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Estradas de Portugal, S.A.

ROADWAY INFRASTRUCTURES

Estradas de Portugal, SA
Road Network Characterisation

Investing in our common future

ATLANTIC AREA Transnational Programme

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1. Presentation – EP Estradas de Portugal, SA

The main goal of Estradas de Portugal, S.A. is to accomplish, in a business model, a public service that purpose:

Financing, maintenance, operation, qualification and enlargement of roads integrating the National Network;

Conception, project, construction, financing, maintenance, operation, qualification and enlargement of roads integrating the future National Network.

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1. Presentation – EP Estradas de Portugal, SA

Strategic orientation guidelines for EP - Estradas de Portugal, S.A:

Assure the EP financier sustainability in the financing model of the road system.

Pursue the objectives of reduction levels of disaster and environmental sustainability.

Construction goals:

a. Promote the extension of the national road network foresee in the National Road Plan (PRN2000), in the middle of the national and international connectivity;
b Contract the fundamental road network for linking the district capitals and 90% of the motorway network;
c. Encourage the conclusion of the complementary itineraries network;
d. Assure the compliment of the calendar accord defined by Government for the PRN2000 implementation.

Maintenance and Operation goals:

1. Maintain efficient levels of operation and maintenance costs, in line with the best practice;
2. Dispose the way for the people in accord with service levels stipulates for each type of road.

2. National Road Characterisation

PRN 2000
(National Road Plan)

Fundamental Network — Principals Itineraries (IP)
provides the greatest volume of traffic and connect the major cities and international highways

Complementary Network
- Complementary Itineraries (IC)
  lower capacity but national importance
- Nationals Roads (EN)
- Regional Roads (ER)
  for local and lesser traffic

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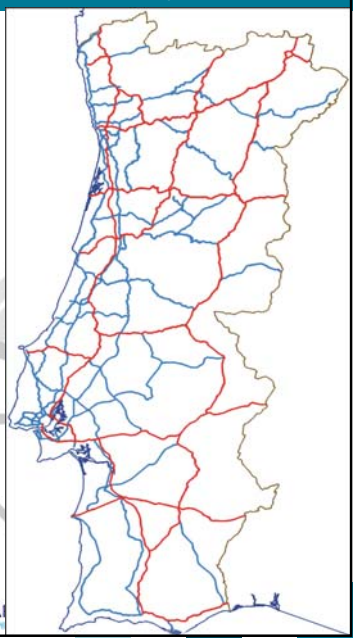
2. National Road Characterisation

PRN 2000
(National Road Plan)

	kms
Principals Itineraries	2 530 km
Complementary Itineraries	3 360 km
Nationals Roads	5 300 km
Regional Roads	5 100 km
	16 290 km
Network Concessioned	2 709 km
Network Sub-concessioned	2 325 km
EP - Network	**11 256 km**



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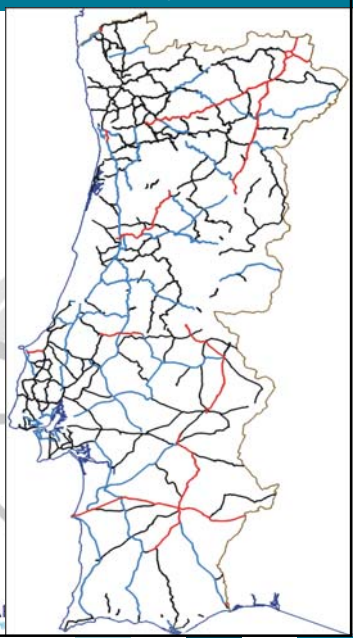
2. National Road Characterisation

EP Operation

	Kms
Principals Itineraries	817 km
Complementary Itineraries	2 046 km
Nationals Roads	4 689 km



* ROADS DECLASSIFIED BY THE PRN EXCLUDING SECTIONS THAT PLAY, TEMPORARILY, FUNCTIONS OF IP OR IC.

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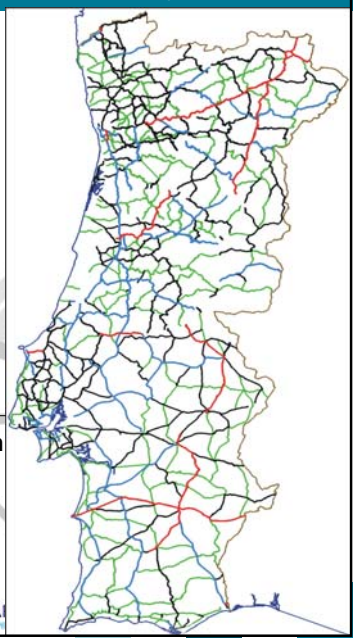
2. National Road Characterisation

EP Operation

	Kms
Principals Itineraries	817 km
Complementary Itineraries	2 046 km
Nationals Roads	4 689 km
Regional Roads	3 417 km
TOTAL (Classified Roads)	**10 976 km**

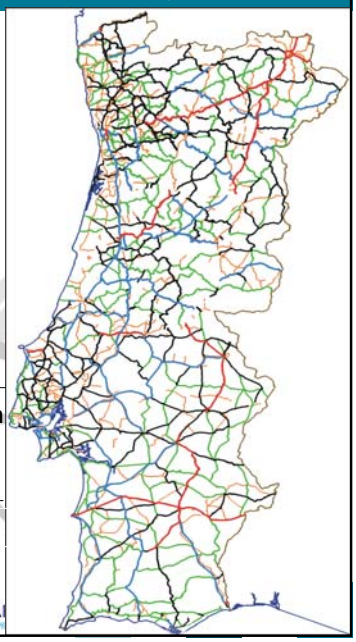


2. National Road Characterisation

EP Operation

	Kms
Principals Itineraries	817 km
Complementary Itineraries	2 046 km
Nationals Roads	4 689 km
Regional Roads	3 417 km
TOTAL (Classified Roads)	**10 976 km**
Declassified roads *	3 200 km
TOTAL	**14 176 km**

* ROADS DECLASSIFIED BY THE PRN EXCLUDING SECTIONS THAT PLAY, TEMPORARILY, FUNCTIONS OF IP OR IC.



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2. National Road Characterisation

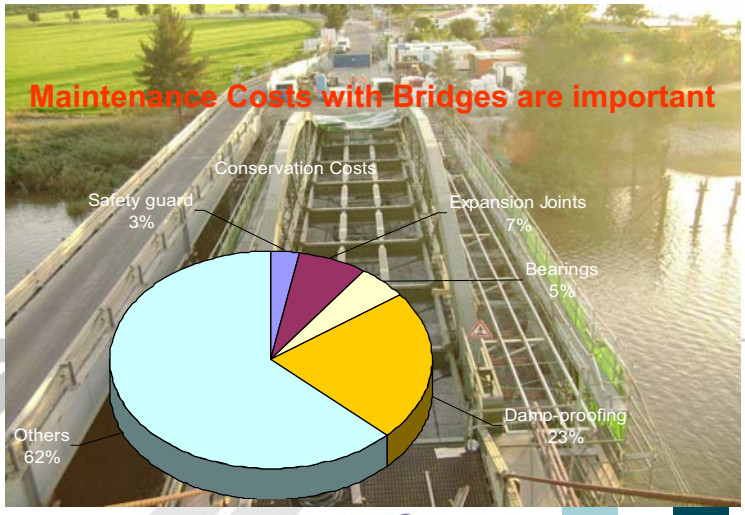
EP - National Road Network

	IP *	IC *	EN	ER	TOTAL
Aveiro	2	170	173	92	**437**
Beja	186	164	255	440	**1 045**
Braga	0	0	424	203	**627**
Bragança	179	106	278	249	**812**
Castelo Branco	2	115	147	167	**431**
Coimbra	30	126	229	148	**533**
Évora	66	70	354	310	**799**
Faro	3	123	139	198	**463**
Guarda	57	120	310	252	**739**
Leiria	18	205	182	97	**503**
Lisboa	0	79	373	98	**550**
Portalegre	84	107	283	172	**645**
Porto	18	40	220	202	**480**
Santarém	36	228	331	105	**700**
Setúbal	20	198	239	279	**736**
Viana do Castelo	5	55	210	116	**387**
Vila Real	59	34	222	145	**460**
Viseu	53	106	319	151	**629**
TOTAIS	**817**	**2 046**	**4 689**	**3 424**	**10 976**

Extension (km)

* INCLUDING SECTIONS THAT PLAY, TEMPORARILY, FUNCTIONS OF IP OR IC

3. Bridge Management System (BMS)



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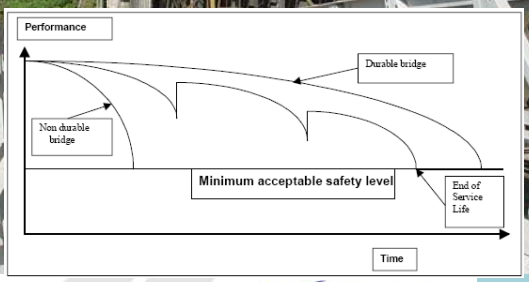
3. Bridge Management System (BMS)

Why a BMS ?

- Need for aggregation of all information relevant to the conservation of bridges, making it quickly and systematically.
- Need to develop a management pro-active rather than reactive management.
- During the life of a road engineering structure is necessary perform maintenance and rehabilitation activities.
- Need of optimize the investment associated with bridges



3. Bridge Management System (BMS)

Modules / System Activities


Inventory


Routine Inspection


Principal Inspection

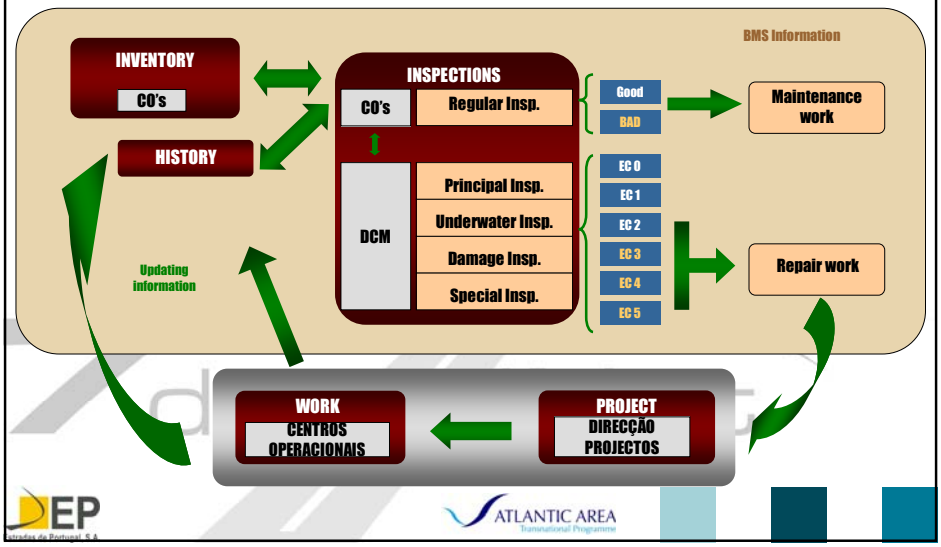

Underwater Inspection


Special Transport


Search / History

3. Bridge Management System (BMS)

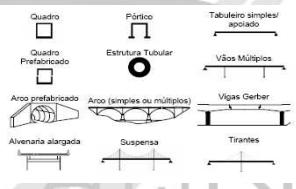
EP BMS Methodology



3. Bridge Management System (BMS)

Inventory of bridges

Administrative Data	Technical Data	Creation data
➢ **Unambiguous identification and location of the bridge;**	➢ **Structural type, size** and **main characteristics of the bridge;**	➢ Description and **quantification of material** and **equipment used.**
➢ **Responsible for management of** Bridges and entities **involved in the design and construction;**	➢ **Environmental conditions** and **characteristics of the pathways that interfere with the work;**	
➢ **allows connection to geographic information systems;**		



Contains the information of interest to the procedures relating to the conservation of bridges.

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3. Bridge Management System (BMS)

Routine Inspection

- ➢ **Annual basis**
- ➢ Evaluation of the **Maintenance level (EM)**
- ➢ Identification of anomalies within the **scope of Maintenance work**, involving only small-scale, without great technical complexity

Good
Is not necessary to perform Maintenance work

Bad
Is necessary to perform Maintenance work

Preliminary budgets Maintenance work for the following year

May trigger the need for Principal Inspection

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3. Bridge Management System (BMS)

Principal Inspection

- Maximum period of 5 years
- Condition Assessment (EC) of each component and the bridge in general

Reflects the conditions of deterioration, operation, performance, etc., affecting the durability, operation and structural safety

EC 0 - Great
EC 1
EC 2

EC 3
EC 4
EC 5 – Very bad

Repair work

List of bridges that need Repair work

Preliminary budgets
Repair/conservation work carried out in a period of five years

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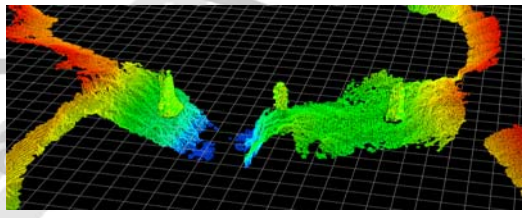
3. Bridge Management System (BMS)

Principal Underwater Inspections

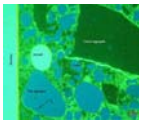
- Inspections **planned**, implemented with a maximum **period of five years**
- **Condition Assessment (EC)** of **elements** of the bridge **submerged and submersible**
- **Evaluation** of the characteristics of the **area surrounding the foundations** of **support located in the bed of the water lines**
- Usually accompanied by **bathymetric surveys**, that allow the **registration of shares to fund the bed** of the lines of water and supplemented with **video** recordings of the submerged parts.



3. Bridge Management System (BMS)

Special Inspections

- Performed in general after **Principal Inspections**
- Within **structural Design or Assessment**
- **Further evaluation of certain** anomalies already detected
- Within onsite tests
- Use of **resources and / or specific equipment**



Damage Inspection

- **Similar to a Principal Inspection**
- Result in an **alert warning, accident** or other **extraordinary occurrence**
- **Unscheduled Inspections**

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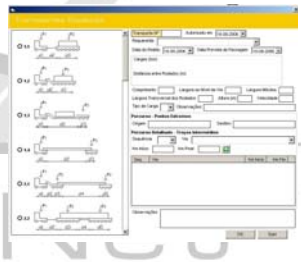
3. Bridge Management System (BMS)

Special Transports

Objectives:

- **Registration** requests **for special transports**;
- **Technical advise** for the **transit of special vehicles**, based on the **comparison of the characteristics of the transport** with the **inventory data** from the bridge, **Condition Assessment**, **constraints** and **historical data**.
- **Identification of bridges** with **constraints to the passage** of vehicles on a given route.



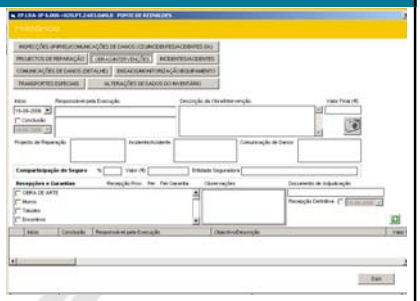
Module of Special Transport

3. Bridge Management System (BMS)

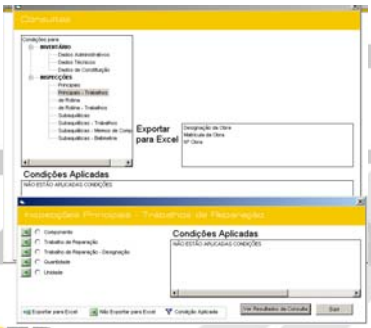
History / Search

Objectives:

•**History - Centralization** of **information on the bridge**, including the date of construction, inspections, repairs, accidents, monitoring, etc.



Module History



Search Module

•**Search - Manipulation of information** contained in the database and can **export reports** to and **interconnection with GIS** (Administrative data, Technical, Inspections, work, etc.)

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3. Bridge Management System (BMS)

3.1. BRIDGE MANAGEMENT SYSTEM SITUATION

DECEMBER 2008

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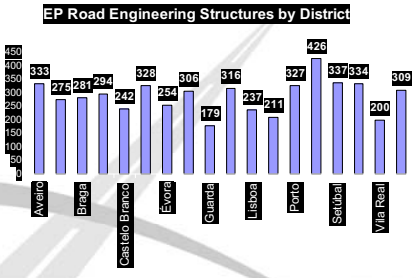
Road Engineering Structures

District	EP	Other Entities	Total Inventoried
Aveiro	333	32	365
Beja	275	5	280
Braga	281	52	333
Bragança	294	0	294
C. Branco	242	17	259
Coimbra	328	12	340
Évora	254	13	267
Faro	306	16	322
Guarda	179	42	221
Leiria	316	23	339
Lisboa	237	151	388
Portalegre	211	8	219
Porto	327	40	367
Santarém	426	16	442
Setúbal	337	47	384
V. Castelo	334	29	363
Vila Real	200	15	215
Viseu	309	17	326
Total	5189	535	5724



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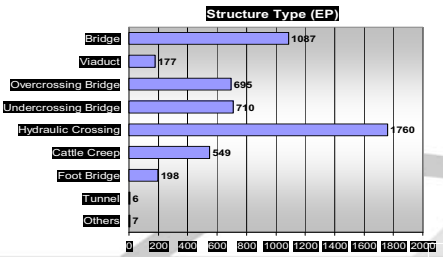
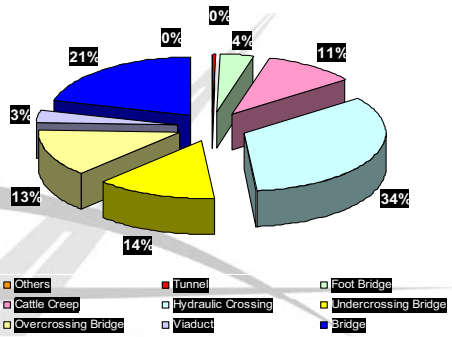
Bridge Type





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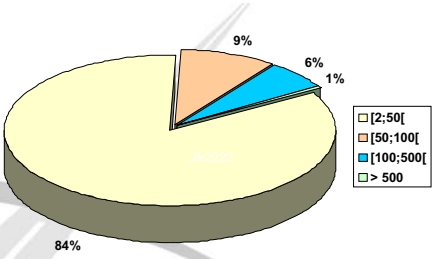
EP Bridges distribution, by District and Length

District	[2;10[	[10;50[	[50;100[	[100;500[	>500	TOTAL
Aveiro	145	129	36	19	4	333
Beja	167	79	19	10	0	275
Braga	139	90	33	17	2	281
Bragança	158	97	14	23	2	294
C. Branco	155	63	13	11	0	242
Coimbra	119	127	41	39	2	328
Évora	167	62	18	6	1	254
Faro	153	118	23	10	2	306
Guarda	112	49	9	8	0	178
Leiria	142	121	29	19	5	316
Lisboa	153	66	17	8	1	237
Portalegre	125	70	10	6	0	211
Porto	150	123	29	24	1	327
Santarém	198	119	66	35	8	426
Setúbal	169	91	57	19	2	338
V. Castelo	211	72	20	27	4	334
Vila Real	111	72	8	9	0	200
Viseu	130	106	55	18	0	309
Total	2704	1654	489	308	34	5189
	4358					



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Age Bridge Distribution

Total Bridges by Construction Date	2224 (42%)

Ano	Total
> 2000	536
] 1950 – 2000]	1374
] 1900 – 1950]	161
] 1850 – 1900]	138
] 1800 – 1850]	9
< 1800	6

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Structural Deck Materials

Material	%
Concrete	65%
Masonry	28%
Steel	7%

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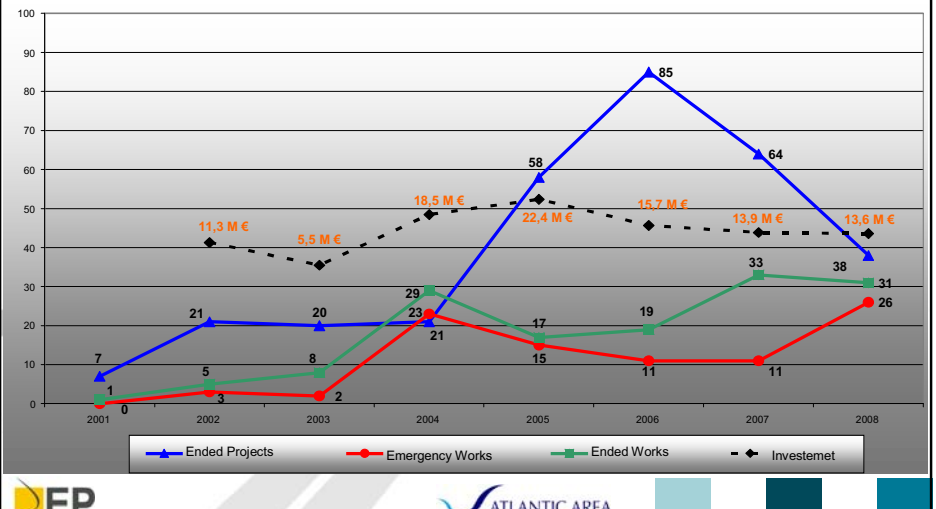
EP BRIDGES CONSERVATION INVESTMENT (2002 – 2008)

(Projects, Construction and Rehabilitation Works)



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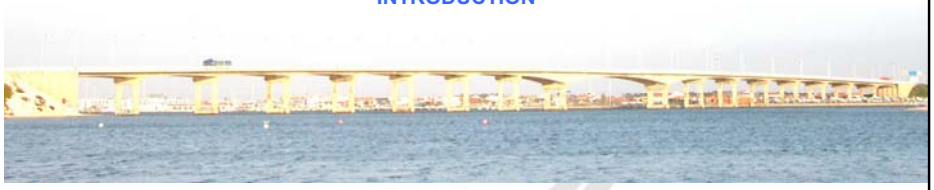
4 – An example of Rehabilitation

INTRODUCTION



- The Barra Bridge crosses the Mira Canal, in Aveiro, on the E.N. 109-7.
- Designed by the Prof. Edgar Cardoso in 1971, opened to traffic in 1975.
- The aim of the rehabilitation design was to adjust the bridge to the new code rules, thus securing the improvement of its performance levels.

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4 – An example of Rehabilitation

CONSERVATION PROBLEMS DETECTED

- The Barra Bridge is a reinforced pre-stressed concrete structure.

- It is located in one of the most aggressive environments in Portugal.
- The structure was at a stage of high degradation.
- Based on a multi-barrier strategy, the repair purpose was to level the construction performance up to the requirements of the most recent European Codes.

4 – An example of Rehabilitation

CONSERVATION PROBLEMS DETECTED

REPAIR PROJECT CRITERIA

- Concerning rehabilitation there isn't in Europe any formal code, though there are since the 80's "procedure recommendations":
  - The Rehabilitation Project established the products and methods according the EN 1504.
- Multi-barrier strategy was adopted in the repair side of the Project.

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4 – An example of Rehabilitation

STRUCTURAL PROBLEMS DETECTED

- First sign - the development of an excessive deflection of the central span cantilevers, due to the structural system choice and excessive creep.
- Since then, several inspections to the bridge have been carried out:

Inspections	showed →	Maintenance problems, mainly due to aggressive environmental effects
Structural Analysis	showed →	Need for global and local strengthening

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4 – An example of Rehabilitation

STRENGTHENING SOLUTIONS ADOPTED



Application of carbon fiber laminates

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4 – An example of Rehabilitation

STRENGTHENING SOLUTIONS ADOPTED


Pier strengthening - Fiber anchorage zones

EP
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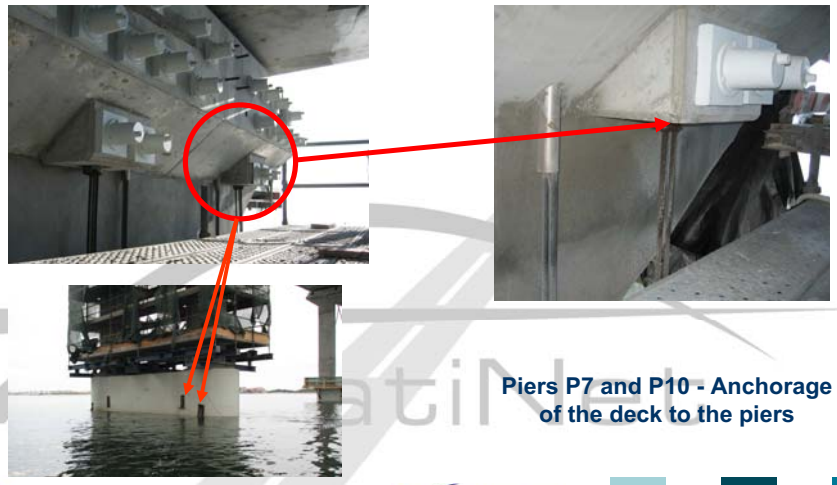
4 – An example of Rehabilitation

STRENGTHENING SOLUTIONS ADOPTED



Piers P7 and P10 - Anchorage of the deck to the piers

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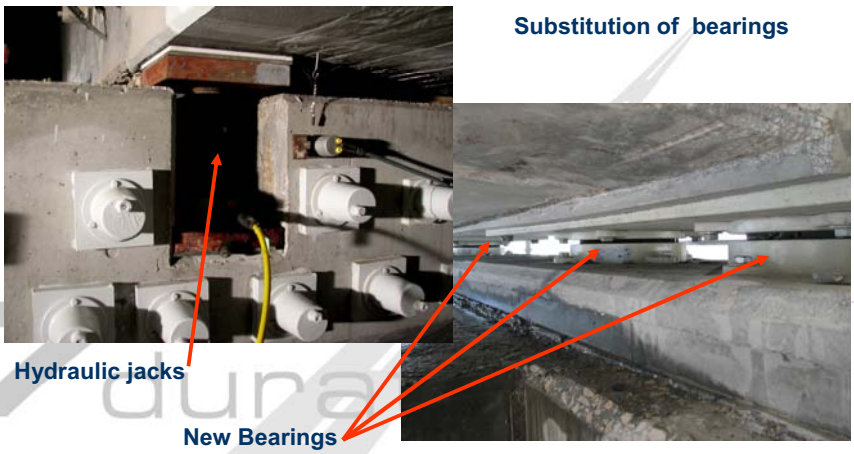
4 – An example of Rehabilitation

STRENGTHENING SOLUTIONS ADOPTED

Substitution of bearings



Hydraulic jacks

New Bearings

5 – FINAL CONSIDERATIONS

One of EP, SA main guidelines, concerning Conservation and Exploitation is to improve further levels of efficiency in operating costs and maintenance, in line with best practice.

The maintenance and conservation needs associated to low budgets impose very tight criteria towards bridge management.

In the last years bridge structures with unusual levels of deterioration have been detected and, in many cases, with only a few years old.

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5 – FINAL CONSIDERATIONS

What we know

It should be noted that there is a wealth of information on the causes but relatively little information on prevention.

The decisions in which Engineers are involved during construction or exploitation fase require answers in the fields of prevention and treatment of the works.

There isn't yet a methodology of treatment sufficiently effective to stop the evolution of disorders.

In many cases the deterioration is unusual because the structures are only a few years old.

5 – FINAL CONSIDERATIONS

What we need

To create new competences at the level of infrastructure maintenance.

To identify new expertise on applied research concerning quality control needs and reducing maintenance costs.

Extensive analysis and identification of anomalies and repair solutions to implement.

Solutions to design more efficient in terms of durability and the environmental protection.

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5 – FINAL CONSIDERATIONS

TANK YOU