COST ACTION TU1406

QUALITY SPECIFICATIONS FOR ROADWAY BRIDGES,
STANDARDIZATION AT A EUROPEAN LEVEL

# TU1406 WG4 Final report

# Appendix A14

# Bridge Case study

# Girder bridge – Güney Yaklaşım Viyadüğü (South Approach Viaduct), Altınova, TURKEY

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Date December, 2018

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# 1. GENERAL DATA OF THE BRIDGE

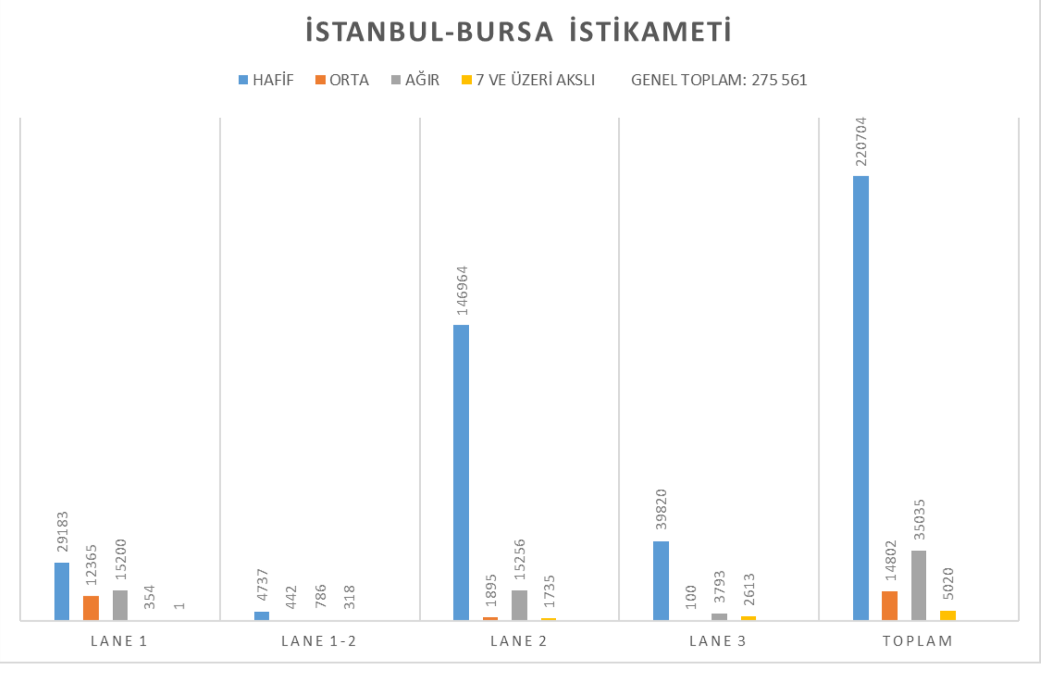
## 1.1. BRIDGE LOCATION

South Approach Viaduct is 1,378 meters long and located at south of Osmangazi Bridge in TURKEY. Areal map of the bridge location is presented below:


***Figure 1**: Bridge location*

## 1.2. TRAFFIC INFORMATION

| | |
|---|---|
| Number of cars / 30 days in Bursa direction | : 275,561.- |
| Number of cars / 30 days in İstanbul direction | : 286,896.- |
| Heavy Vehicles | : %5 |



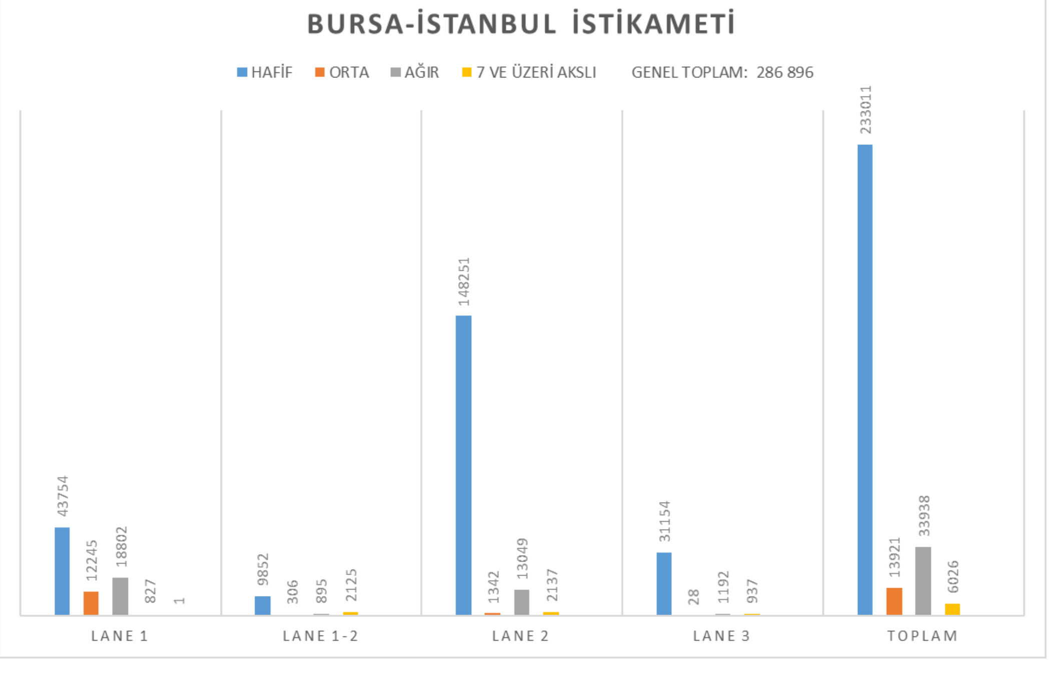




***Figure 2:*** *Number of cars from WIM report*

## 1.3. PLAN AND CROSS-SECTION OF BRIDGE

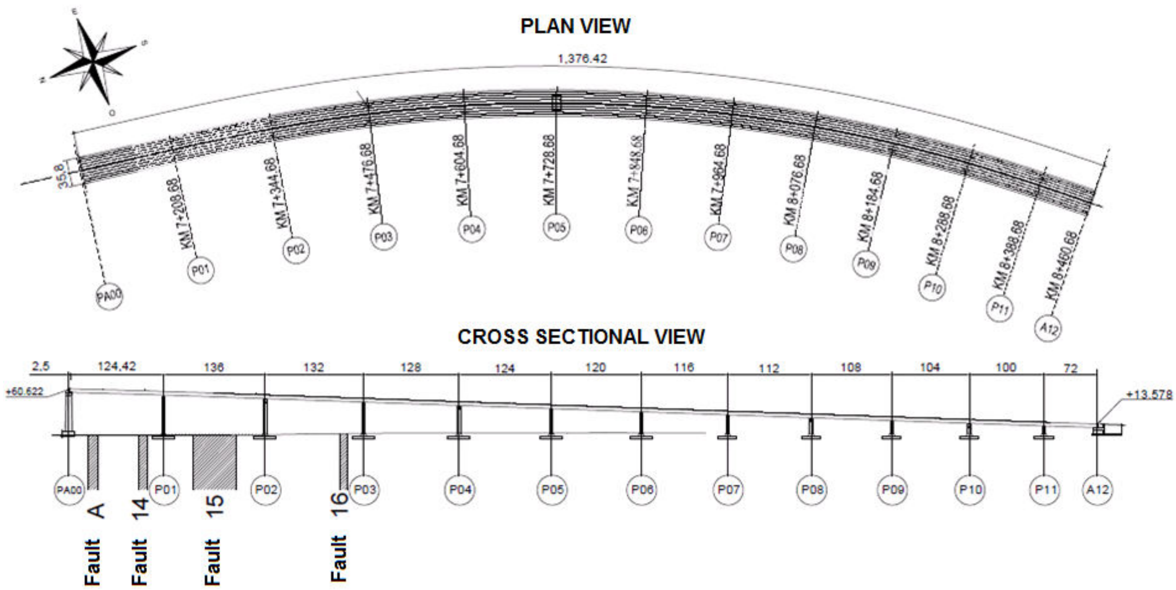



***Figure 3:*** *Bridge plan and longitudinal cross-section*

## 1.4. SEISMICITY OF AREA

South Approach Viaduct is constructed in one of the most seismically active places in the world. The bridge connects the Diliskelesi peninsula to the North with the Hersek peninsula on the south. The proposed project site spans the plate boundary between the Anatolian plate on the south and the Eurasian plate on the north and will experience significant earthquakes on the North Anatolian Fault Zone (source of the 1999 Magnitude Mw 7.4 Izmit and Mw 7.2 Düzce earthquakes).

## 1.5. BRIDGE PROPERTIES

The South Approach Viaduct of the Osmangazi Bridge Crossing brings the bridge down from on the order of elevation 60 meters at the South Anchorage to an elevated embankment approximately 1378 meters further south. The bridge consists of 11 Piers and 10 standard intermediate spans with lengths varying between 136 m and 100 m and two bank spans one of 125 m, attached to the main bridge and the other of 72 m attached to the south embankment (Figure 4). The South Approach Viaduct is located between km 7+084.26 (Pier P0) and km 8+462.43 (Pier A12). The SAV piers are numbered consecutively starting from Pier P1 which is located south of the South Anchorage of the main Bridge to Pier P11 and terminating at the south embankment A12, located south of Pier P11. The interface between the Osmangazi Bridge and the SAV is at the South Anchorage of the Osmangazi Bridge (Pier P0).


***Figure 4:*** *General layout of footings*

## 1.6. SUBSOIL AND GEOLOGY

Prior to the construction of the foundations, a detailed geophysical and geotechnical survey program was executed between 2011 and 2012. The site investigation consisted of 10 no. of boreholes down to 60 m depth; 126 no. of Menard Pressuremeter tests in all boreholes; 48 no. of CPT; and laboratory tests. Since the site is underlain by deep deposits of soft soils, and areas of unstable and liquefiable soils, characterizing the geological, seismological and geotechnical setting, foundation soil conditions, fault locations, as well as developing an appropriate design criteria was the most critical component for the project.

## 1.7. FOUNDATION CONCEPT

Analyses were performed to evaluate the performance of two different foundation types for the SAV piers, a shallow foundation and a diaphragm wall foundation system. Due to the severity of the design ground motions, the superstructure introduces significant moments on the foundation. For a shallow footing solution, the size of the footing is driven by the overturning resistance to the superstructure loads rather than the vertical bearing capacity. Additionally, since fault rupture through a pier foundation is the main concern for this project, the foundation system was found to play a key role in the response of structures subjected to fault induced ground movement. Structures resting on rigid and continuous foundation systems (such as a raft, or a box-type foundation) have demonstrated to be capable of achieving a very satisfactory performance, irrespective of the faulting type. As a result; a caisson-type of foundation was selected as the most suitable foundation system; which consists of four perimeter diaphragm walls, a concrete cap, and a diaphragm wall constructed along the bridge transverse direction under each Pier legs. The thickness of the diaphragm walls is 1.00 meter and the cap thickness is 3 meters. The foundation concept is shown schematically in Figure 5. A total of 14,400 m2 diaphragm wall with a maximum depth of 23 m was executed.

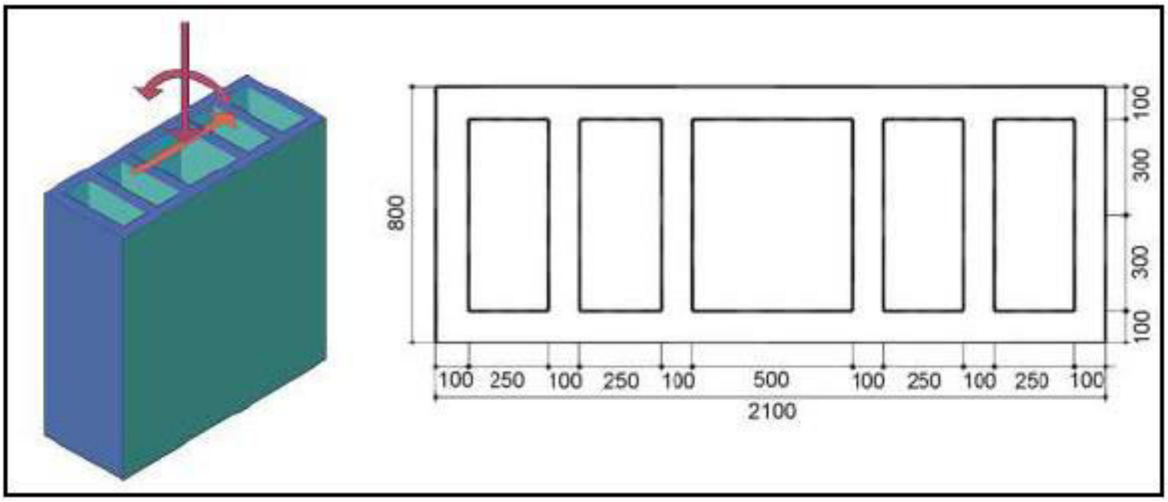



***Figure 5****:Foundation Concept*

## 1.8. SUPERSTRUCTURE

Supestructure comprises of a steel deck with a length of approximately 1.379 m, 11 steel piers and an abutment made of reinforced concrete. 32.000 tons of steel used in superstructure. The deck section is a twin box orthotropic steel structure continuous for the entire length of the bridge. The two box sections are linked by a series of transvers steel beams which are spaced at 4 m.

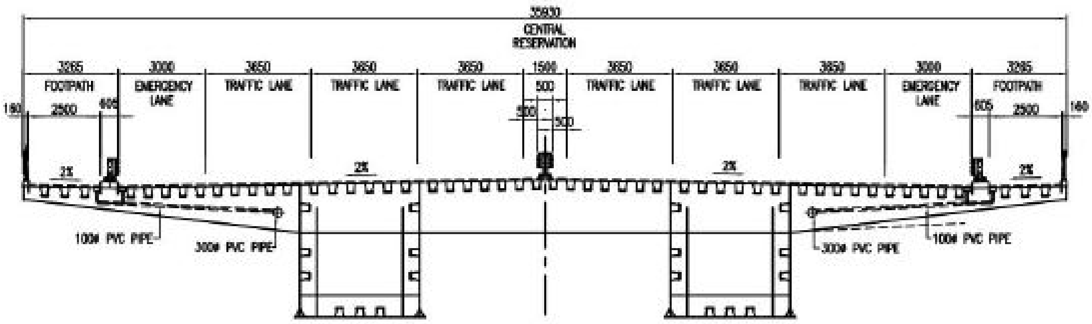



***Figure 6****:Deck cross-section*

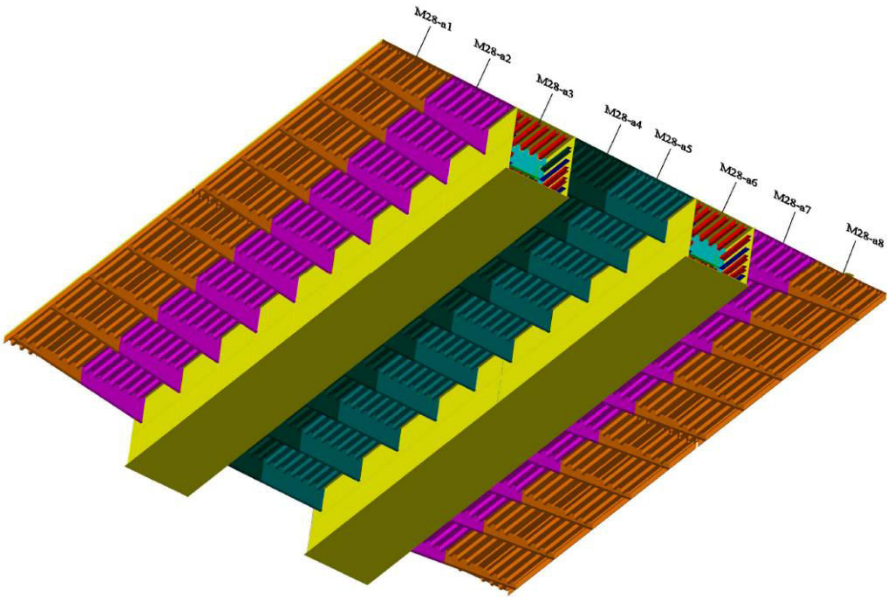



***Figure 7***:*Deck*

Piers are flexible steel box (4 m X 4 m) columns. The reason of the selection of the pier strcuture type and shape is to reduce mass and decrease the structural stiffness which results in a period shift. An increased structural period generally results in a reduction of acceleration. Total weight of piers is 7000 tons.

***Figure 8*** :*Piers*

All enclosed spaces such as the inside of the piers and cap beam as well as the two boxes of the superstructure are protected against corrosion pimarily by dehumidification system.

Due to the fact that this bridge is located in a highly seismic area, with the added complication of a potential fault rupture zone traversing the alignment of the bridge it was required to come up with a special seismic isolation solution for this project in order to ensure that this structure will withstand the specified EQ. The isolation system chosen for this bridge had to fulfill several critical conditions one being the potential large displacement as a result of fault rupture and the second being to ensure and guarantee adequate isolation of the superstructure, to ensure that it performs in accordance with the clients seismic performance requirements. The isolation system that fulfilled all of the requirements essentially consists of LRB bearings as the main vertical load bearing members, in conjunction with a finely tuned damper system that effectively isolates the superstructure form the substructure during an extreme seismic event, at the same time dissipating large amounts of energy, which is essential for the survivability of this structure.

## 1.9. PAVEMENT

The area of the main carriageway of South Approach Viaduct is approximately 40,600 square meters. Asphalt pavement built up in two layers comprising a wearing surface stone mastic asphalt top layer and a mastic asphalt layer over waterproofing system on steel decks. It is planned to remove the Stone Mastic Asphalt wearing surface in surface damages without touching the Mastic Asphalt Layer and Waterproofing Layer.


*Figure 9:Waterproofing of deck*

Wearing course, t = 30 mm
Intermediate layer, t = 28 mm
Water proofing, t = 2-4 mm
Primer

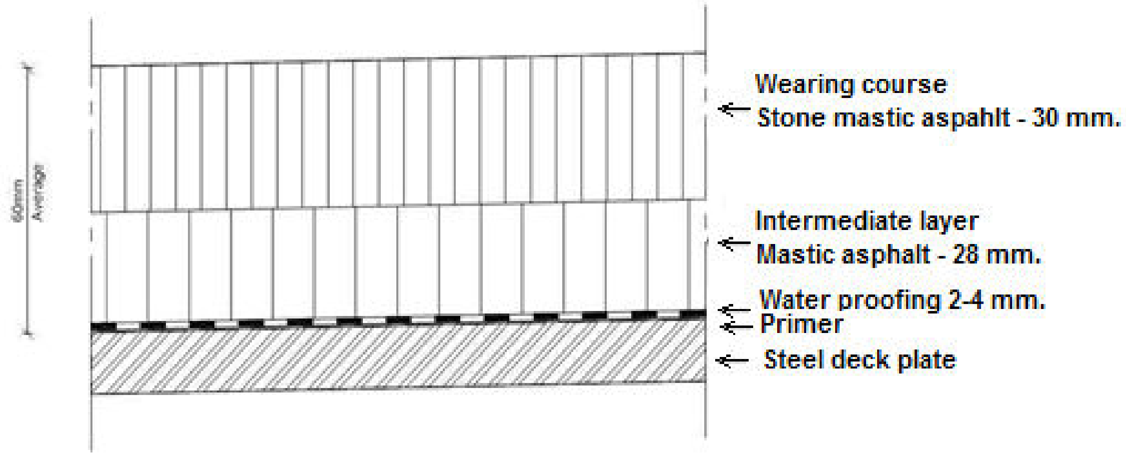



***Figure 10***:*Typical pavement section*

## 1.10.ACCESSORIES

The inspection walkway is protected with anti-skid waterproofing layer and has hot dip galvanized steel barriers. Main reason of selection of the coating system is providing best conditions technically and environmentally on the viaduct walkways. Regarding the specifications, coating system complies wih ISO-12944 C5I/M High standard to protect steel surfaces against corrosion. The coating system has its unique properties to provide corrosion resistance according to ISO standard and anti-skid properties. Priority of the system is corrosion protection which is provided by the system contains Zinga and Alufer N. Then Zingacolor and Zinga MixFloor application provides anti-skid feature of the walkways.

Wire type traffic barriers monuted on galvanized steel posts bolted to steel deck. Swivel joist expansion joints(DS1200 and DS880), LRB bearings(with capacity upto 42 MN each), longitudinal and transverse seismic dampers(with stroke of up to 1,175 mm) are installed for isolation.


***Figure 11***:*Expansion joint, seismic damper and bearing*

## 1.11.ELECTRO-MECHANICAL INSTALLATIONS

South Approach Viaduct has following electro-mechanical installations:

- Power supply system
- CCTV system
- Highway lighting system
- Architectural lighting system
- Access control system
- Fire alarm system
- Fire fighting system
- Dehumidification system
- SOS telephones and communication system


*Figure 11:Electro-Mechanical systems*

The control and monitoring of the technical installations on the bridge are carried out from two redundant control rooms located at the following facilities:

• Main Control Room in the Main Control Building
• Slave Control Room in South Substation Building

These rooms are center of SCADA to control and monitor all bridge structural and operational functions.

## 1.12.DEHUMIDIFICATION SYSTEM

Corrosion of structural steel elements are main factors adversely affecting the condition of the steel bridges. All closed parts of South Approach Viaduct are equipped with dehumidification system, monitored and controlled from bridge control center. Dehumidificaton system introduces dry air into the internal parts of bridge to remove moisture and to maintain a relative humidity below 40% level to suppress corrosion.

## 1.13.DESIGN SPECIFICATION

The main steel structural design carried out in accordance with AASHTO LRFD Bridge Design Specifications, 6th Edition – 2012.

## 1.14. DESIGN LOADS

Permanent Loads:
(a) dead load (DL)
(b) superimposed dead load (SDL)
(c) horizontal earth pressure (EH)
(d) creep and shrinkage (CR+SH)

Transient Loads:
(a) vehicular live load (LL)
(b) vehicular dynamic load allowance (IM)
(c) vehicular braking load (BR)
(d) vehicular centrifugal load (CE)
(e) live load surcharge (LS)
(f) pedestrian live load (PL)
(g) special vehicles (LLs)
(h) wind load on structure (WS)
(i) wind on live load (WL)
(j) force effect due to uniform temperature (TU)
(k) force effect due to gradient temperature (TG)
(l) force effect due to settlement (SE)
(m) earthquake load (EQ)

Design truck : (H30-S24)
The design tandem : A pair of 110 kN axles spaced 1.20m apart.
The design lane load : A load of 15.0 kN/m uniformly distributed in the longitudinal direction. Transversely, the design lane load shall be assumed to be uniformly distributed over a 3.00 m width.
Abnormal highway loading : “Special vehicles” with reference to EN 1991-2. Section 4.3.4. And the design live load intensity of 81.7 kN/m in UDL system.
Abnormal load Type A : Unlimited convoy of two tracked crawler military tank weighing 1335kN.
Abnormal load Type B : Unlimited convoy of vehicles weighing 1512kN and having five axles.
Abnormal load Type C : Single vehicle weighing 1800 kN and having four axles.
The wind pressure : Specified in AASHTO LRFD was assumed to be caused by a base design wind velocity, VB, of 160 km/hr.
Seismic Loading: Analysis of extreme and lower risk design earthquake events, with a final check on the bridge design for a third more extreme seismic event. The bridge is designed to provide the specified levels of seismic performance described below. It shall be designed to resist three levels of earthquake:

- A Functional Evaluation Earthquake (FEE), with a 50% probability of occurrence in the 100-year design life specified for the bridge (return period of ~150 years).
- A Safety Evaluation Earthquake (SEE), with a 10% probability of occurrence in the 100-year design life specified for the bridge (return period of ~1,000 years).
- A No Collapse Earthquake (NCE), with a 4% probability of occurrence in the 100-year design life specified for the bridge (return period of ~2,475 years).

# 2. TECHNICAL CONDITION

## 2.1. BRIDGE ROUTINE INSPECTION

The bridge is periodically inspected by GIIB (Gebze Izmir Motorway Operation and Maintenance Co.Inc.) personnel since openning to traffic in July 1st, 2016. Operation and maintenance was contracted to GIIB by Concessioanare “OTOYOL Yatırım ve İşletme A.Ş.” who got BOT of the huge “Gebze-Izmir Motorway” project (400 kms) for 22 years and 4 months. Inspection and maintenance is done based on operation and maintenance manual provided by EPC Contractor.

| Kapsam | Muayene Görevi | İlgili Bakım Görevi | Periyot | İlgili Form | OCAK | ŞUBAT | MART | NİSAN | MAYIS | HAZİRAN | TEMMUZ | AĞUSTOS | EYLÜL | EKİM | KASIM | ARALIK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 |
| Beton ayak Dışı | Beton ve çelik yüzeyler, ataşmanlar ve erişim yollarını kontrol et. Mevcut erişim yolları ve dürbün kullan. | Gerekirse düzeltici faaliyet başlatımı | 1 MUAYENE/YIL | GYVRM-001 | | | | | | Y | | | | | | |
| Tabliye Dışı | Çelik yüzeyleri, ataşmaları ve erişim yollarını kontrol et. Tabliye platformları yada platform olmayan yerlerde dürbün kullan. | Gerekirse düzeltici faaliyet başlatımı | 1 MUAYENE/YIL | GYVRM-002 | | | | | | Y | | | | | | |
| Tabliyeler, Çelik Ayaklar İçi | İçinden yürüyerek geç. Erişim yollarında sıkı olmama (gevşeme) belirtileri, içeri su sızması ve M&E parçalarının bütünlüğü. Nem alma sisteminin faal ve çalışıyor olduğunun kontrolü. | Gerekirse düzeltici faaliyet başlatımı | 2 MUAYENE/YIL | GYVRM-003 | | | | | | 6A | | | | | | 6A |
| Mesnet ve hidrolik sönümleyiciler | Herbirini Muayene et. Mesnet ve sönümleyicilerin işlev, konum ve durumu. Aynı zamanda tedarikçi İ&B El kitaplarına başvurun. | Gerekirse düzeltici faaliyet başlatımı | 2 MUAYENE/YIL ya da tedarikçinin önerdiği sıklıkta | GYVRM-007 | | | | | | 6A | | | | | | 6A |
| Genleşme Derzleri | Görsel muayene. Yol genleşme derzleri işlev ve durumu. Farklı gelecek ise, öngörülmeyen hareketler ve gevşemiş ve aşınmış parçalara karşı kontrol yapın. Aynı zamanda tedarikçi İ&B El kitaplarına başvurun. | İşlev kaybını önlemek için önleyici bakım işi. Gerekirse düzeltici faaliyet başlatımı | 1 MUAYENE/AY ya da tedarikçinin önerdiği sıklıkta | GYVRM-008 | A | A | A | A | A | A | A | A | A | A | A | A |
| Araç yolu ve Yürüme Yolu | Yaya yolundan araçla geçerken ara sıra yalardan muayene için durup<br>yürüyün.<br>Yol yüzey kaplama, bariyerler, parapetler, rüzgar kalkanları, drenaj, yangın sistemi ve diğer döşemeler durumunu kontrol et. | Temizlik. Çöp ve düşen parçaların toplanması. Gevşeyen parçaların sabitlenmesi. Yol asfalt çukurlarının ara tamirlerinin yapımı. | 1 MUAYENE/HAFTA ve (gerektikçe) | GYVRM-009 | H H H H | H H H H | H H H H | H H H H | H H H H | H H H H | H H H H | H H H H | H H H H | H H H H | H H H H | H H H H |
| Aydınlatma | Araçla yada yürüyerek. Yol ve muayene yaya yolu harici aydınlatması deniz ve havacılık ışıklarının düzgün çalıştığının kontrolü. | Ampul ve sigortaların değiştirilmesi. | 1 MUAYENE/HAFTA | GYVRM-011 | H H H H | H H H H | H H H H | H H H H | H H H H | H H H H | H H H H | H H H H | H H H H | H H H H | H H H H | H H H H |

H: Hafta A: Ay 3A:3 AY 6A:6 Ay Y:Yıl

HAZIRLAYAN : ONAYLAYAN

***Table 11**: Yearly routine inspection plan*

| KAPSAMDA BULUNAN SİSTEM VE ALANLAR | İlgili Form | 2016 (Devreye alma) | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Altyapı | | | | | | | | | | | | | | | | | | | | | | | |
| Beton ayak temelleri, Dış | GYVBM-001 | | | | | | BM | | | | | BM | | | | | | | | | | BM | |
| Çelik Ayaklar, Dış | GYVBM-005 | | | | | | | BM | | | | | BM | | | | | BM | | | | | |
| Çelik Ayaklar, İç | GYVBM-006 | | | | | | | BM | | | | | BM | | | | | BM | | | | | |
| Üstyapı | | | | | | | | | | | | | | | | | | | | | | | |
| Tabliye, Dış | GYVBM-009 | | | | | | | BM | | | | | BM | | | | | BM | | | | | BM |
| Tabliye, İç | GYVBM-010 | | | | | | | BM | | | | | BM | | | | | BM | | | | | BM |
| Mesnetler | GYVBM-013 | | Ö | Ö | Ö | Ö | BM | | | | | BM | | | | | BM | | | | | BM | |
| Genleşme Derzleri | GYVBM-014 | | Ö | Ö | Ö | Ö | BM | | | | | BM | | | | | BM | | | | | BM | |
| Yüzey kaplaması, yol ve servis yayayolu | GYVBM-015 | | | | | | BM | | | | | BM | | | | | BM | | | | | BM | |
| Yardımcı Yapılar | | | | | | | | | | | | | | | | | | | | | | | |
| Emniyet Bariyeri, Araç Parapeti, Yaya Parapeti ve Rüzgar Kalkanları (İç ve Dış) | GYVBM-016 | | | | | | BM | | | | | BM | | | | | BM | | | | | BM | |
| Kapılar, Kapaklar, Tırmanma ve Basamaklı Merdivenler | GYVBM-017 | | | | | | BM | | | | | BM | | | | | BM | | | | | BM | |
| Aydınlatma direkleri, (bilgi) İşaretleri ve diğer Dekoratif parçalar | GYVBM-018 | | | | | | BM | | | | | BM | | | | | BM | | | | | BM | |
| Mekanik & elektrik (tesisat) | | | | | | | | | | | | | | | | | | | | | | | |
| Drenaj sistemi | GYVBM-019 | | | | | | BM | | | | | BM | | | | | BM | | | | | BM | |
| Harici aydınlatma | GYVBM-020 | | | | | | | BM | | | | | BM | | | | | BM | | | | | BM |
| Tesisat (kablolama, trafolar, dahili aydınlatma) | GYVBM-021 | | | | | | | | | | | | BM | | | | | | | | | | BM |
| Yıldırım koruma ve topraklama | GYVBM-023 | | | | | | | | | | | | BM | | | | | | | | | | BM |
| Tabliye ve Çelik Ayak Nem alma Sistemi | GYVBM-032 | | | | BM | | | | | BM | | | | | BM | | | | | BM | | | |
| Hidrolik sönümleyiciler | GYVBM-035 | | | | | | BM | | | | | BM | | | | | BM | | | | | BM | |
| Ölçümler | | | | | | | | | | | | | | | | | | | | | | | |
| Genel ölçüm(İlk 3 yılda 1 defa, sonra 2-5-10 yıl ara ile) | GYVBM-037 | | Ö | Ö | Ö | | Ö | | | | | Ö | | | | | | | | | | Ö | |
| BM : Büyük Muayene Ö : Ölçüm | | | | | | | | | | | | | | | | | | | | | | | |
| HAZIRLAYAN : | | | | | | | | | | | | ONAYLAYAN : | | | | | | | | | | | |

***Table 12:*** *Principal inspection plan*

Damages identified by Principle Inspection are documented according to the following principles with categorization of inspection results into 4 damage levels.

| Damage Level | Damage | Documentation |
|---|---|---|
| 0 | No damage (not visible within arms length) | Condition may be noted as a general observation. |
| 1 | Minor damage. Damage is stable. | Condition is noted and sample picture taken for record |
| 2 | Moderate damage. Damage may develop into damage level 3 before next Principle Inspection. | Condition is noted and damage described. Sample picture of damage and cause of damage.<br><br>Repair may be considered if economical feasible. |
| 3 | Serious damage. Damage has or will before next Principle Inspection, develop into failure or loss of function. | Condition is noted and damage described. Sample picture of damage and cause of damage.<br><br>All damages are documented in detail as a basis for ordering Special Inspection and repair or replacement. |

***Table 13*** *: Damage levels for inspection*

FORM NO: GYVRM-003

GÜNEY YAKLAŞIM VİYADÜĞÜ

Tabliyeler, Çelik Ayaklar içi

RUTİN MUAYENE FORMU

TARİH

| | | | |
|---|---|---|---|
| KODU | | ÜRETİCİSİ | |
| TİPİ | | ÖNCEKİ BAKIM TARİHİ | |
| YERİ | | SONRAKİ BAKIM TARİHİ | |
| ÇİZİM NO | W12005-DD-SS-300-...-313 / W12005-DD-SS-400-...-429 / W12005-DD-GE-100-...-301 / W12005-DD-MA-100-101-104 | | |

**MUAYENE ÖNCESİ DURUM**

| | | | | | |
|---|---|---|---|---|---|
| NORMAL ÇALIŞIYOR | | ARIZASI VAR | | ÇALIŞMIYOR | |

MUAYENE ÖNCESİ TESPİTLER:

| MUAYENE SIKLIĞI | | | | | | HASAR SEVİYESİ | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| HAFTALIK | AYLIK | 3 AYLIK | 6 AYLIK | YILLIK | MUAYENE KONULARI | 0 | 1 | 2 | 3 | AÇIKLAMA |
| | | | V | | İş güvenliği önlemlerini al | | | | | |
| | | | V | | Aydınlatma kontrolünü yap | | | | | |
| | | | V | | Gaz ölçümünü yap | | | | | |
| | | | V | | Erişim yollarının kontrolünü yap | | | | | |
| | | | V | | Beklenmedik ses, kir vs. kontrolünü yap | | | | | |
| | | | V | | Korozyon kontrolünü yap | | | | | |
| | | | V | | Kaynak bölgelerinin gözle muayene kontrolünü yap(%10) | | | | | |
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HASAR SEVİYESİ

0: Hasar Yok

1: Küçük Hasar (Hasar kayıt altına alınır)

2: Orta Hasar (Tamir Gerekebilir)

3: Ciddi Hasar (Tamir ya da Değiştirme Gerekebilir)

MUAYENE SONRASI TESPİTLER:

**PERSONEL BİLGİLERİ**

| | |
|---|---|
| **MUAYENEYİ YAPAN** | **ONAY** |

***Table 14:*** *Sample routine inspetion from to be filled*

## 2.2. ACCESS FOR INSPECTION AND MAINTENANCE

Access for inspction and maintenance were taken into consideration during design phase. There is an inspection walkway on both side of roadway in each direction. Doors, hatches and stairs are provided to reach to deck and piers wheras mobile underdeck platform is sued to access to underdeck and outside of piers.

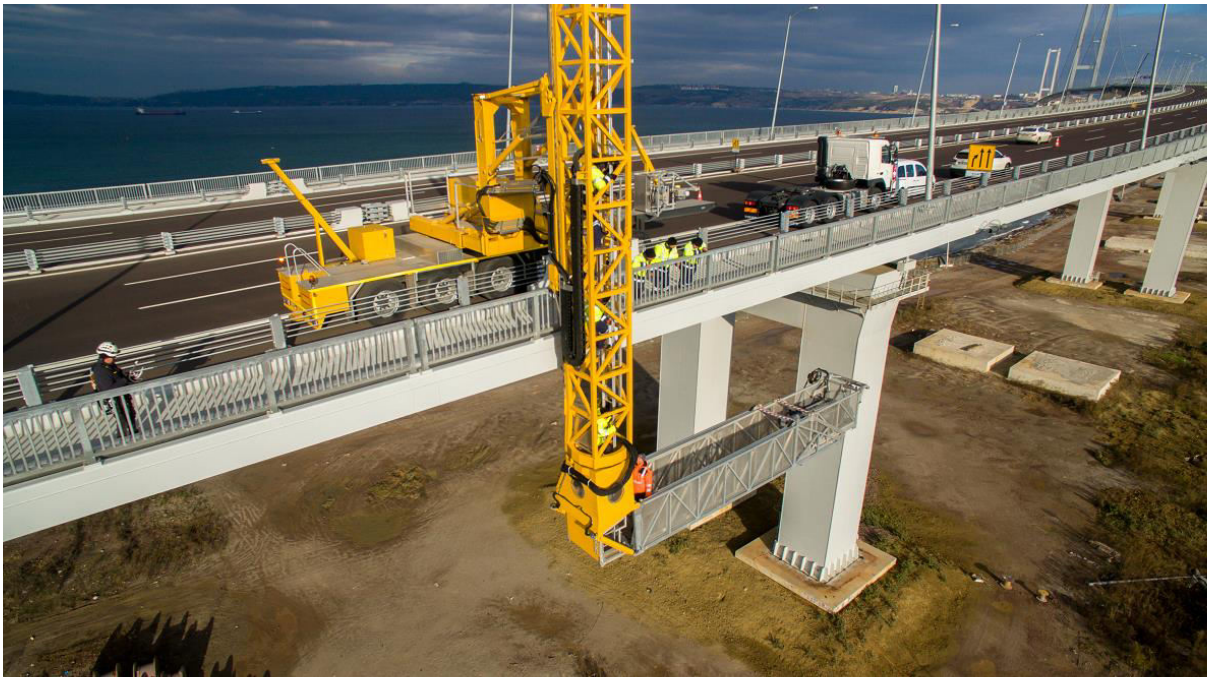


***Figure 12:*** *Mobile underdeck gantry*

***Figure 13****: inspection walkway (fixing of bird protection on pedestrian barrier)*

## 2.3. VULNERABLE POINTS

The designer adviced following points to check closely within the operaton and maintenance manual:

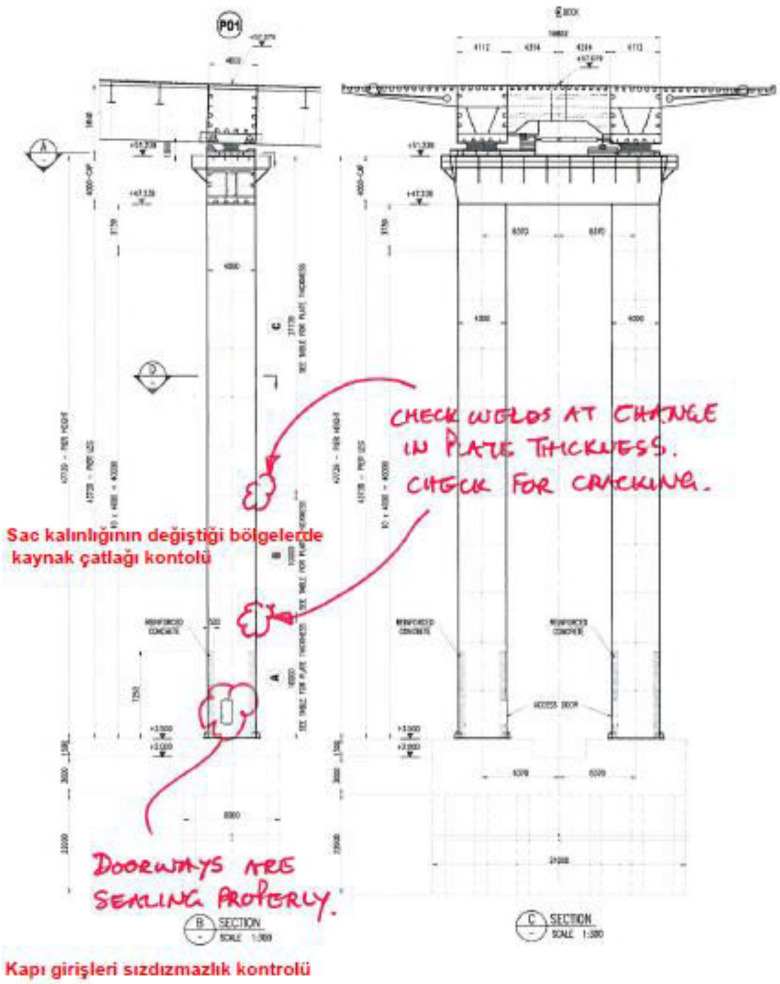



***Figure 14 :*** *Guide for inspection of piers*

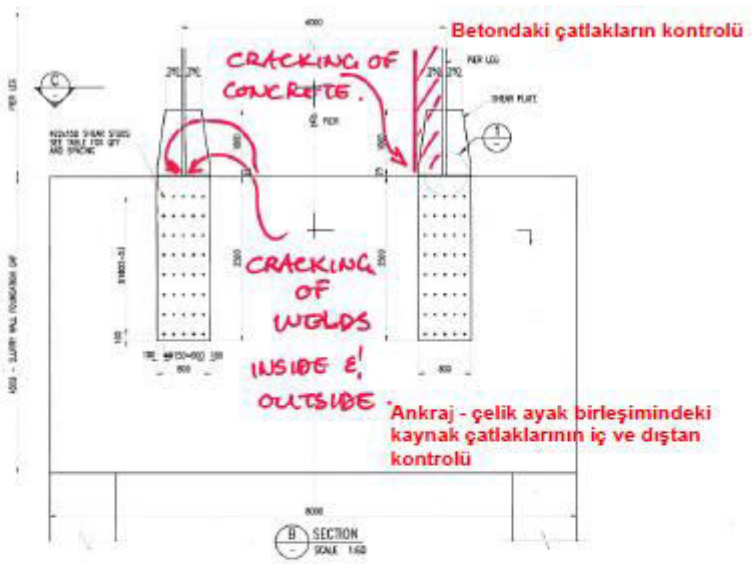



***Figure 15:*** *Guide for inspection of foundations*

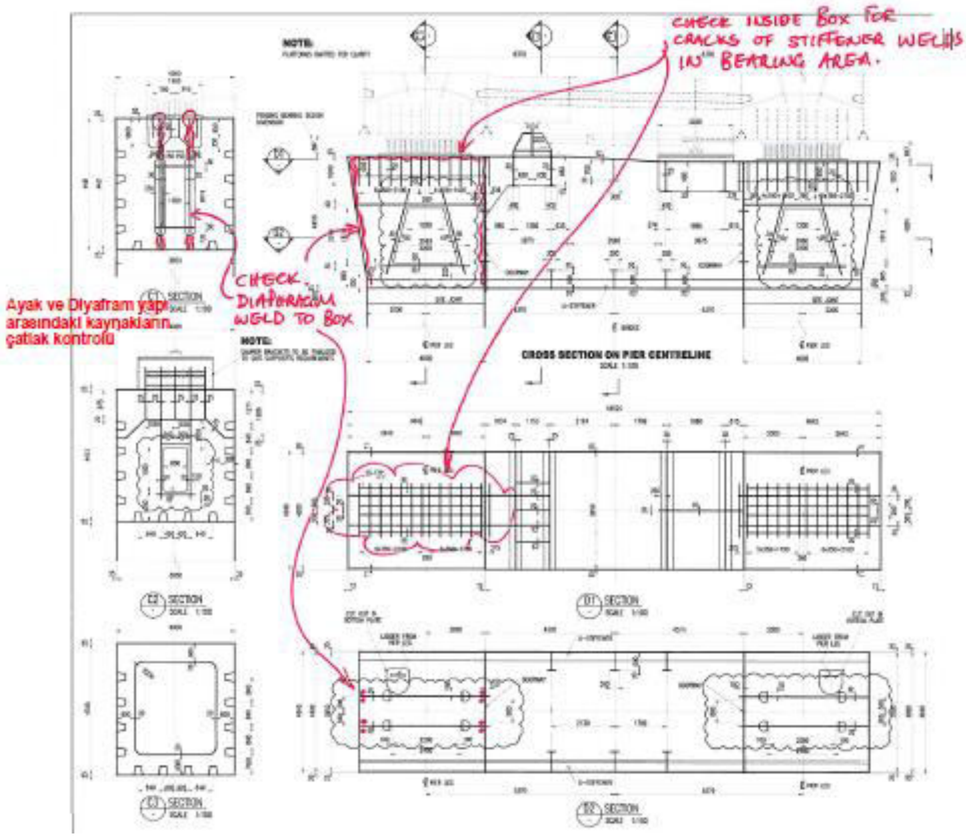



***Figure 16:*** *Guide for crack inspection of stiffener plates at location of pier bearings*

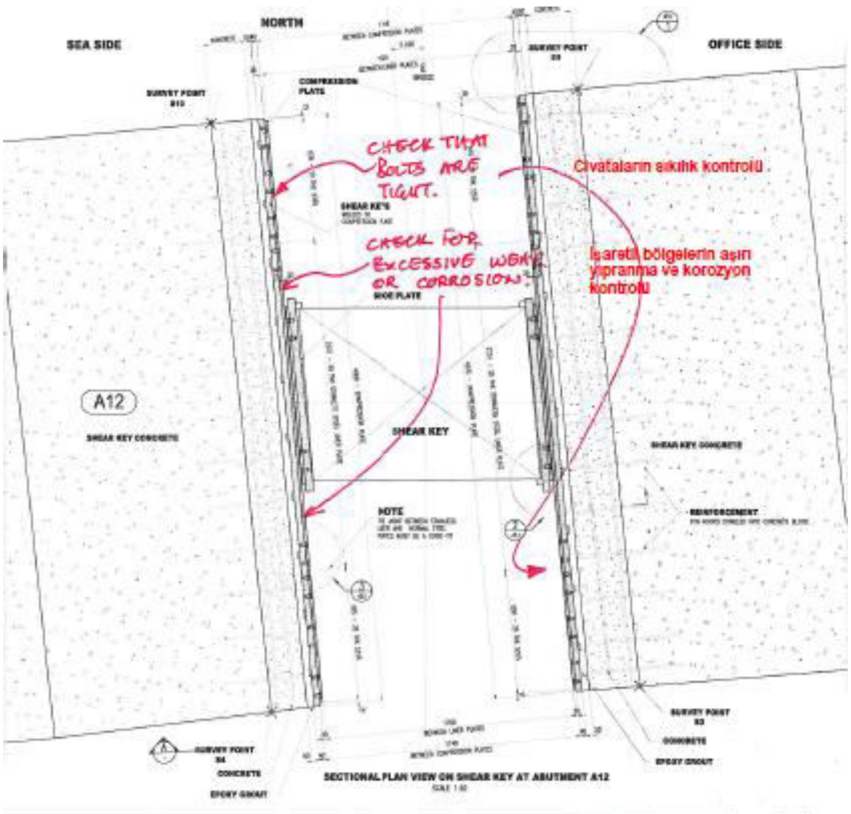



***Figure 17:*** *Guide for inspection of expansion joints*

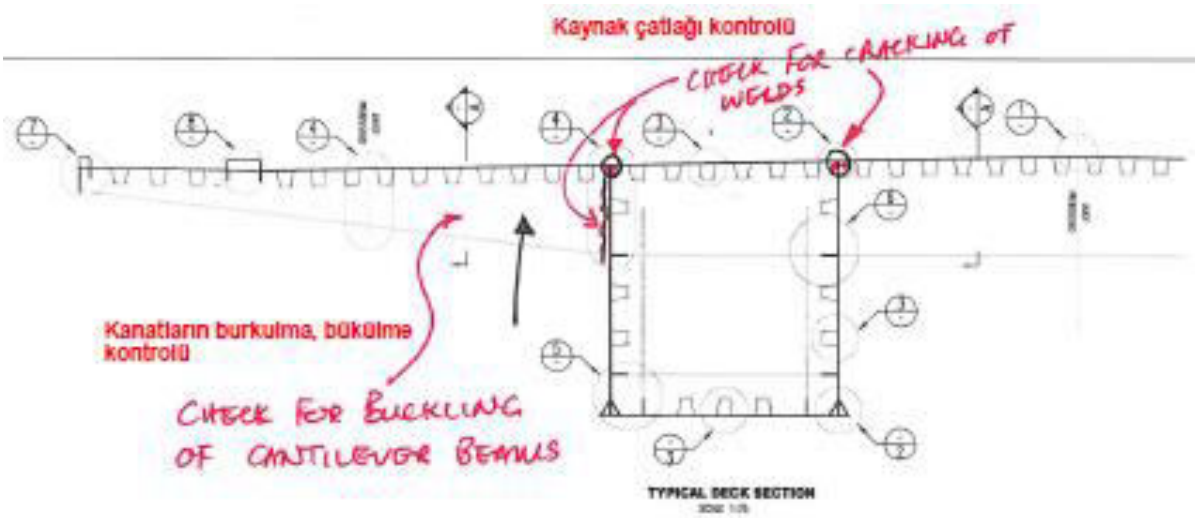



***Figure 18:*** *Guide for inspection of deck welds*

# 3. DEFECTS

The bridge is designed for 100 years and material are selected to fullfill this requirement. Since the bridge is new and well maintained only minor defects are observed during routine inspection. The biggest defect observed yet from openning was the defected area of asphalt pavement at km: 7+660 in Izmir direction.

## 3.1. ASFALT DEFECT AT KM: 7+660

Asphalt defect was observed on 28.02.2018, and cold patch was applied immediately to ensure traffic safety. Permanent repair was postponed to a suitable day.

***Figure 19:*** *Defect in asphalt*

***Figure 20****: Cold patch as temporray repair*

Asphalt defect was permanently repaired 02.04.2018 and following sequence is applied as per repair procedure:

- Removal of loose ashalt portion
- Removal of existing waterproofing layers
- Sand blasting  SA 2 ½ of steel deck
- Application of new waterproofing layers
- Application of mastic asphalt


***Figure 21:*** *Removal of existing waterproofing layers and sand blasting*


Figure 22: Primer


Figure 23: 1st layer waterproofing membrane


Figure 24: 2nd layer waterproofing membrane


Figure 25: tack coat


Figure 26: Laying of mastic asphalt


Figure 27: completed repair

# 4. POTENTIAL FAILURE MODE OF THE BRIDGE

The bridge is designed for 100 years to withstand design loads and even not collapse in earthquake of NCE with a 4% probability of occurrence in the 100-year design life specified for the bridge (return period of ~2,475 years). The bridge is continuously monitored with CCTV and SCADA systems plus regularly inspected by GIIB maintenance teams. The data from SHMS (Structural Health Monitoring System), SCADA system and other sub-control systems (such as dehumidifation system) are used to make assessment and optimize the required maintenance.

# 5. MATERIALS OF THE BRIDGE

Special performance based C45/55 concrete comprising 380 $kg/m^3$ slag cement, W/C ratio 0,38 and chloride migration coeffiecient at 28 days is smaller than $3x10^{-12}$ $m^2/s$ is used. C50 prefabricated concrete spacers are used in concrete covers.

S355 J2+N quality structural steel used in piers and decks and externally coated with Zinga zinch rich paint to serve minimum 35 years without any major repair. The surface of the decks are painted with zinc rich epoxy as first coat, polyamide cured epoxy or fast dry zinc phosphate epoxy used as an intermediate coat and aliphatic polyurethane paint to be used as final coat which has been specified as follows;

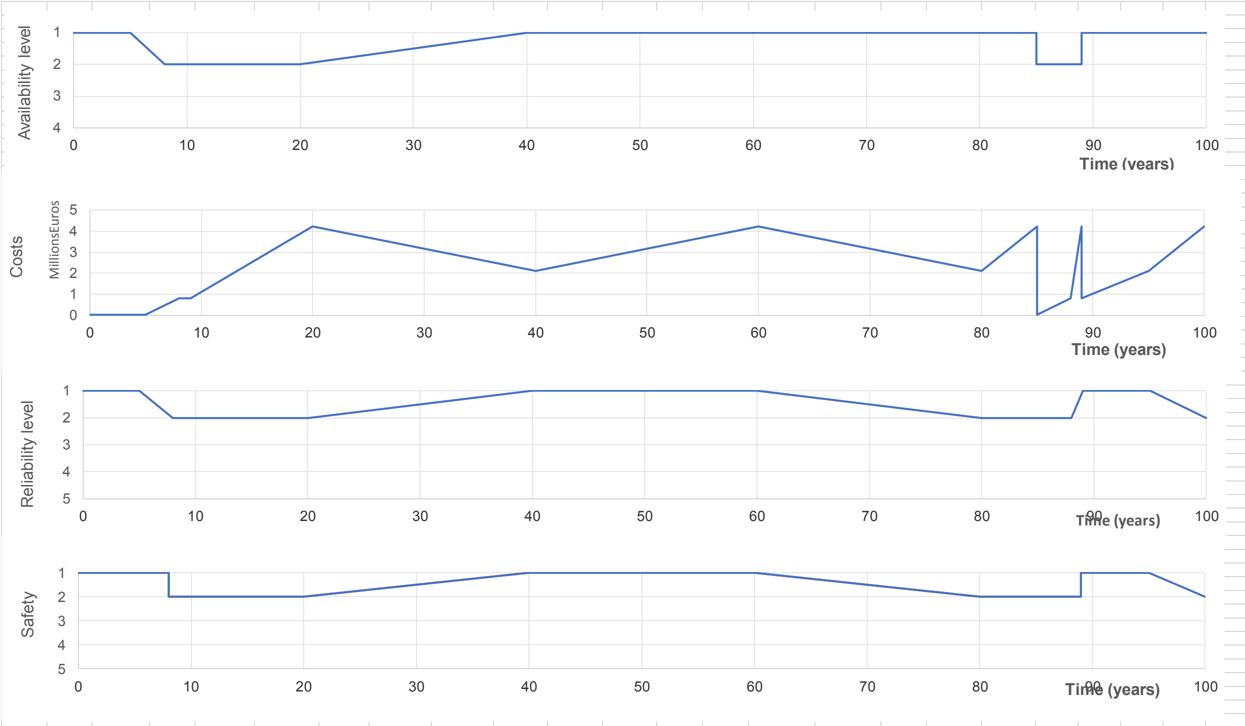
- 1x60 micron Primer : Zinga
- 1x80 micron Intermediate : Alufer N
- 1x60 micron Final : Zingaceram PU

# 6. PERFORMANCE APPROACH

## 6.1. PREVENTATIVE APPROACH

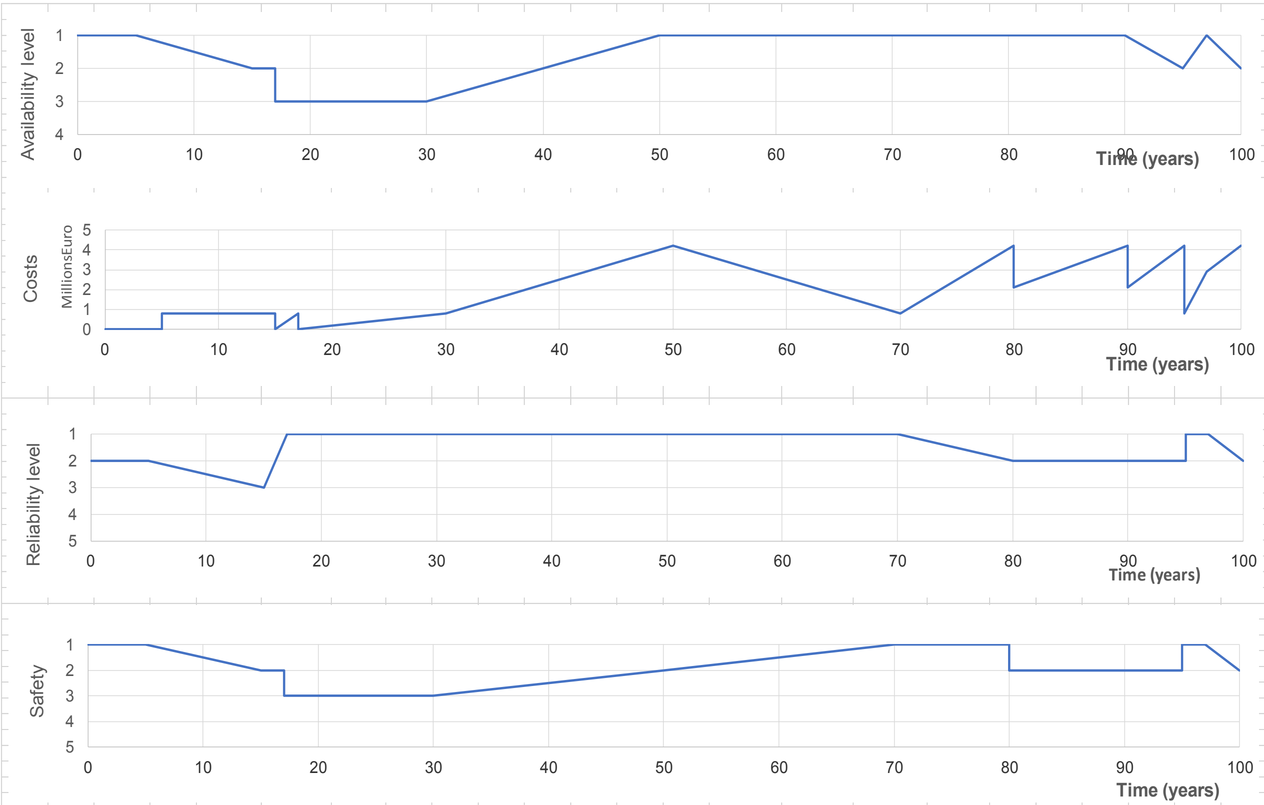
As a policy of the Concessionare company, routine inspections will be carried out regularly by bridge control team, sufficient spare part shall be kept in stock and any observed defect shall be immediately repaired to ensure durability of the South Approach Viaduct that is a part of Osmangazi Bridge crossing for uninterrupted and safe traffic flow of Gebze-Izmir Motorway. The wearing surface asphalt pavement replacement assumed to be after fifteen years. Planned maintanence intervals for replacement of major maintanence items are selected as below:

| | |
|---|---|
| Surfacing replacement | : 25 years |
| Structural bearings | : 25 – 50 years |
| Expansion joints | : 25 years |
| Dampers | : 25 years |
| Concrete surface repairs | : Nil – 100 years |
| Structural steelwork minor | : 15 years |
| Structural steelwork paint | : 35 years |
| Lighting columns (structure) | : 30 years |
| Sign gantries (structure) | : 30 years |

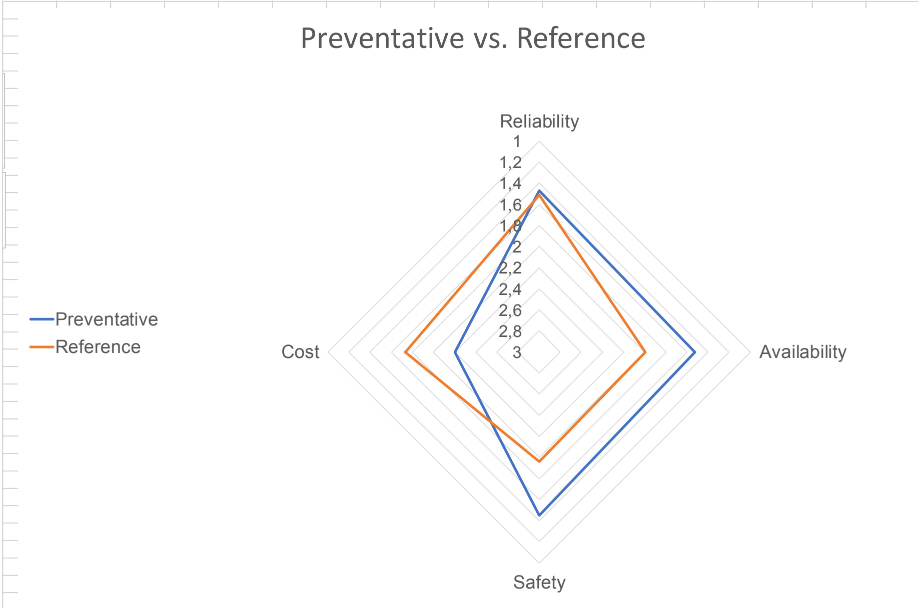



## 6.2. REFERANCE APPROACH

Although this approach is not applicable to management policy of oparator, it is studied as to perform the minor repairs and postpone the significant repairs.




Comparision of two approaches is shown in following spider diagram:




Preventative approach is more appropriate for South Approach Viaduct.

# 7. CONCLUSION

With challenging contruction materials (like use of protective coating of zinch rich Zinga paint instead of classical three-coat paint system) and protective measures(like dehumidifation system) South Approach Viaduct will have a longer life and require less maintenance.

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