REPAIR AND CONSERVATION WORKS ON TAGUS SUSPENSION BRIDGE

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[a]STAP; [b]AMAL; [c]EP

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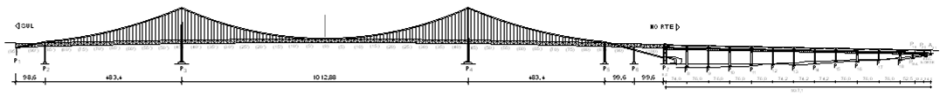
1. 25th of April Bridge

SUSPENSION BRIDGE	
Distance between anchorages	2.227,64m
Central span	1.012,88m
Height of towers from water level	190,5m
Depth of south tower below water level	80m
Depth of north tower below water level	35m



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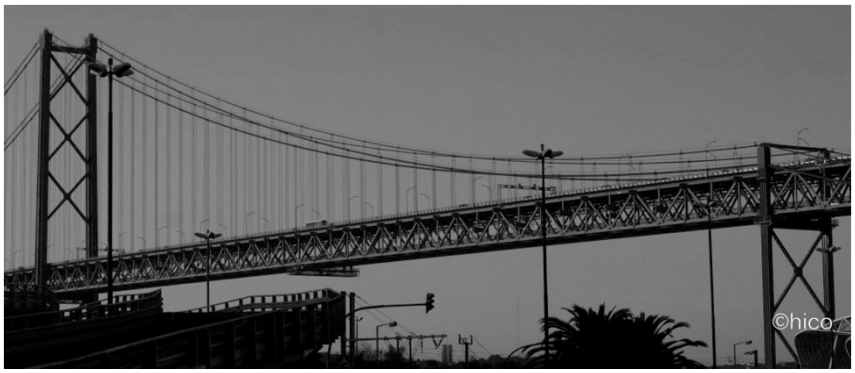
1. 25th of April Bridge



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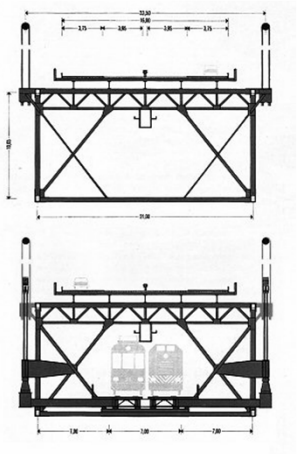
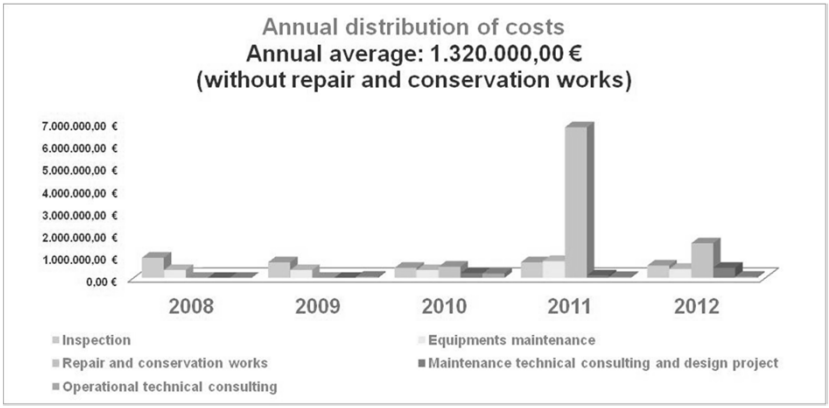


2. MAINTENANCE MANAGEMENT

In 2008 the 25th of April Office was created within *Estradas de Portugal*. The Office is responsible for promoting the development of inspection, maintenance and repair actions in order to appropriate conditions of service use of the Bridge over Tagus.

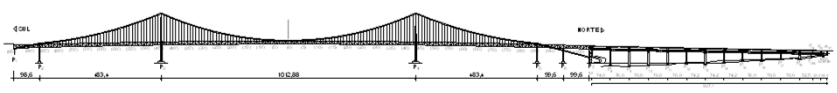


3. REPAIR AND CONSERVATION WORKS

3.1 OBJECTIVES

The prime **objectives** of the works were the:

- execution of rehabilitation works due to normal use of the infrastructure, identified through regular inspection activities by ISQ;
- enhancement of security and accessibility conditions for the maintenance and inspection teams;
- creation of accesses to the inferior zone of the slab of the north viaduct.



3. REPAIR AND CONSERVATION WORKS

3.1 OBJECTIVES

- Dono de Obra: EP – Estradas de Portugal, S.A.
- Projectista: TALPROJECTO – Projectos, Estudos e Serviços de Engenharia, Lda
- Empreiteiro: STAP - Reparação, Consolidação e Modificação de Estruturas, S.A.
  AMAL Construções Metálicas S.A.
- Fiscalização: ISQ – Instituto de Soldadura e Qualidade
- Anúncio do concurso: 19 Fev. 2010
- Valor da Obra: 7.985.617,61€
- Adjudicação: 30 Junho 2010
- Consignação: 30 Agosto 2010
- Conclusão prevista: 2.º Trimestre 2012

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3. REPAIR AND CONSERVATION WORKS

3.2 MAIN CONSTRAINTS

- Strategic importance - heavy traffic crossing - 150.000 daily vehicles, corresponding to 300.000; 150 daily trains, corresponding to 80.000 users.
- North connection through a viaduct integrated in a crucial urban road network

3. REPAIR AND CONSERVATION WORKS

3.2 MAIN CONSTRAINTS

- Location and dimensional aspects

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3. REPAIR AND CONSERVATION WORKS

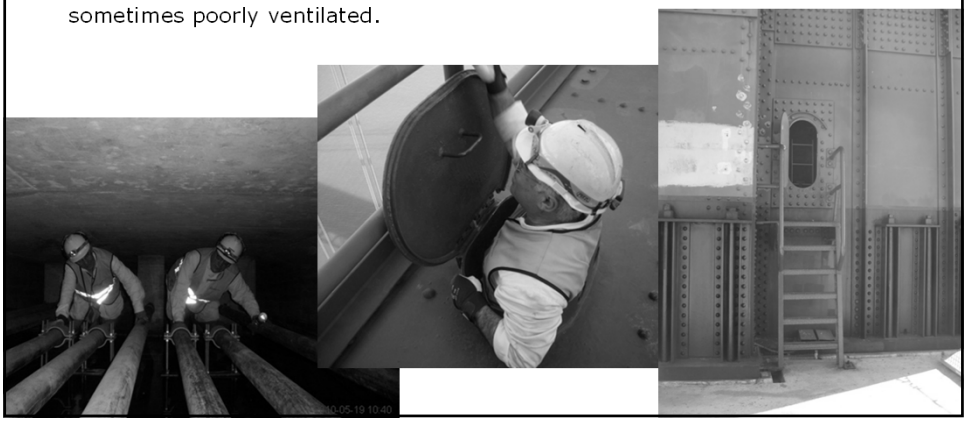
3.2 MAIN CONSTRAINTS

- Use of the road and railway platform exclusively in the night period (time schedule permitted by Lusoponte and Refer);
- High circulation constraints of the road gangways;
- Proximity of the railway to some working and/or circulation places;
- Operable use of the evacuation gangways;

3. REPAIR AND CONSERVATION WORKS

3.2 MAIN CONSTRAINTS

- Lack of permanent access to the working zones;
- Narrowness of the majority of the interior spaces, dim lightened and sometimes poorly ventilated.



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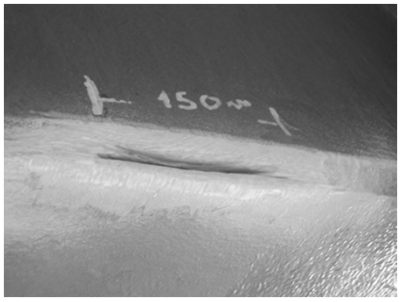
4. SUSPENDED RIGIDITY BEAM

4.1 Repair of the welds of the rigidity beam



Seam weld prepared for welding after preparation of the surface

Magnetic particle test after welding.

4. SUSPENDED RIGIDITY BEAM

4.2 Restoration of the anti-corrosive protective coating

Total coating area: 1.260m^2.
Total of bolts: 65.000.

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4. SUSPENDED RIGIDITY BEAM

4.3 Replacement of the central inspection walkway

Total length of the walkway: 2.278m.

5. BRIDGE TOWERS AND COLUMNS

5.1 Rehabilitation of the steel elements

Base of towers and columns - Restoration of the anti-corrosive protective coating

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5. BRIDGE TOWERS AND COLUMNS

5.1 Rehabilitation of the steel elements

Top of the towers - Restoration of the anti-corrosive protective coating

5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases

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5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases

5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases

Rehabilitation of the concrete structural elements was achieved through the application of three techniques:

- sprayed concrete,
- hand applied mortar,
- treatment of cracks.

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5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases

Main difficulties associated with these works were due to its location in the river so that all of the equipment and materials necessary for the execution of the techniques had to be transported by boat as well as the supplying of water and energy.

5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases

Mapping of defects before application of repair techniques.

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5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases

Preparation of surfaces before application of **sprayed concrete**.

5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases

Concrete repair by sprayed concrete.

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5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases

Preparation of surfaces before application of **sprayed concrete** - Tower 4.

5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases

Sprayed concrete and quality testing - Tower 4.

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5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases

Concrete repair by sprayed concrete – column P5.

5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases

Sprayed concrete

- Very effective technique for the repair of reinforced concrete.

- High adhesion to older concrete and reinforcement.
- High density.
- Reduced permeability.
- High durability.
- High strength.

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5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases

Hand applied mortar repair.

5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases

Treatment of concrete cracks.

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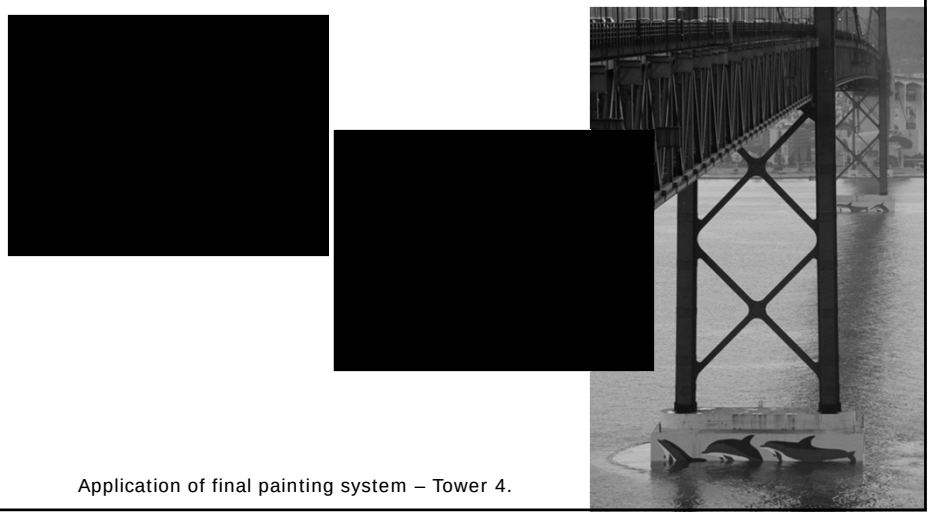
5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases



Application of final painting system – Tower 4.

5. BRIDGE TOWERS AND COLUMNS

5.2 Rehabilitation of the reinforced concrete bases

Application of final painting system – Tower 4.

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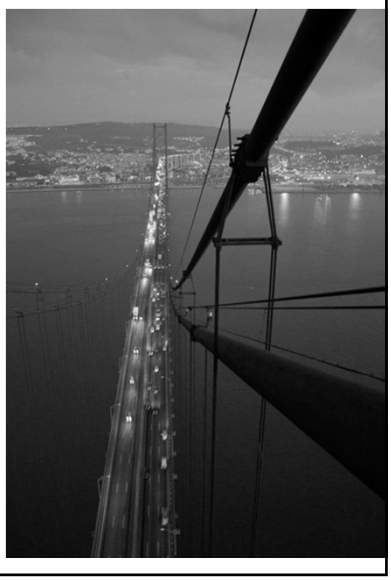
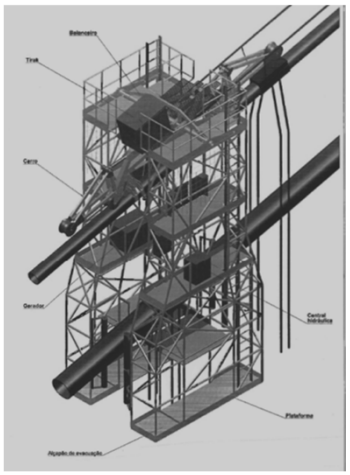
6. CABLES

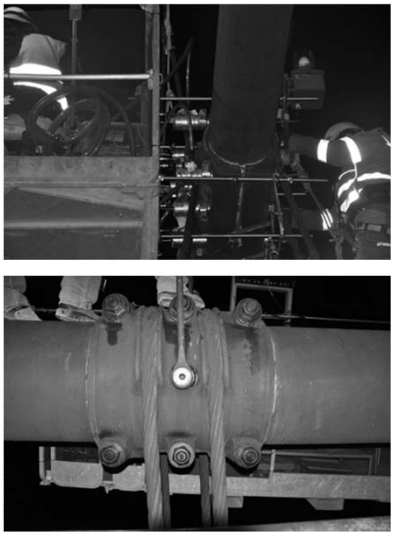
Diameter of **principal cables**	58,6cm
Nº of steel strands of each principal cable	11.248
Diameter of each steel strand of the principal cables	4,877mm
Total length of strand of the principals cables	54.196km
Diameter of **secondary cables**	35,44cm
Nº of steel strands of each secondary cable	4.104
Diameter of each steel strand of the secondary cables	4,98mm
Total length of strand of the secondary cables	20.000km



6. CABLES



Double mobile platform created for the refastening of the cables.



Refastening of the cables (2.664 bolts).

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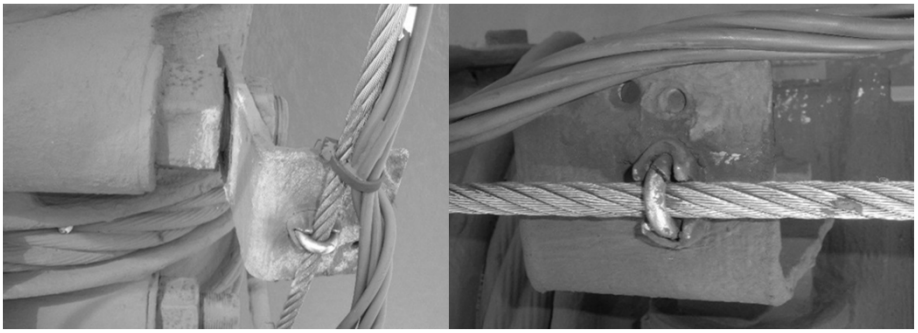
6. CABLES



Refastening of bolts (6.284) and replacement of cable clamps (40).

6. CABLES

Replacement of plastic braces (31.680).

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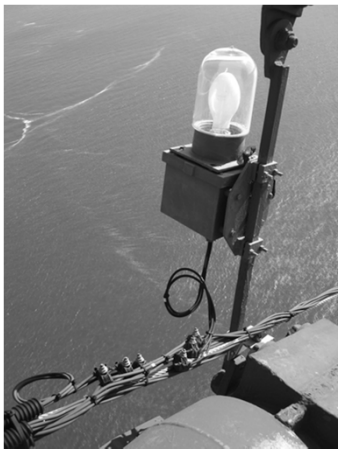
6. CABLES



Verification and correction of electric connections.

7. CABLES ANCHORAGE BLOCKS

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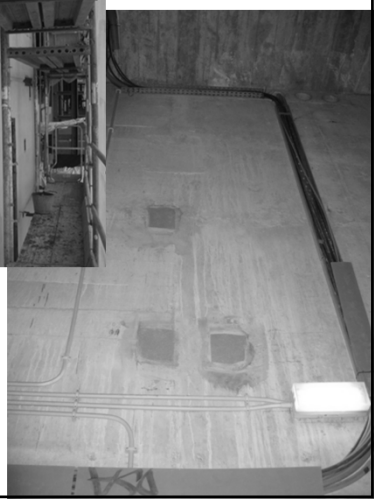
7. CABLES ANCHORAGE BLOCKS



7. CABLES ANCHORAGE BLOCKS

Mapping of cracks for treatment – north anchorage block.

Preparation for injection of cracks – north anchorage block.

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7. CABLES ANCHORAGE BLOCKS

Treatment of cracks – north anchorage block.

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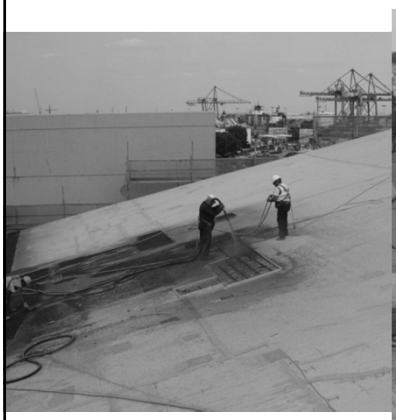

North anchorage block restoration by sprayed concrete.

7. CABLES ANCHORAGE BLOCKS

North anchorage block restoration by sprayed concrete.

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7. CABLES ANCHORAGE BLOCKS

Replacement of stairs and platforms and installation of railings.

8. NORTH ACCESS VIADUCT COLUMNS AND CANTILEVERS

View of the scaffolds for the repair works in the north viaduct.

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8. NORTH ACCESS VIADUCT COLUMNS AND CANTILEVERS

Concrete cracks injection.

8. NORTH ACCESS VIADUCT COLUMNS AND CANTILEVERS

Repair of the anticorrosive protection of the anchors of the vertical prestress.

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8. NORTH ACCESS VIADUCT COLUMNS AND CANTILEVERS

Replacement of stairs and platforms and installation of railings.

9. CONCLUSION

The Bridge over Tagus and its north viaduct have been subjected to almost unnoticeable maintenance works for nearly the last two years.

Such barely perceptible maintenance actions effectively contribute to protect the structure and extend its lifespan. Durable structures undoubtedly meet sustainability growing needs.

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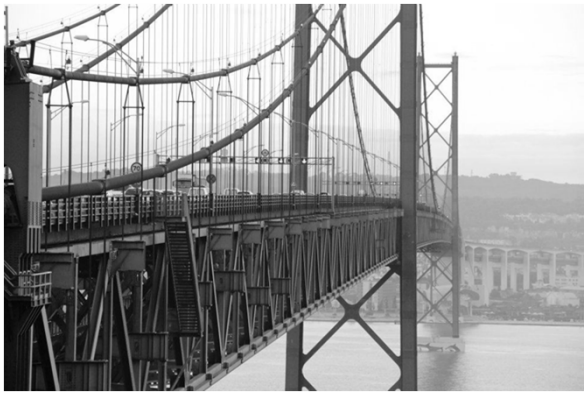
9. CONCLUSION

The maintenance works corresponded to functional beneficiations and metallic and concrete rehabilitation. Specialized rehabilitation techniques requiring considerable expertise were used on the Bridge.

Both of the two contractors, Amal and Stap, have been acting on the rehab market for years, benefiting from being comprised of qualified professionals as well as constant technological and innovation efforts.



Gratos pela vossa atenção.

stap Reparação, Consolidação e Modificação de Estruturas, S.A.

AMAL CONSTRUÇÕES METÁLICAS, S.A.

EP Estradas de Portugal, S.A.