third brackets)
- B - Fixing plates
- C - Semi-flexible fastening position (A) in relation to front axle centre-line
- D - Lateral guiding and elastic fastening zone
- E - Plate guiding and fastening zone
- F - Sidemember height = 302 mm
- X - Front axle centre-line

(See following pages).

LOAD TEST VEHICLE

RENAULT  
KERAX 420 dCi  
6x4



# STATİK YÜKLEME TESTLERİ

# Kamyon Yükleme Pozisyonları

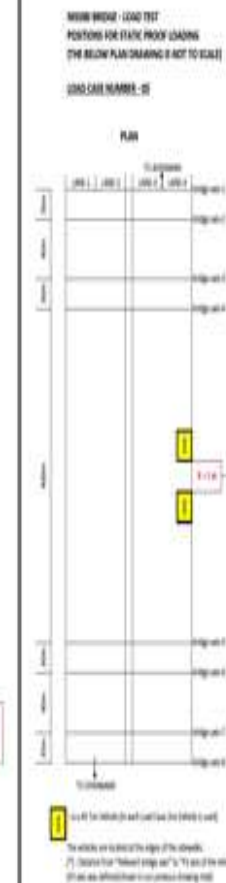
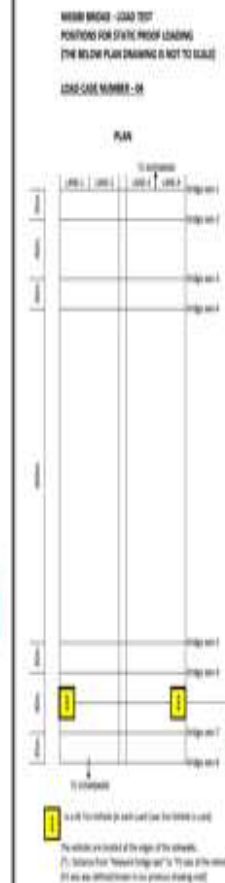
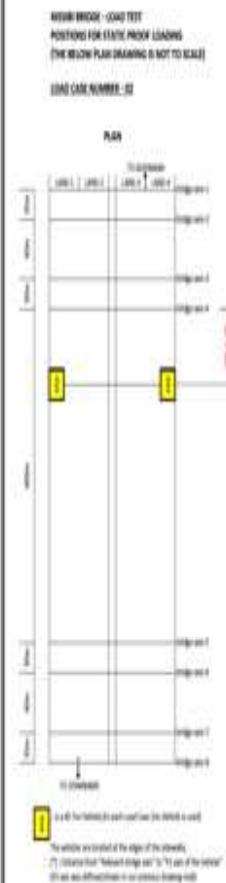
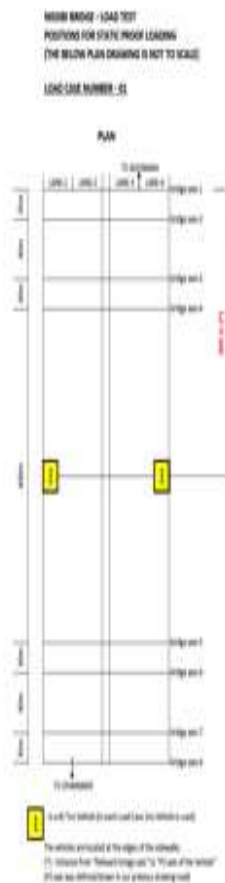
SY-1

SY-II

SY-II

SY-IV

SY-V



### Nissibi Köprüsü Yapısal İzleme Sistemi ve Yükleme Testleri

6. Çelik Köprüler ve Yapılar Çalıştayı, 15 Mayıs 2017, Ankara



# STATİK YÜKLEME TESTLERİ



Jeodezik ölçümlere ait görüşler



Statik yükleme sırasında kamyon pozisyonlarına ait görüşler

# STATİK YÜKLEME TESTLERİ

Statik yükleme durumları için tabloye oluşan maksimum düşey yerdeğiştirmeler

SY-I (2+464.50)						
KM	SOL KENAR (8.50m)		EKSEN (0.00)		SAĞ KENAR (8.50m)	
	ÖLÇÜLEN(mm)	HESAP(mm)	ÖLÇÜLEN(mm)	HESAP(mm)	ÖLÇÜLEN(mm)	HESAP(mm)
2+464.50	-64	-67.32	-65	-67.32	-66	-67.32

SY-II (2+364.50)						
KM	SOL KENAR (8.50m)		EKSEN (0.00)		SAĞ KENAR (8.50m)	
	ÖLÇÜLEN(mm)	HESAP(mm)	ÖLÇÜLEN(mm)	HESAP(mm)	ÖLÇÜLEN(mm)	HESAP(mm)
2+363.50	-29	-36.36	-31	-36.36	-32	-36.36

SY-III (2+564.50)						
KM	SOL KENAR (8.50m)		EKSEN (0.00)		SAĞ KENAR (8.50m)	
	ÖLÇÜLEN(mm)	HESAP(mm)	ÖLÇÜLEN(mm)	HESAP(mm)	ÖLÇÜLEN(mm)	HESAP(mm)
2+564.50	-34	-37.45	-32	-37.47	-34	-37.45

SY-IV (2+214.50)						
KM	SOL KENAR (8.50m)		EKSEN (0.00)		SAĞ KENAR (8.50m)	
	ÖLÇÜLEN(mm)	HESAP(mm)	ÖLÇÜLEN(mm)	HESAP(mm)	ÖLÇÜLEN(mm)	HESAP(mm)
2+214.50	-1	-0.434	-1	-0.434	-1	-0.434

SY-V (2+464.50)						
KM	SOL KENAR (8.50m)		EKSEN (0.00)		SAĞ KENAR (8.50m)	
	ÖLÇÜLEN(mm)	HESAP(mm)	ÖLÇÜLEN(mm)	HESAP(mm)	ÖLÇÜLEN(mm)	HESAP(mm)
2+464.50	-67	-67.11	-65	-67.11	-63	-67.11

SY-I ve SY-V yükleme durumları için

P4 kulesinde oluşan maksimum yerdeğiştirmeler

SY-I (2+464.50)		
KOT (m)	ÖLÇÜLEN(mm)	HESAP(mm)
642.5	-7.64	-7.717

SY-V (2+464.50)		
KOT (m)	ÖLÇÜLEN(mm)	HESAP(mm)
642.5	-6.92	-7.354

SY-V yükleme durumu için

P5 kulesinde oluşan maksimum yerdeğiştirmeler

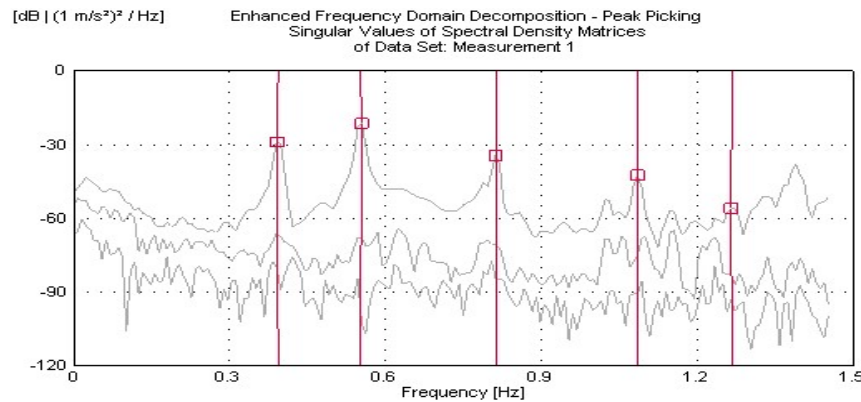
SY-V (2+464.50)		
KOT (m)	ÖLÇÜLEN(mm)	HESAP(mm)
642.5	-7.23	-7.35

# DİNAMİK YÜKLEME TESTLERİ

## Dinamik Yükleme Testleri



Nissibi Köprüsü'nde dinamik yüklemelere ait bazı görüşler



Yükleme	Hız (km/h)	Doğal Frekanslar (Hz)
DYD-I-20	20	0.394-0.552-0.815-1.087-1.272
DYD-I-40	40	0.394-0.552-0.814-1.076-1.268
DYD-I-60	60	0.393-0.552-0.812-1.086-1.250
DYD-II-L/2-20	20	0.392-0.550-0.815-1.088-1.271
DYD-II-L/2-40	40	0.394-0.552-0.812-1.086-1.285
DYD-II-L/2-60	60	0.393-0.551-0.813-1.074-1.292
DYD-II-L/4-20	20	0.393-0.549-0.811-1.088-1.289
DYD-II-L/4-40	40	0.392-0.549-0.808-1.082-1.274
DYD-II-L/4-60	60	0.394-0.550-0.813-1.058-1.262
DYD-III-E-L/2-20	20	0.393-0.551-0.805-1.084-1.292
DYD-III-E-L/2-40	40	0.394-0.552-0.815-1.087-1.272
DYD-III-E-L/2-60	60	0.397-0.557-0.816-1.090-1.290
DYD-III-E-L/4-20	20	0.393-0.550-0.812-1.083-1.266
DYD-III-E-L/4-40	40	0.391-0.557-0.810-1.090-1.262
DYD-III-E-L/4-60	60	0.395-0.550-0.813-1.089-1.266

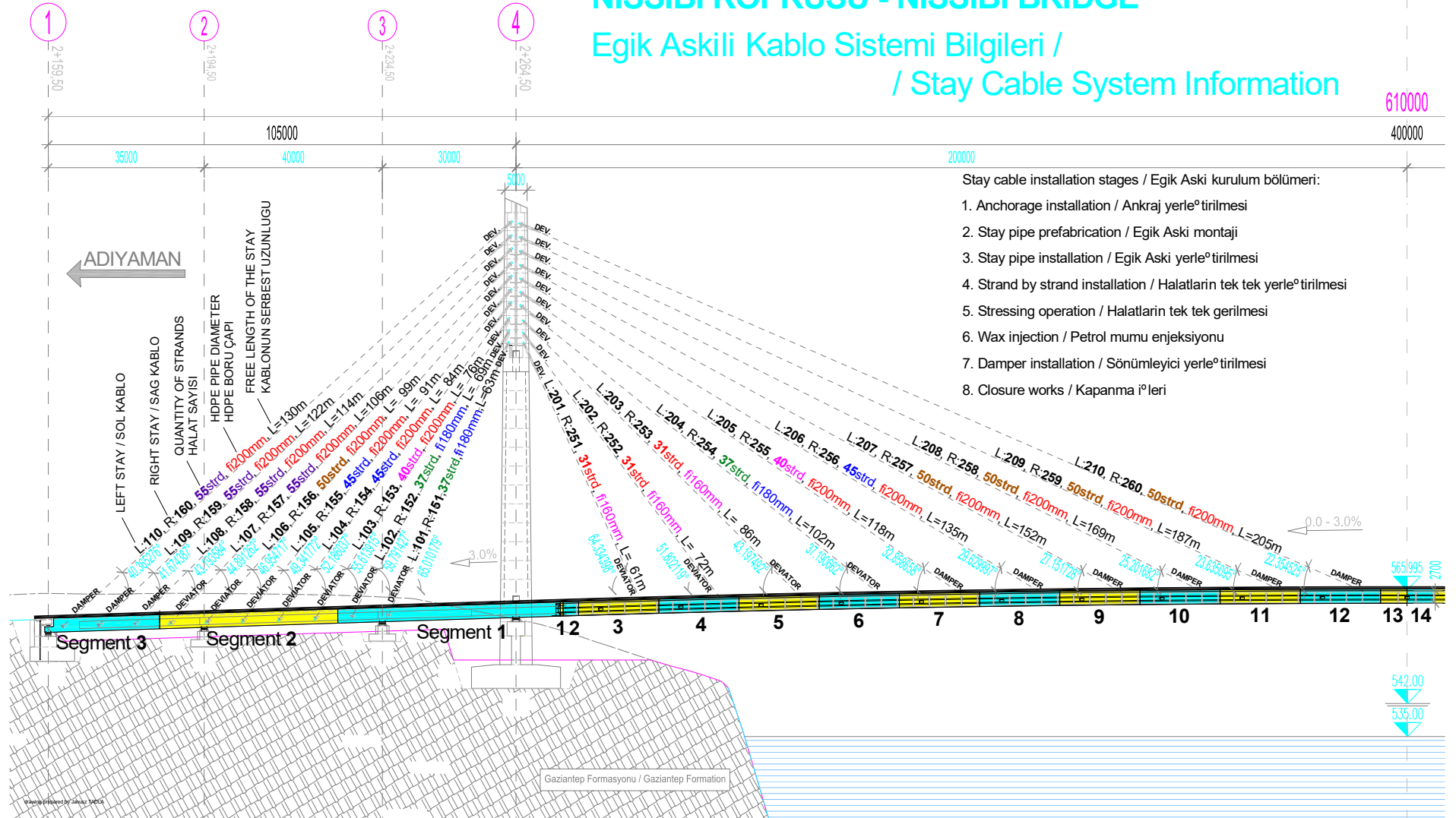


# KÖPRÜ İZLEME SİSTEMİ ÖRNEK ÖLÇÜM SONUÇLARI

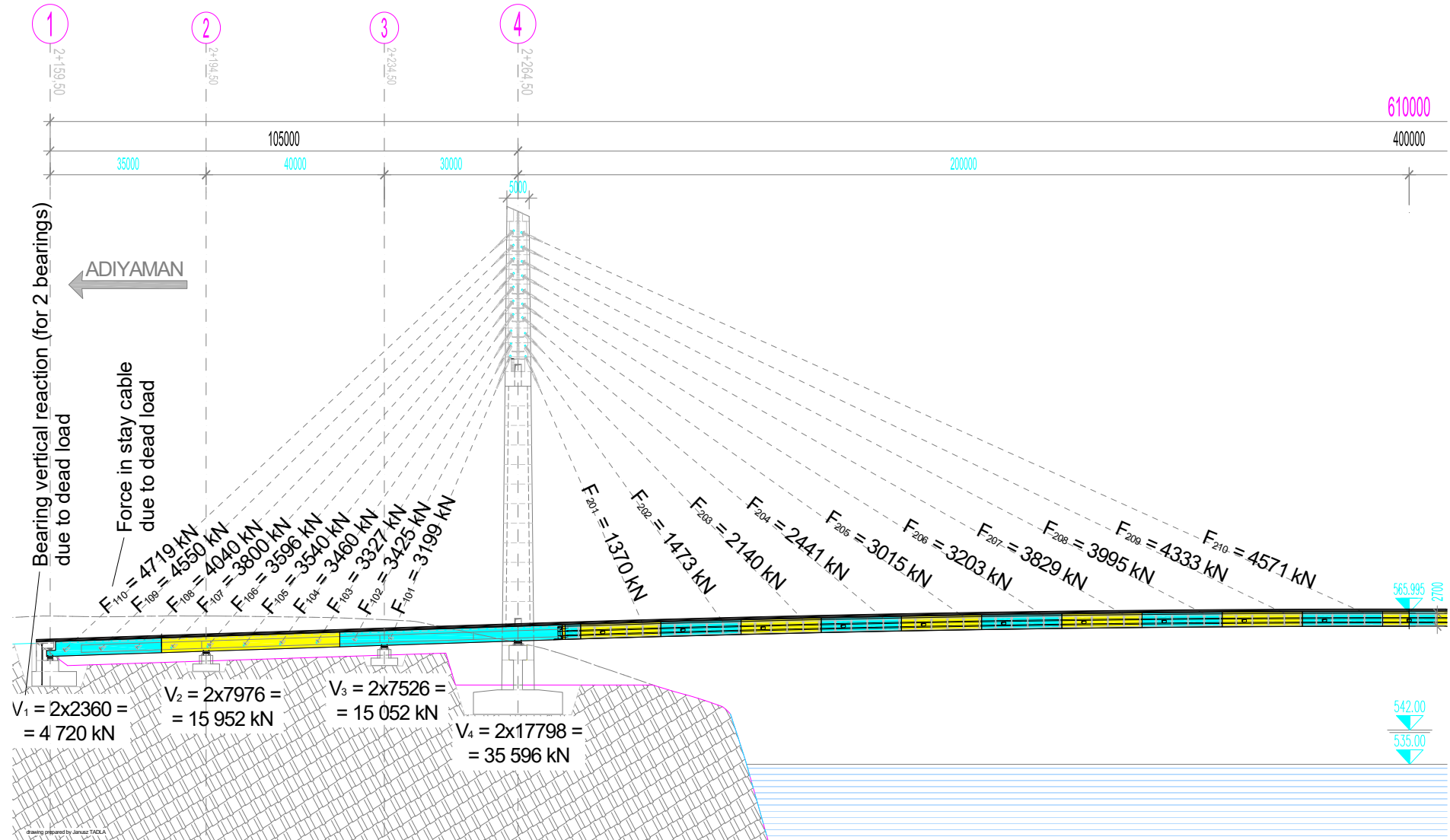
## NISSIBI KÖPRÜSÜ - NISSIBI BRIDGE

### Egik Askılı Kablo Sistemi Bilgileri /

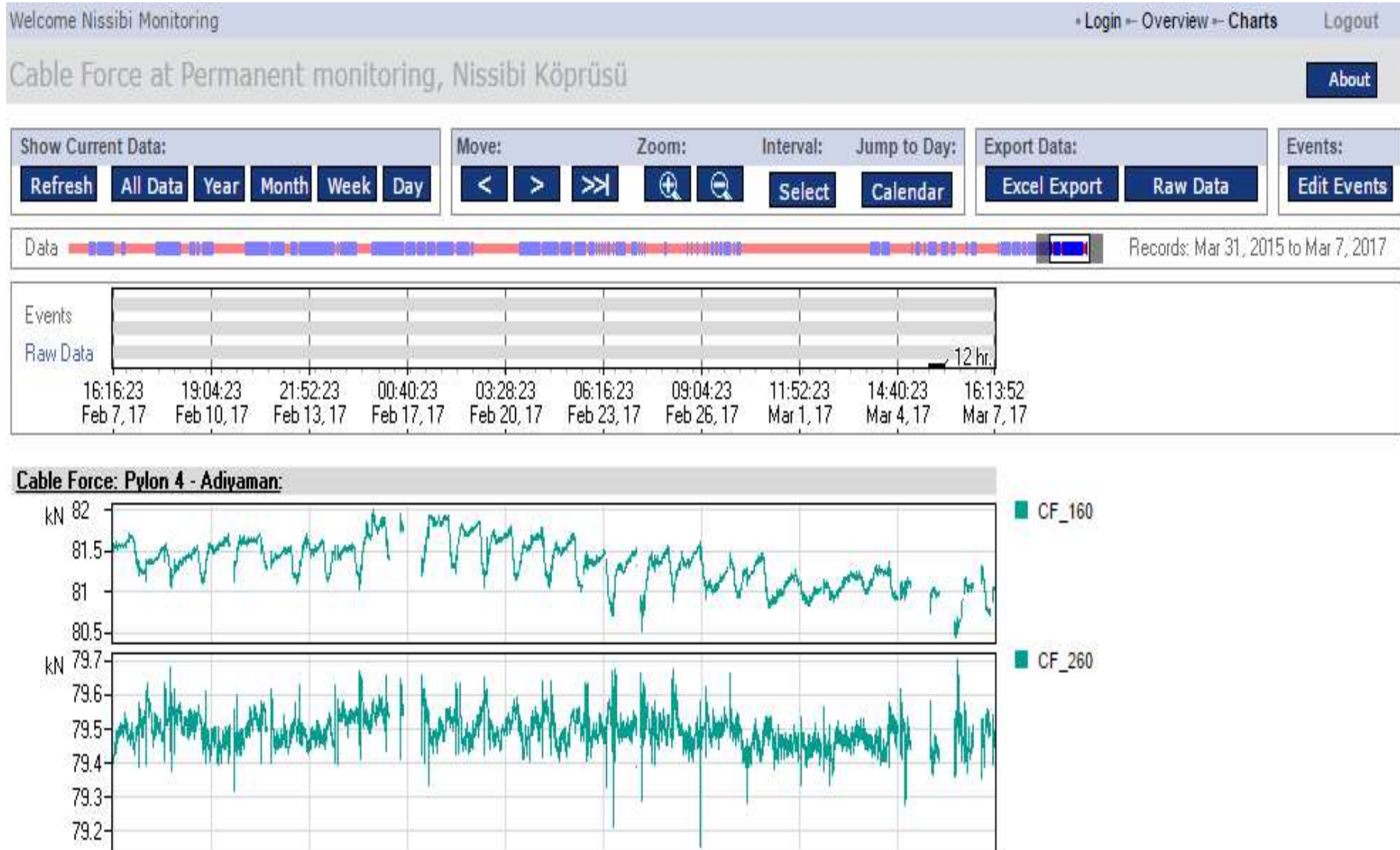
### / Stay Cable System Information



# KÖPRÜ İZLEME SİSTEMİ ÖRNEK ÖLÇÜM SONUÇLARI

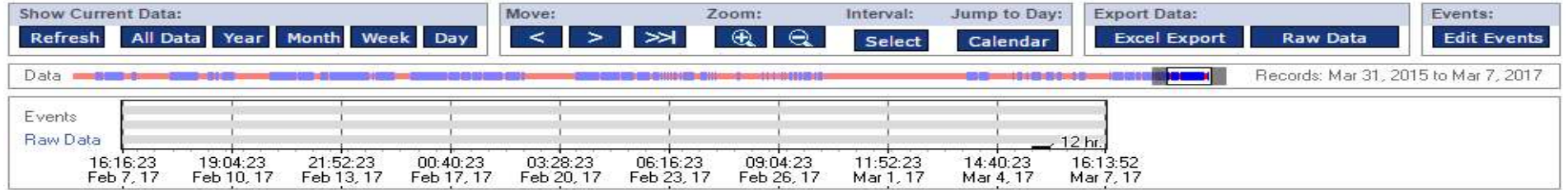


# KÖPRÜ İZLEME SİSTEMİ ÖRNEK ÖLÇÜM SONUÇLARI

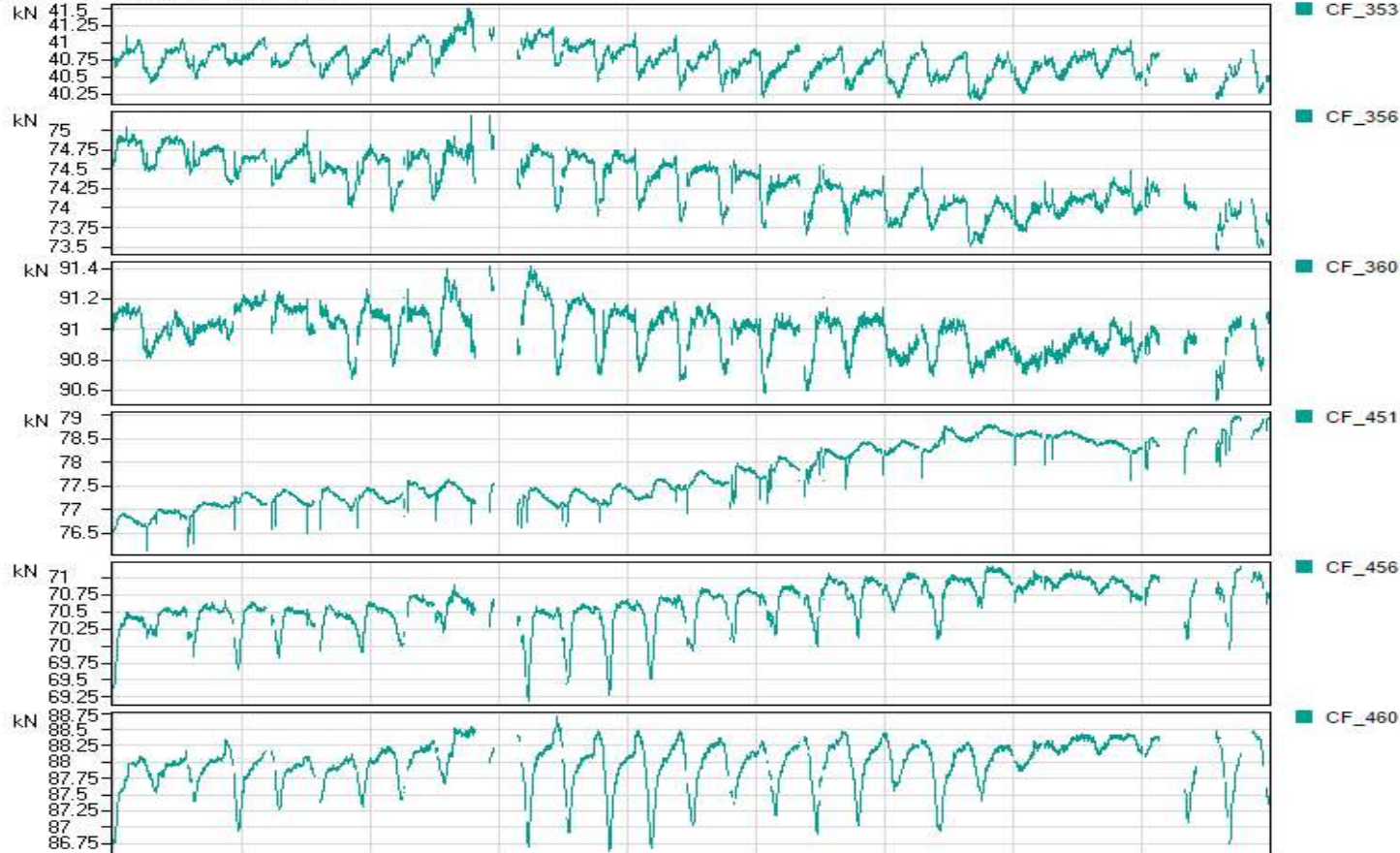




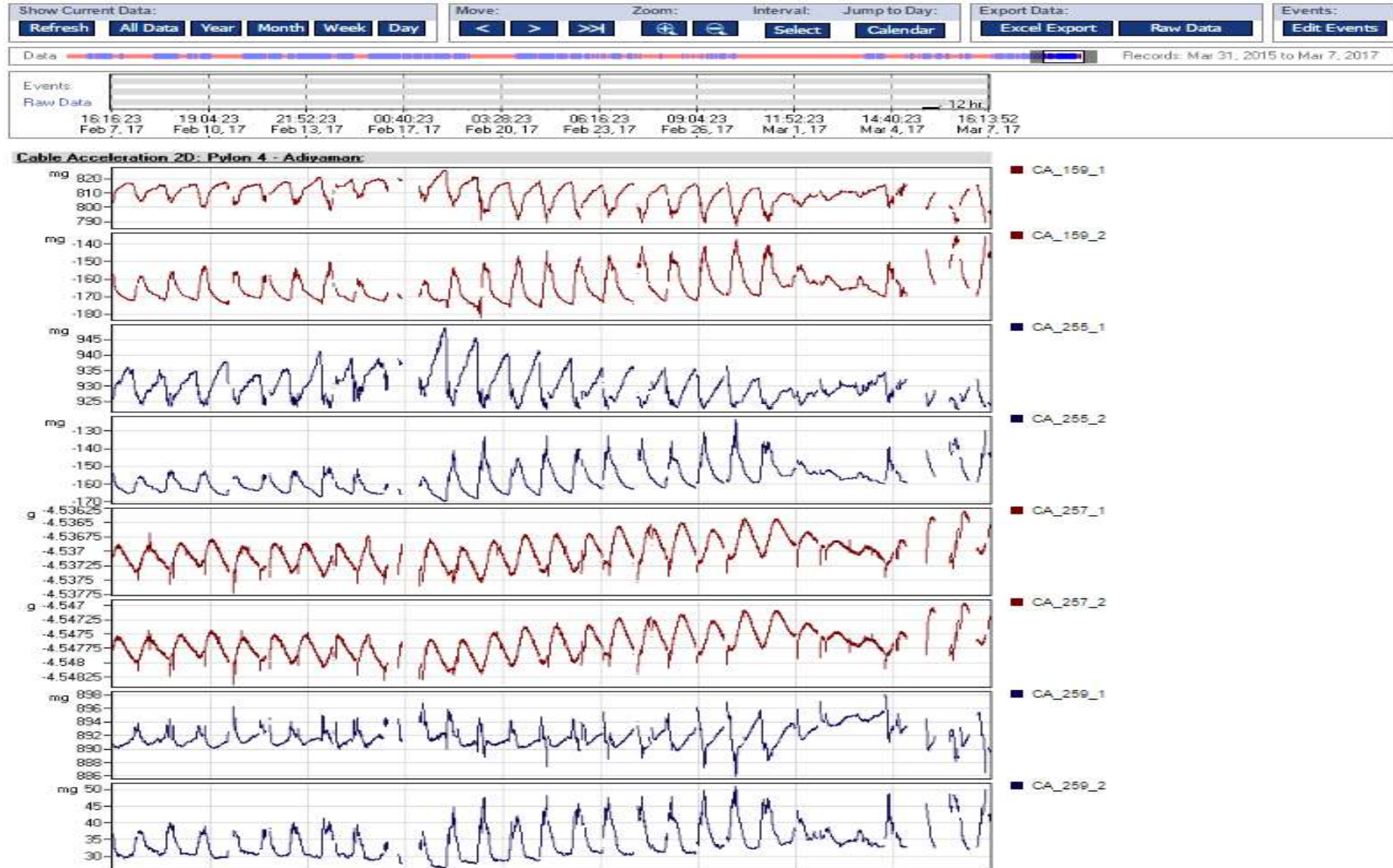
# KÖPRÜ İZLEME SİSTEMİ ÖRNEK ÖLÇÜM SONUÇLARI



Cable Force: Pylon 5 - Diyarbakir:

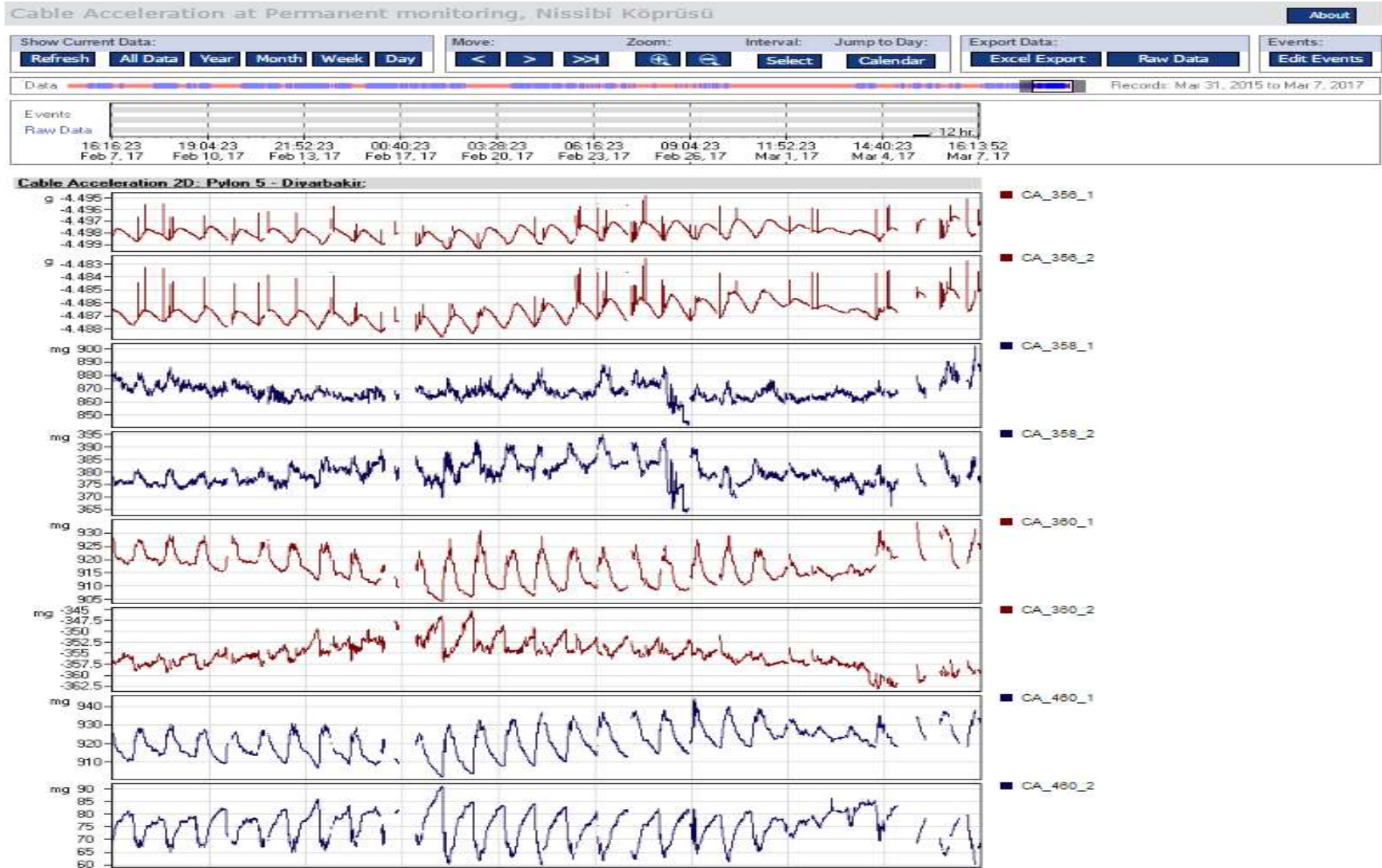


# KÖPRÜ İZLEME SİSTEMİ ÖRNEK ÖLÇÜM SONUÇLARI



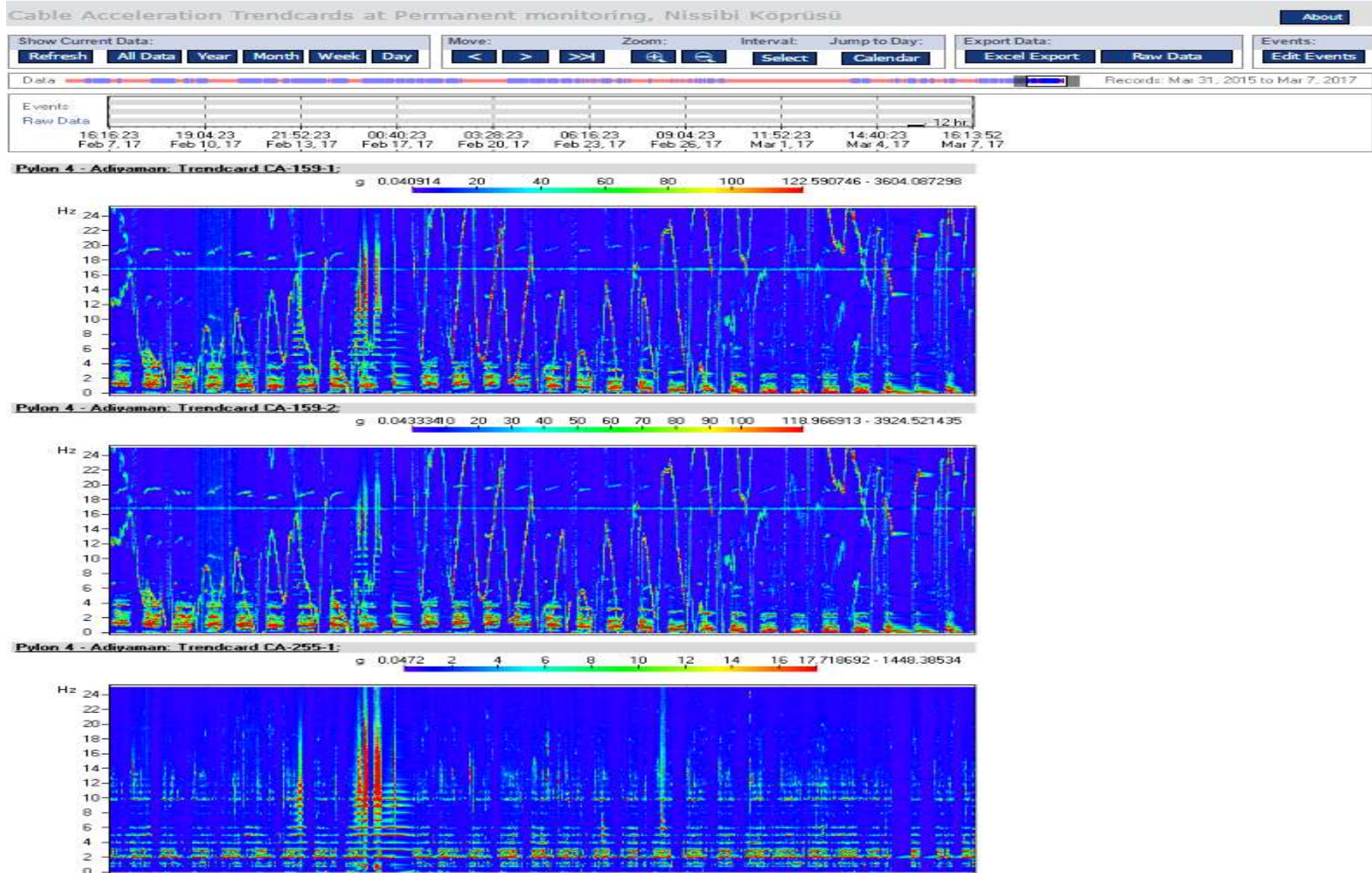


# KÖPRÜ İZLEME SİSTEMİ ÖRNEK ÖLÇÜM SONUÇLARI





# KÖPRÜ İZLEME SİSTEMİ ÖRNEK ÖLÇÜM SONUÇLARI



# KÖPRÜ İZLEME SİSTEMİ ÖRNEK ÖLÇÜM SONUÇLARI

Acceleration 3D at Permanent monitoring, Nissibi Köprüsü

About

Show Current Data:

Refresh All Data Year Month Week Day

Move:

< > >>

Zoom:

⌕ ⌕

Interval:

Select

Jump to Day:

Calendar

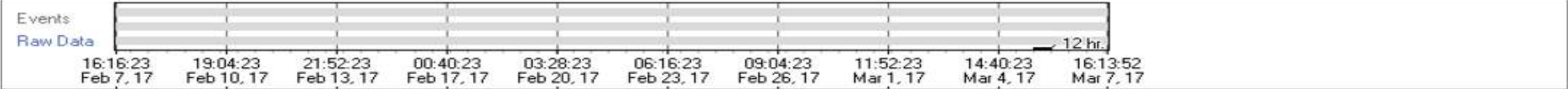
Export Data:

Excel Export Raw Data

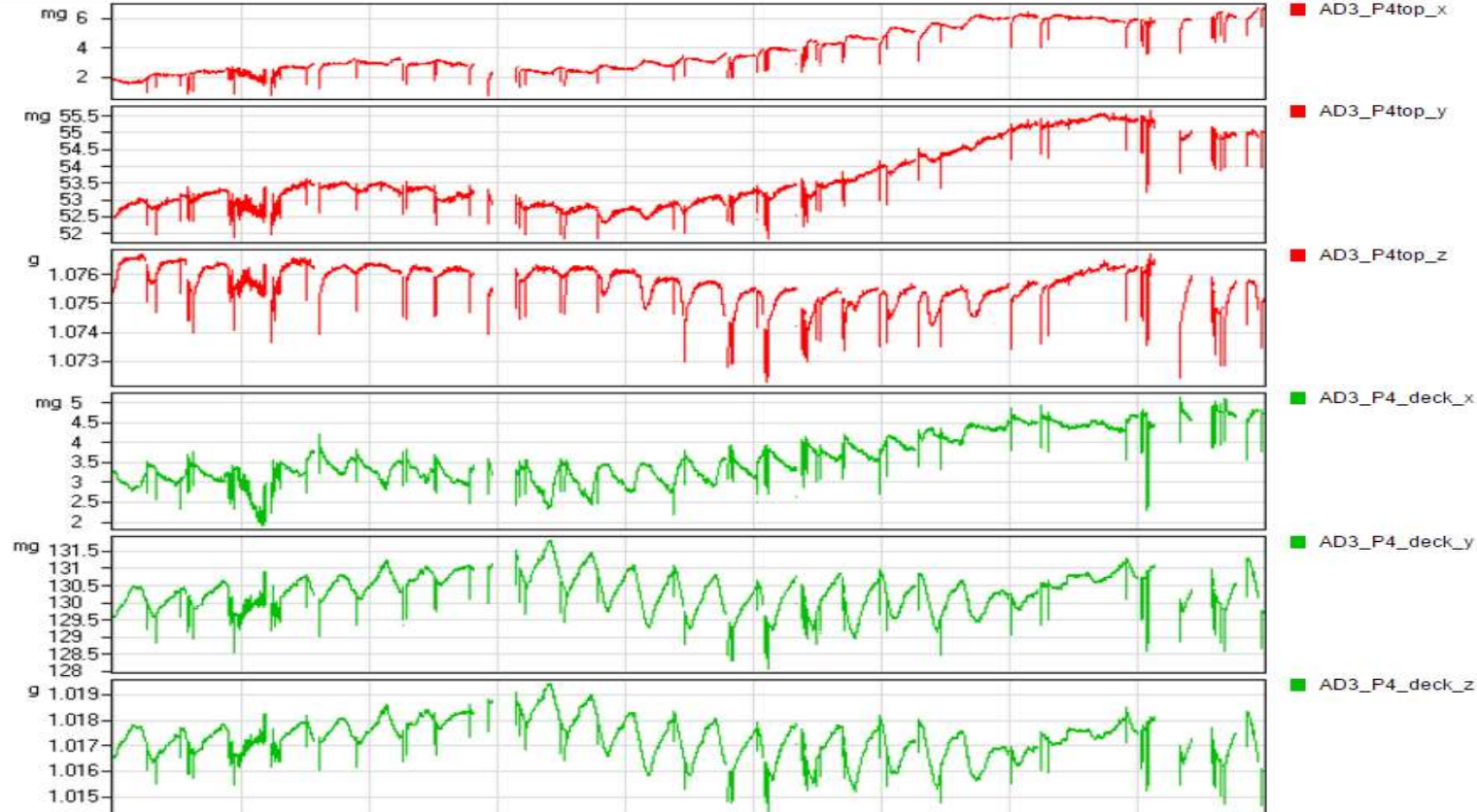
Events:

Edit Events

Data Records: Mar 31, 2015 to Mar 7, 2017



Acceleration 3D: Pylon 4 - Adıyaman:





# KÖPRÜ İZLEME SİSTEMİ ÖRNEK ÖLÇÜM SONUÇLARI

Acceleration 3D at Permanent monitoring, Nissibi Köprüsü

About

Show Current Data:

Refresh

All Data

Year

Month

Week

Day

Move:

<

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>>

+

-

Interval:

Select

Jump to Day:

Calendar

Export Data:

Excel Export

Raw Data

Events:

Edit Events

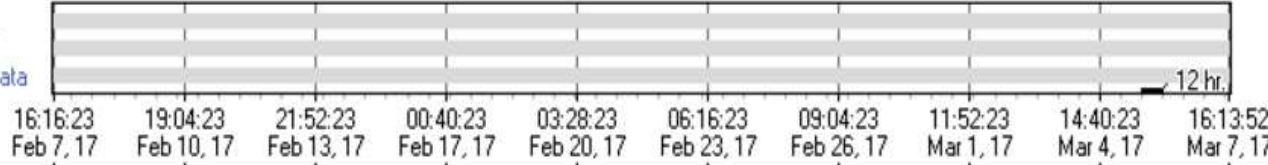
Data



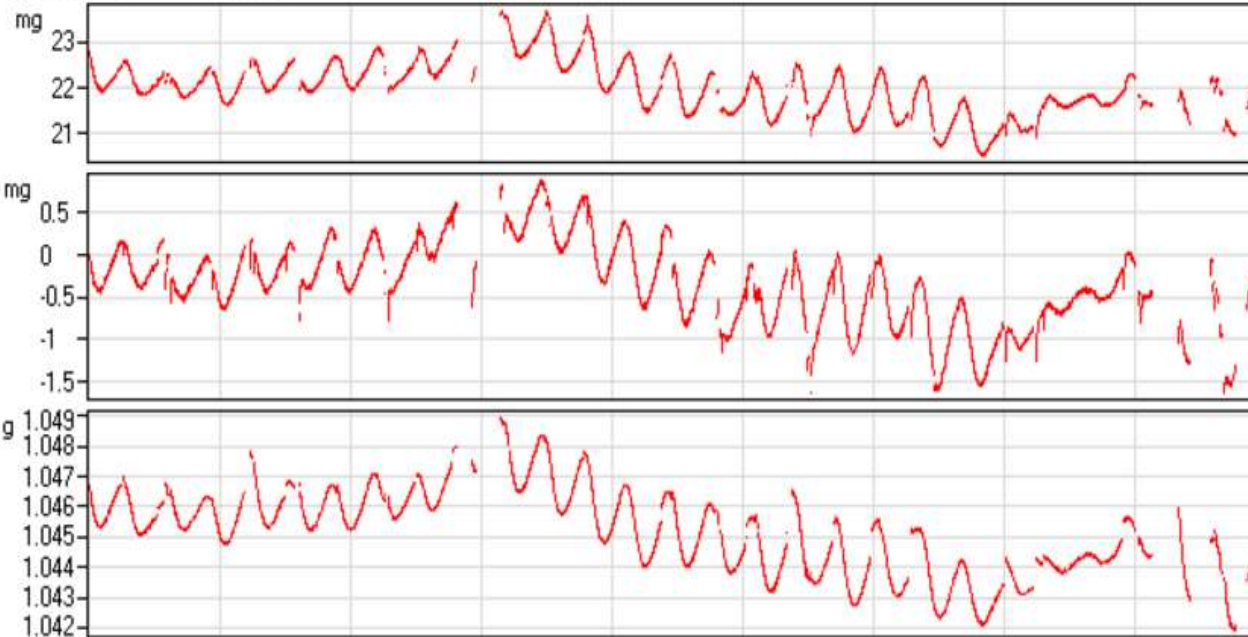
Records: Mar 31, 2015 to Mar 7, 2017

Events

Raw Data



Acceleration 3D: Center deck:



AD3\_center\_deck\_x

AD3\_center\_deck\_y

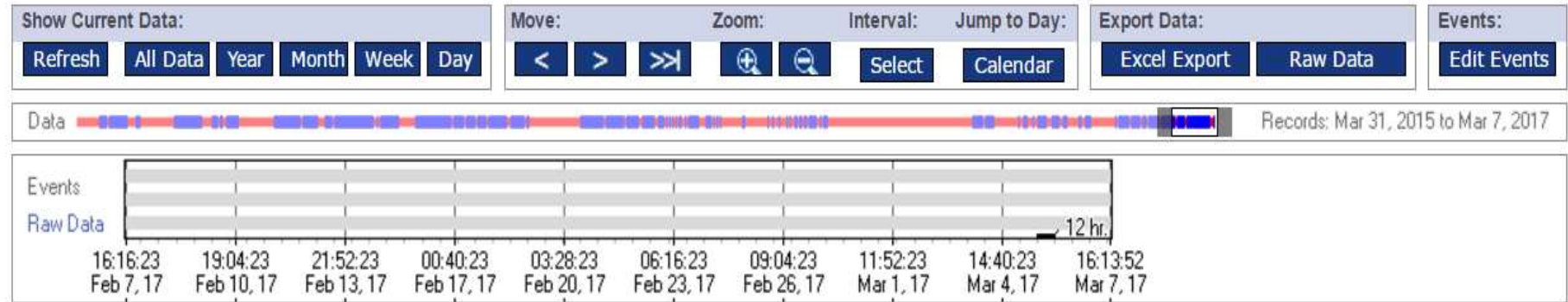
AD3\_center\_deck\_z



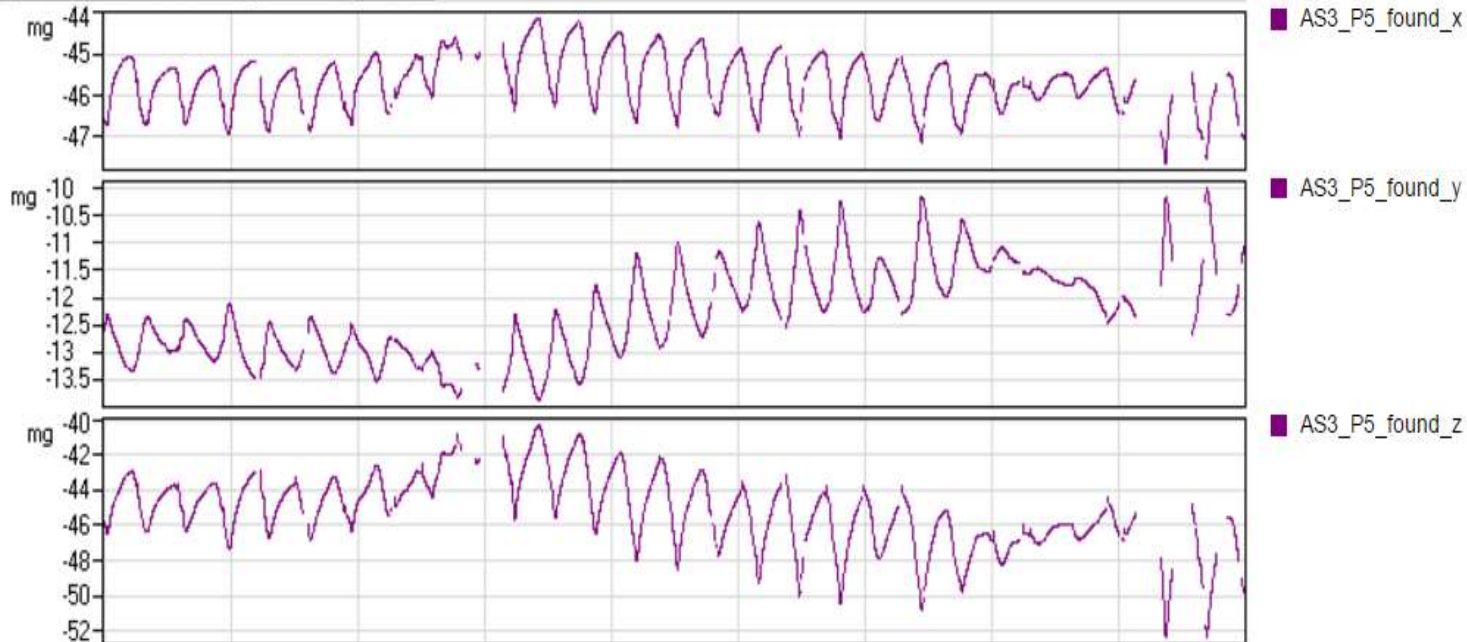
# KÖPRÜ İZLEME SİSTEMİ ÖRNEK ÖLÇÜM SONUÇLARI

Seismic Acceleration 3D at Permanent monitoring, Nissibi Köprüsü

About



Seismic Acceleration: Pylon 5 - Diyarbakir:



# 2 MART 2017 SAMSAT-ADİYAMAN DEPREMİ (MW=5.5) SIRASINDA KÖPRÜ DAVRANIŞI

Tarih-Saat: 02.03.2017 14:07(TS)

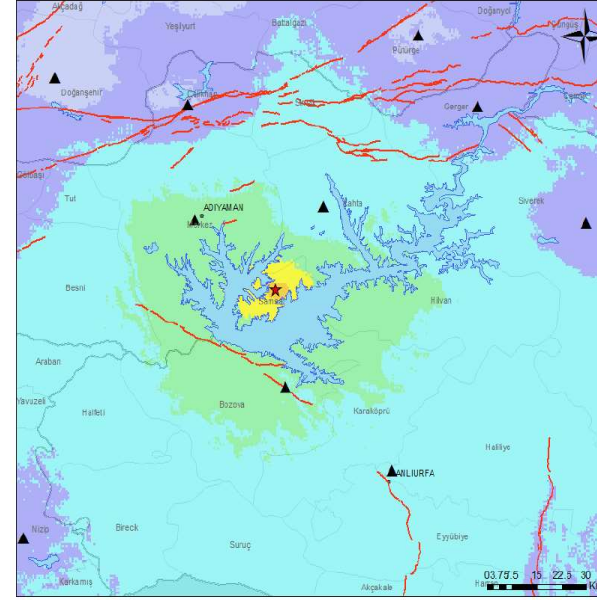
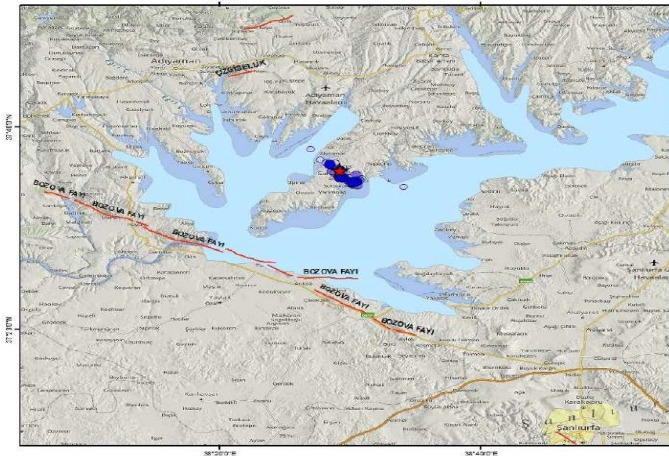
Yer: Samsat-Adıyaman

Büyükölç: 5.5 (Mw)

Derinlik: 9.76 (km)

Enlem: 37.5955E

Boylam: 38.4866D



Başbakanlık  
Afet ve Acil Durum Yönetimi Başkanlığı  
Deprem Dairesi Başkanlığı  
02/03/2017 Adıyaman Samsat  
Depremi Mw:5.5  
Tahmini Sismik Şiddet Haritası  
AFAD-RED

## Açıklamalar

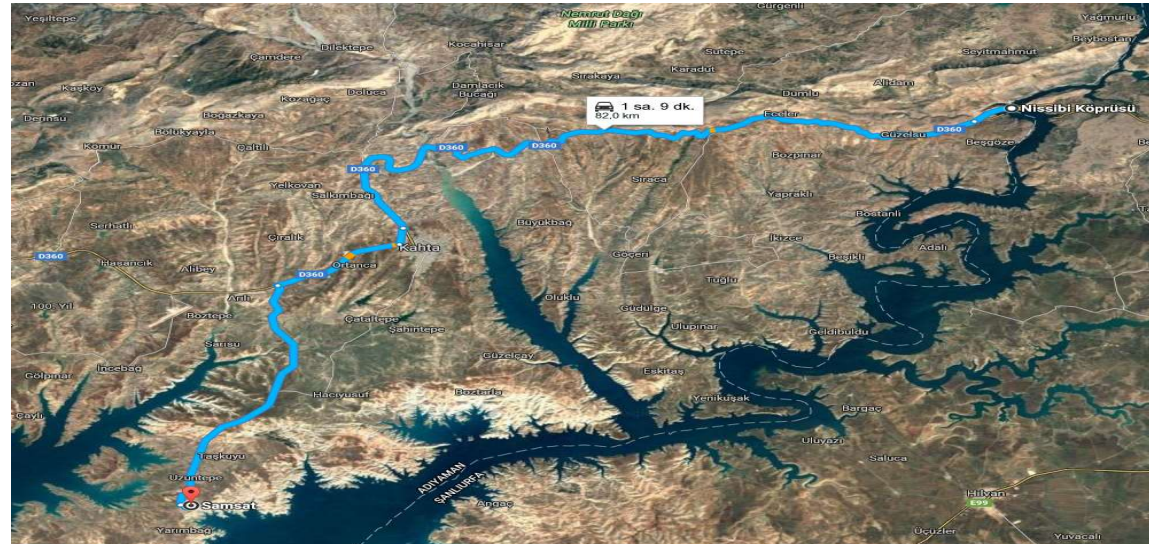
▲ Kış İstasyonları  
— MTA Diri Fayları (2011)

02/03/2017 Adıyaman Samsat Depremi

## İNTENSİTE

I Hisse edilmez  
II Zayıf  
III Hafif  
IV Orta  
V Oldukça güçlü  
VI Güçlü  
VII Çok güçlü  
VIII Yıkıcı  
IX Şiddetli  
X Yoğun  
XI Ağır  
XII Tam yıkım

02.03.2017 Samsat-Adıyaman Depremi (Mw=5.5) (Diri faylar, MTA-2012)



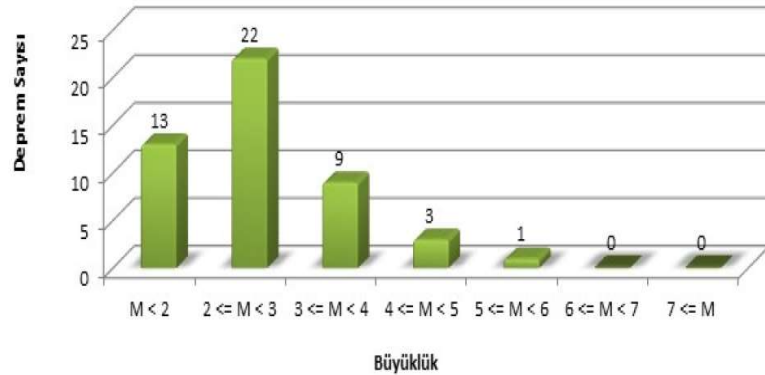
Nissibi Köprüsü Yapısal İzleme Sistemi ve Yükleme Testleri

6. Çelik Köprüler ve Yapılar Çalıştayı, 15 Mayıs 2017, Ankara



# 2 MART 2017 SAMSAT-ADİYAMAN DEPREMİ (MW=5.5) SIRASINDA KÖPRÜ DAVRANIŞI

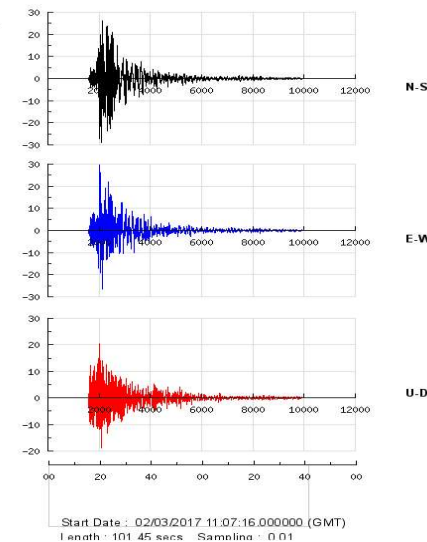
02 Mart 2017 tarihinden itibaren Adıyaman-Samsat Depremleri  
Deprem Sayısı - Büyüklük Grafiği  
(Toplam :48)



İSTASYON							ÖLÇÜLEN İVME DEĞERLERİ (gal)			Uzaklık Repi (km)	
No	İL	İLÇE / SEMT	Kodu	Enlem	Boylam	Rakım(m)	CİHAZ TÜRÜ	K-G	D-B	Düşey	
1	Adıyaman	Kahta	0205	37.7917	38.6159	723	CMG-STD	28.92	29.76	20.45	25
2	Şanlıurfa	Bozova	<a href="#">6304</a>	37.3650	38.5131	617	CMG-STD	56.80	56.44	41.36	26
3	Adıyaman	Merkez	0201	37.7612	38.2674	671	CMG-STD	78.95	58.86	41.13	27
4	Adıyaman	Çelikhan	0207	38.0322	38.2476	1380	CMG-STD	8.63	6.72	5.66	53
5	Şanlıurfa	Merkez	6301	37.1680	38.8013	548	CMG-STD	17.84	27.17	9.14	55

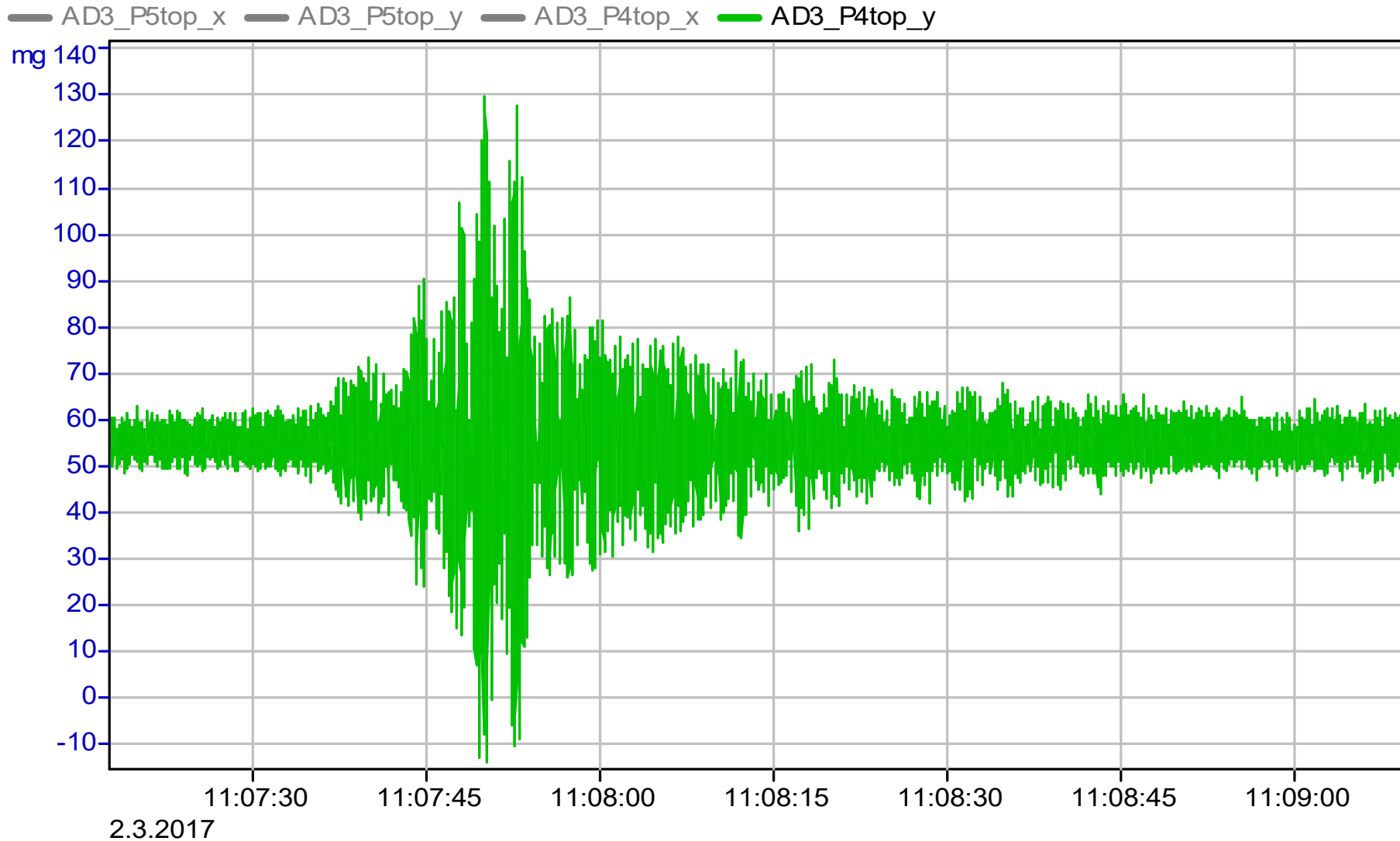
Tarih (TS)	Ajans	Enlem	Boylam	Derinlik	Rms	Tip	Büyüklük	Ülke	İl	İlçe	Köy	Diğer
2/2/2017 14:46:06	DDA	37.5738	38.5020	700	0.25000	ML	2.6	Türkiye	Adıyaman	Samsat	-	-
2/2/2017 14:46:00	DDA	37.5888	38.5080	6.94	0.28000	ML	2.7	Türkiye	Adıyaman	Samsat	-	-
2/2/2017 14:43:35	DDA	37.5785	38.4975	703	0.38000	ML	2.6	Türkiye	Adıyaman	Samsat	-	-
2/2/2017 14:42:11	DDA	37.6131	38.4615	700	0.10000	ML	1.9	Türkiye	Adıyaman	Samsat	-	-
2/2/2017 14:40:17	DDA	39.4891	26.0478	8.41	0.25000	ML	2.0	-	-	-	Ege Denizi, 1.53 km. Ayvacık (Çanakkale)	-
2/2/2017 14:36:06	DDA	37.5911	38.4815	700	0.41000	Mw	2.7	Türkiye	Adıyaman	Samsat	-	-
2/2/2017 14:32:46	DDA	37.5901	38.4911	6.96	0.38000	Mw	3.1	Türkiye	Adıyaman	Samsat	-	-
2/2/2017 14:30:21	DDA	37.5900	38.4855	700	0.25000	ML	2.0	Türkiye	Adıyaman	Samsat	-	-
2/2/2017 14:28:29	DDA	37.5768	38.5083	703	0.28000	Mw	3.7	Türkiye	Adıyaman	Samsat	-	-
2/2/2017 14:22:02	DDA	37.6070	38.4735	700	0.25000	ML	2.2	Türkiye	Adıyaman	Samsat	-	-
2/2/2017 14:20:51	DDA	37.6053	38.4746	6.93	0.34000	ML	3.1	Türkiye	Adıyaman	Samsat	-	-
2/2/2017 14:18:17	DDA	39.5503	26.1925	6.77	0.41000	ML	1.8	Türkiye	Çanakkale	Ayvack	-	-
2/2/2017 14:18:16	DDA	37.5823	38.4915	6.94	0.24000	Mw	4.4	Türkiye	Adıyaman	Samsat	-	-
2/2/2017 14:17:40	DDA	37.5755	38.5021	700	0.24000	Mw	3.8	Türkiye	Adıyaman	Samsat	-	-
2/2/2017 14:16:54	DDA	37.5833	38.4873	718	0.22000	Mw	4.2	Türkiye	Adıyaman	Samsat	-	-
2/2/2017 14:07:23	DDA	37.5955	38.4866	9.76	0.27000	Mw	5.5	Türkiye	Adıyaman	Samsat	-	-
2/2/2017 13:36:05	DDA	39.5560	26.0973	8.33	0.41000	ML	1.3	Türkiye	Çanakkale	Ayvack	-	-
2/2/2017 13:30:42	DDA	39.5486	26.1013	6.92	0.27000	ML	1.5	Türkiye	Çanakkale	Ayvack	-	-
2/2/2017 13:02:05	DDA	41.6953	27.0425	14.43	0.68000	ML	1.3	Türkiye	Kırıkkale	Merkez	-	-
2/2/2017 12:55:08	DDA	39.5970	26.0703	5.99	0.20000	ML	1.4	-	-	-	Ege Denizi, 3.21 km. Ayvacık (Çanakkale)	-
2/2/2017 12:36:48	DDA	39.4728	25.9550	700	0.11000	ML	1.8	-	-	-	Ege Denizi, 9.36 km. Ayvacık (Çanakkale)	-
2/2/2017 12:33:30	DDA	39.5391	26.0963	6.79	0.21000	ML	1.3	Türkiye	Çanakkale	Ayvack	-	-
2/2/2017 12:22:52	DDA	40.7771	31.7328	700	0.15000	ML	1.2	Türkiye	Bolu	Merkez	-	-
2/2/2017 12:26:56	DDA	39.5493	26.1628	3.03	0.50000	ML	2.0	Türkiye	Çanakkale	Ayvack	-	-
2/2/2017 12:25:35	DDA	37.806	27.8513	700	0.46000	ML	1.3	Türkiye	Mugla	Milas	-	-
2/2/2017 12:22:52	DDA	37.703	27.8518	700	0.76000	ML	1.3	Türkiye	Mugla	Milas	-	-
2/2/2017 12:13:13	DDA	37.956	27.8256	700	0.91000	ML	1.2	Türkiye	Mugla	Milas	-	-
2/2/2017 12:11:47	DDA	39.5191	26.0980	6.86	0.12000	ML	1.3	Türkiye	Çanakkale	Ayvack	-	-
2/2/2017 11:06:22	DDA	39.5111	26.0956	9.61	0.45000	ML	1.7	Türkiye	Çanakkale	Ayvack	-	-
2/2/2017 10:57:07	DDA	39.4635	28.1478	703	0.57000	ML	2.0	Türkiye	Balıkesir	Bigadiç	-	-
2/2/2017 10:45:33	DDA	39.2841	40.1013	756	0.44000	ML	1.4	Türkiye	Bingöl	Yayladere	-	-
2/2/2017 10:20:15	DDA	39.4786	26.0800	9.69	0.80000	ML	2.8	Türkiye	Çanakkale	Ayvack	-	-
2/2/2017 10:19:36	DDA	39.4971	25.9256	700	0.88000	ML	2.3	-	-	-	Ege Denizi, 12.03 km. Ayvacık (Çanakkale)	-
2/2/2017 10:18:50	DDA	39.5076	26.1046	11.08	0.35000	ML	3.1	Türkiye	Çanakkale	Ayvack	-	-

STRONG GROUND MOTION RECORDS OF TURKEY  
PLACE : ADIYAMAN KAHTA GIDA TARIM VE HAYVANCILIK MUD.  
EARTHQUAKE DATE : 2017/03/02 11:07:25 (GMT)  
EPICENTER COORDINATES : 37.59550N-38.48660E  
EARTHQUAKE DEPTH (km) : 9.76  
EARTHQUAKE MAGNITUDE : 5.5 Mw  
STATION ID : 0205  
STATION COORDINATES : 37.79177N-38.61597E  
STATION ALTITUDE (m) : 723  
RECORDER TYPE : Guralp cmg5td  
RECORDER SERIAL NO : T5J41/A1042  
RECORD TIME : 02/03/2017 11:07:16.000000 (GMT)  
NUMBER OF DATA : 10145  
SAMPLING INTERVAL (sec) : 0.01  
RAW PGA VALUES (gal) : (N-S) 28.924242 (E-W) 29.755243 (U-D) 20.445435  
Copyright EARTHQUAKE DEPARTMENT  
DISASTER AND EMERGENCY MANAGEMENT PRESIDENCY

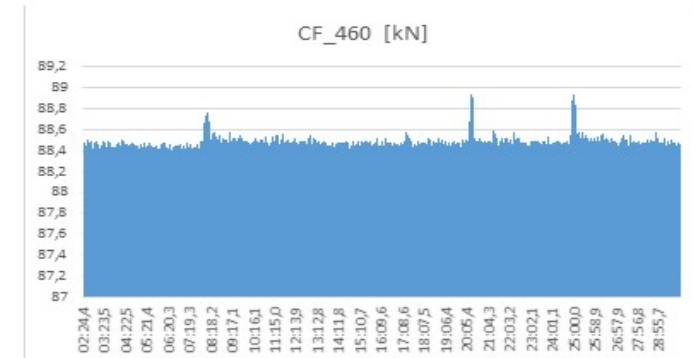
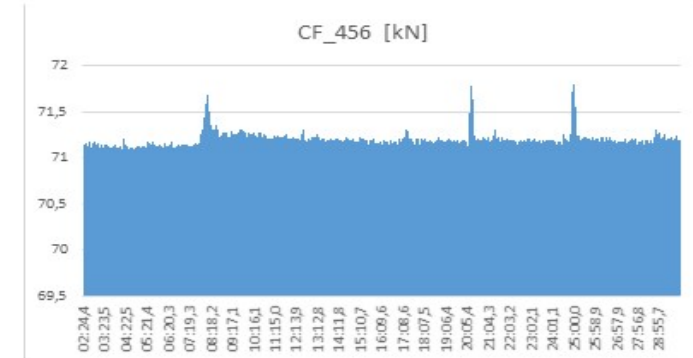
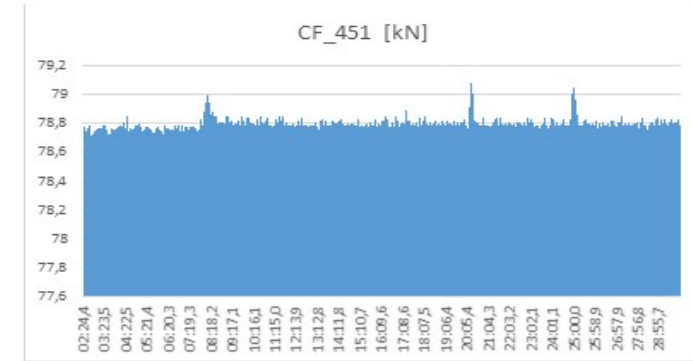
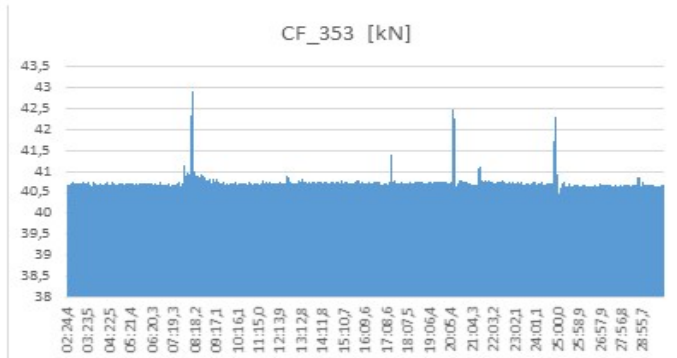
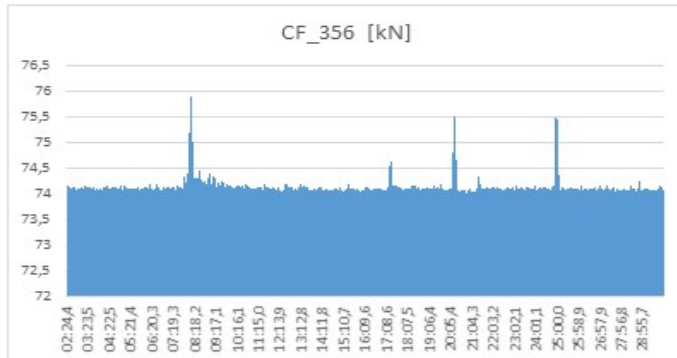
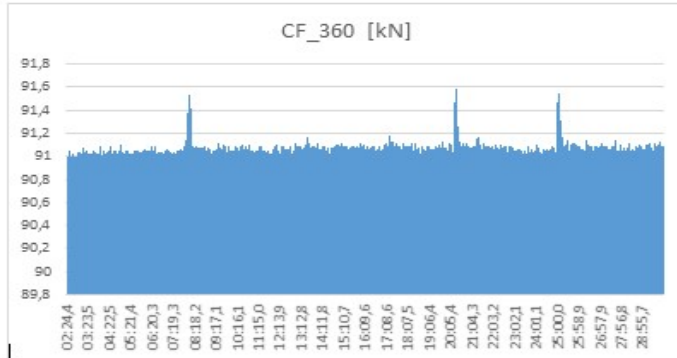




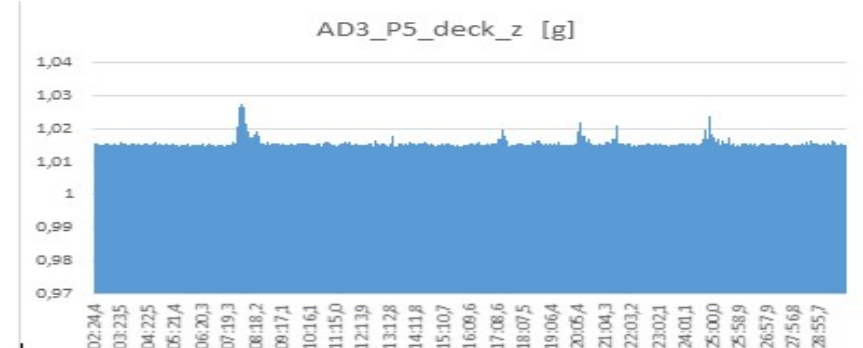
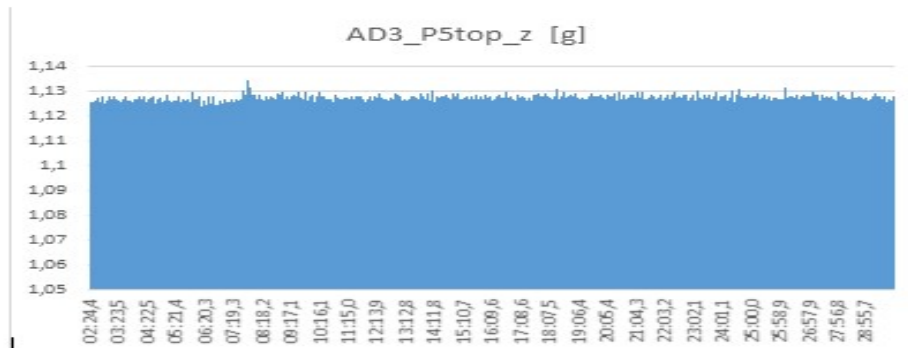
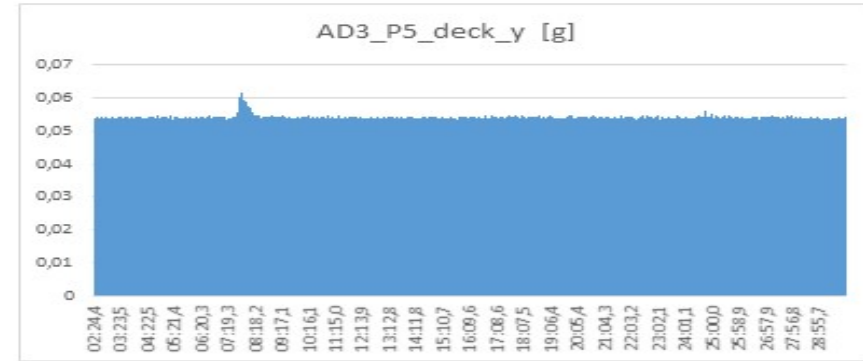
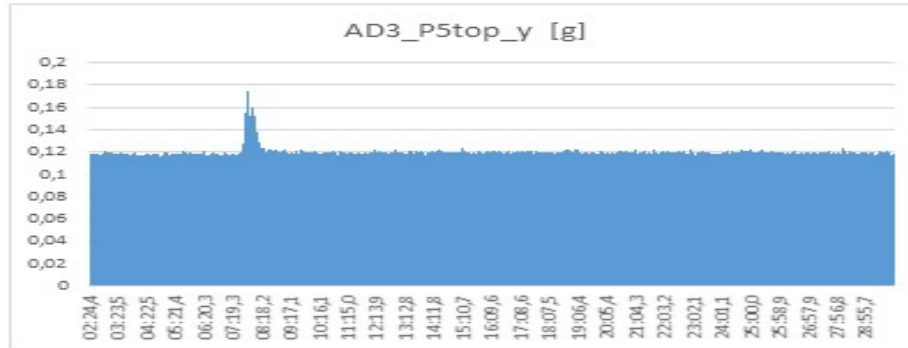
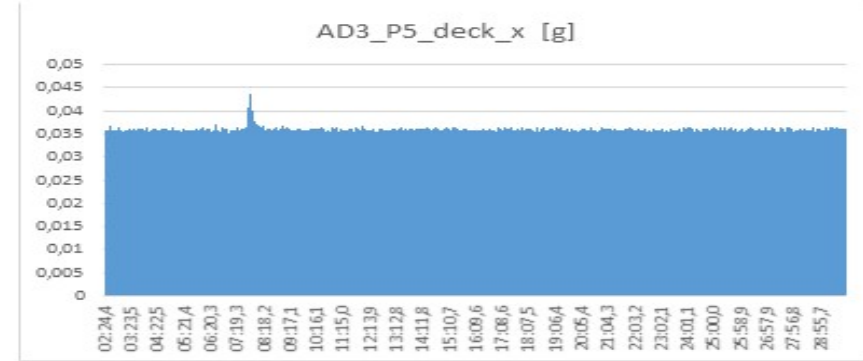
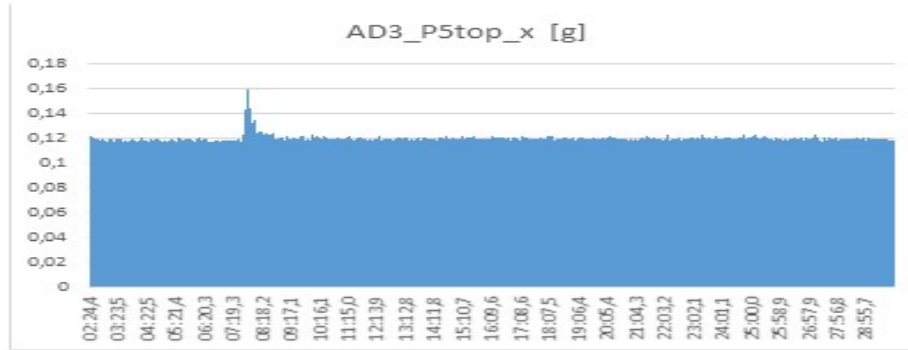
# 2 MART 2017 SAMSAT-ADİYAMAN DEPREMİ (MW=5.5) SIRASINDA KÖPRÜ DAVRANIŞI



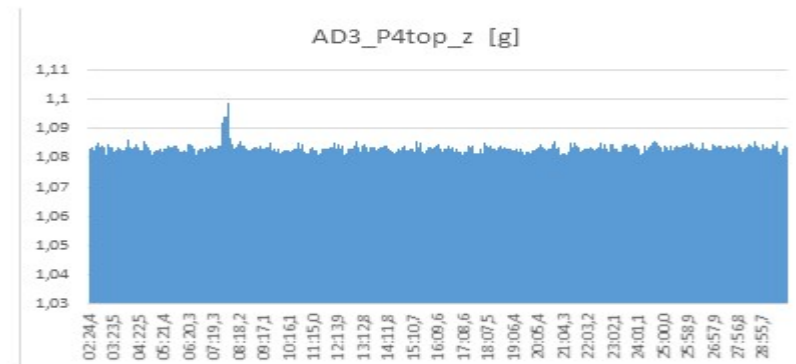
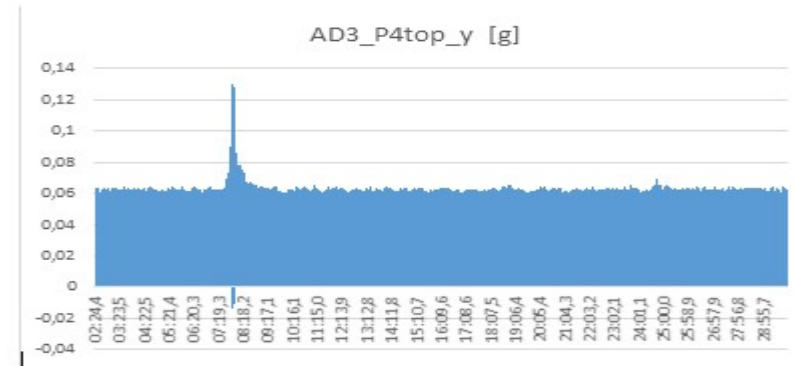
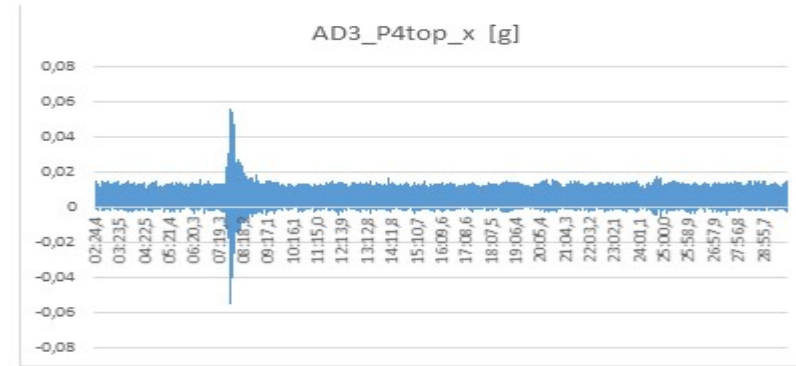
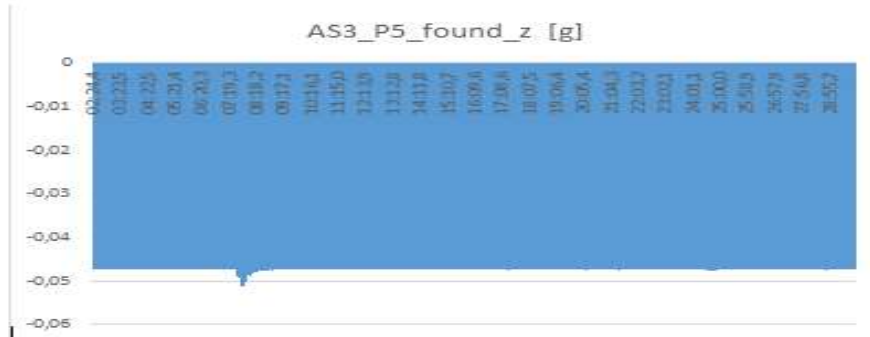
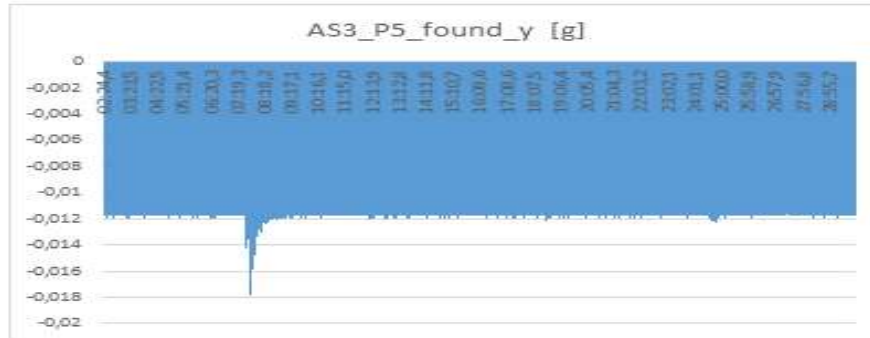
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# 2 MART 2017 SAMSAT-ADIIYAMAN DEPREMİ (MW=5.5) SIRASINDA KÖPRÜ DAVRANIŞI

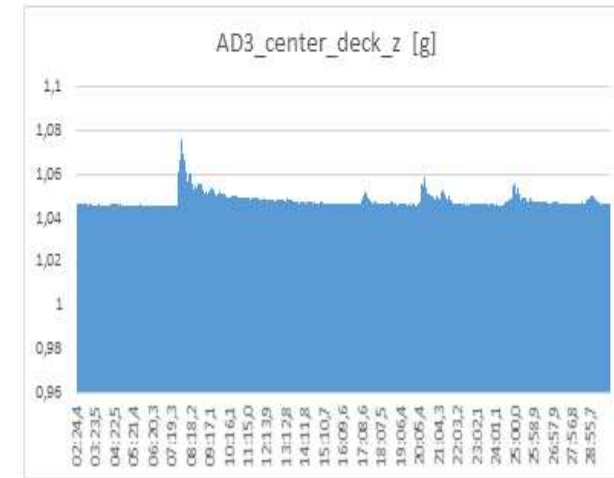
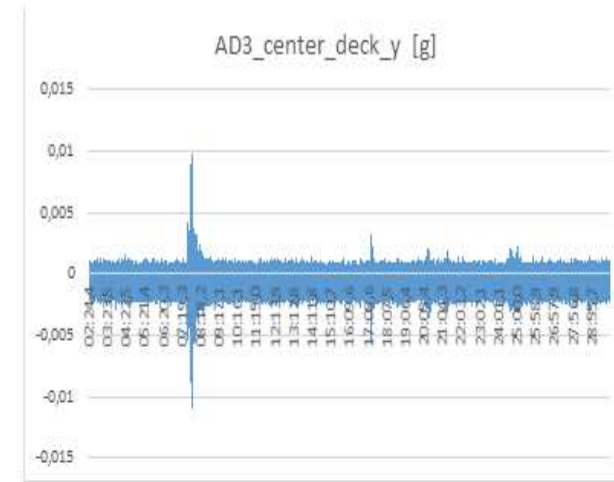
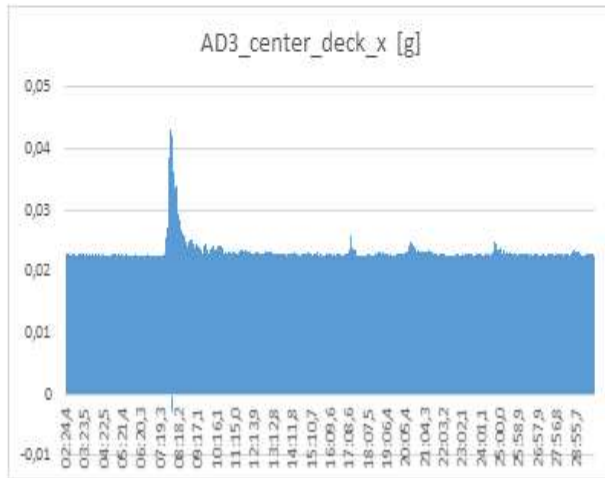
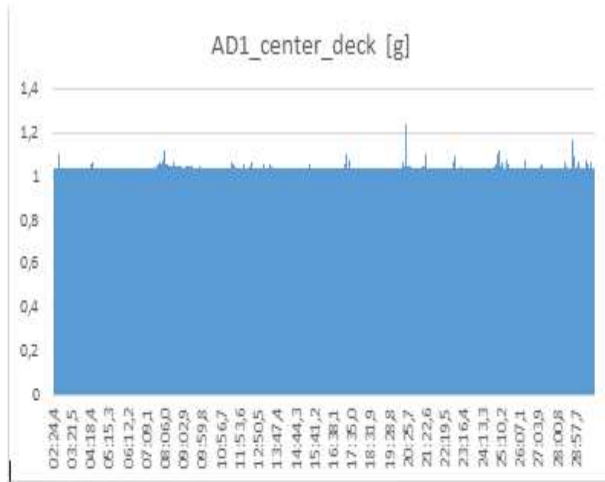


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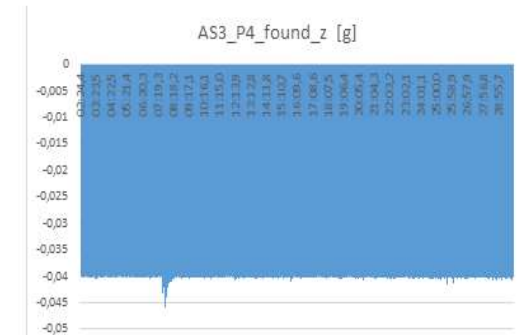
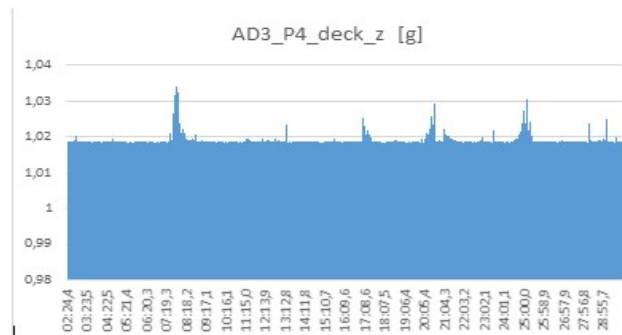
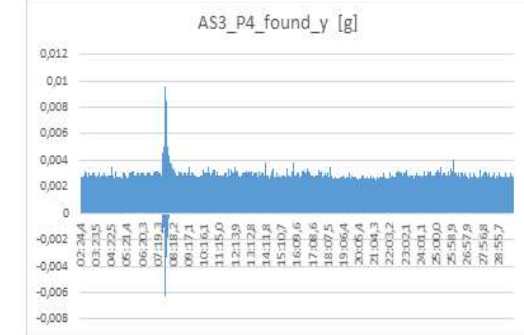
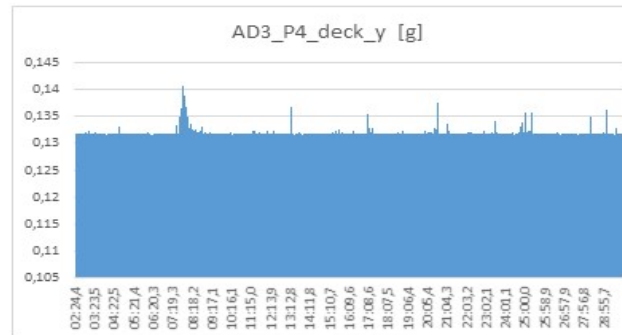
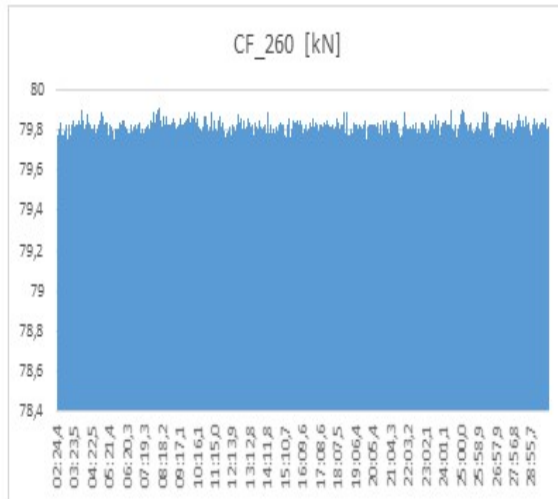
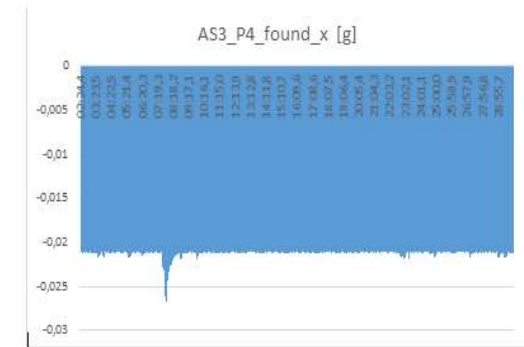
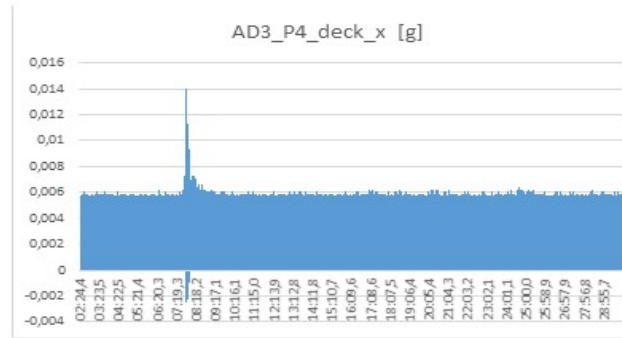
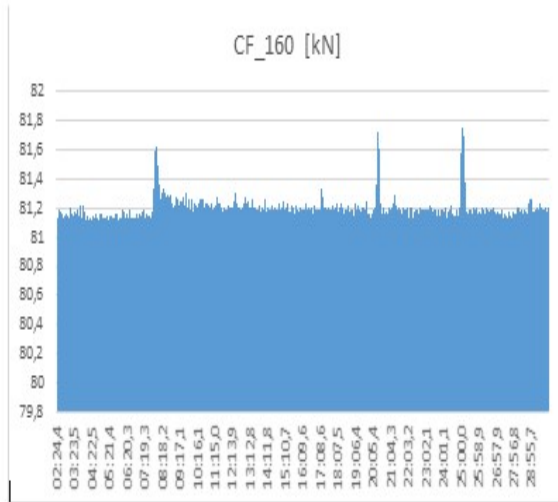




# 2 MART 2017 SAMSAT-ADİYAMAN DEPREMİ (MW=5.5) SIRASINDA KÖPRÜ DAVRANIŞI



# 2 MART 2017 SAMSAT-ADIYAMAN DEPREMİ (MW=5.5) SIRASINDA KÖPRÜ DAVRANIŞI





# TEŞEKKÜR

- Karayolları Genel Müdürlüğü
- Karayolları Diyarbakır 9. Bölge Müdürlüğü
- Gülsan Holding A.Ş.
- Emay A.Ş.
- Yüksel Proje
- Wiecon Com. Ltd.
- Doç. Dr. Temel Türker ve İnş. Yük. Müh. Janusz Tadla