



## TECHNICAL VISIT A8- AUTO-ESTRADA DO OESTE CRIL / LOURES AND LOURES / MALVEIRA BRIDGE OVER THE LOURES RIVER AND MURTEIRA VIADUCT



27<sup>th</sup> May 2010

The A8 highway is considered one of the main Lisbon access radial roads whose main stretches go through an urban environment. (see page 2)

It is precisely to the first two road sections that this visit has been programmed, since necessary works are underway to widen the highway in order to increase the present number of lanes by adding a third one in both directions. (see page 3)

The widening phases are similar on both sites and are being done as per schemes from pages 4 to 8, thus:

**Phase 1** (page 4) – The traffic will flow next to the central reserve using the left verge (narrowing the width of the lanes)

**Phase 2** (page 5) – With the traffic moved to the central reserve the is widened to the exterior.

**Phase 3** (page 6) – The traffic is moved to the widened zone.

**Phase 4** (page 7) – With the traffic circulating in the widened zone (verge and right lane) the works in the central reserve and the existing part of the are executed all the way over to the final surface area.

**Phase 5** (page 7) – The traffic is moved back to the central reserve on the left and central definitive lanes.

**Phase 6** (page 8) – With the traffic circulating on the central zone the final surfacing of the external zone is executed.

In effort to avoid the geometric characteristics of the geometrical profile inducing an erroneous base velocity along this lance of the motorway, and with the consequent negative impacts o circulation and with the safety of the drivers, the lanes will have a width of 3,50 m with a reduction of the central reserve.

### **CRIL / Loures**

The most relevant interventions on the CRIL/Loures road section, with 6300 m extension, are the ones concerning the Engineering Structure (3 Bridges and 8 Current Engineering Structures).

Of the 3 Bridges we selected the one at the Loures' river where we will make a short stop. This was chosen as it is a site to be completely demolished and rebuilt in the same place, but with 4 lanes of traffic.



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The layout of the area is constituted of alluvial deposits where fine matter and sedimentary terrain prevails.

That region is characterised by flat orography and a relatively dense hydrographical network, where the phreatic surfaces are high in the ground, having characteristics that potentiate the occurrence of floods. This set up associated to the nature of the interested formations, constitutes a major conditioning to the execution of the works, namely in what concerns foundations and body of the embankment, to the execution of the engineering and containment structure, as well as drainage systems (superficial and deep).

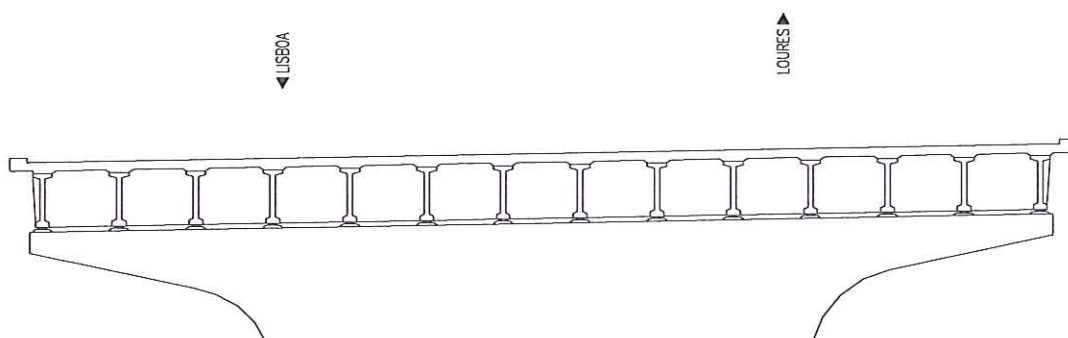
Given the considerable volume of traffic on that stretch of the highway, (where congestion during rush hour has been registered), the intervention on the Bridge over the Loures River, assumes particular relevance, being object of specific planning that can be considered independent from the remaining work, which will be totally demolished to enable the construction of a new structure.

### Bridge over the Loures River

The existing engineering structure, built in the 80's, is composed of seven spans, 6 of about 23,5 m length and a central one of 57,0 m, totalizing 198,0 m extension.

The transversal section is constituted by a 0,22 m deep slab supported by 1,45 m high pre-cast simply placed beams.

The 57,0 m central span, consists of a Gerber type beam made of two 16,0 m brackets that support a simply support 25,0m beam.



The super-structure is supported by two abutments and four intermediate pillars founded through piles.

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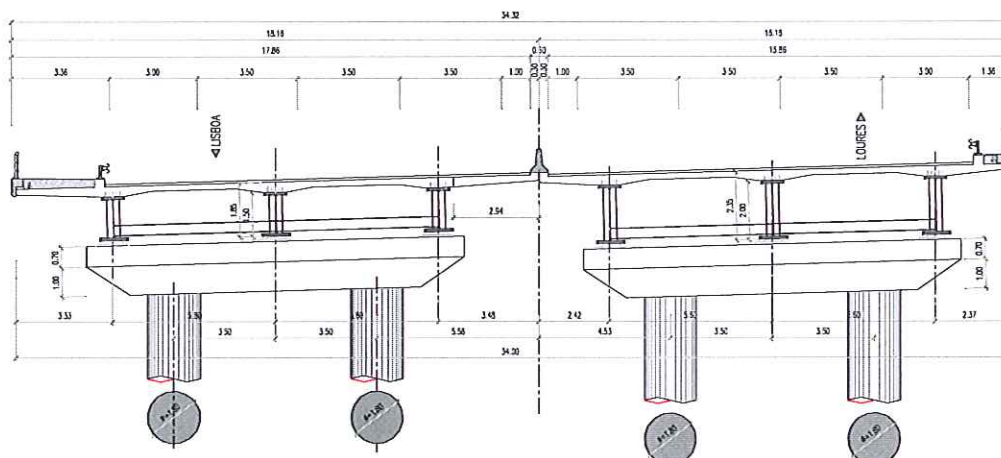
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This structural solution is easily deformed and causes high vibration on the central span. In order to reduce these problems, in 1996, it was subject to reinforcement work on the central span, by way of external pre-stress.

This reinforcement, despite having improved the structural behaviour did not eliminate its conception defects, continuing with a deficient performance in what concerns deformity and vibration.

Thus, in view of the conception deficiencies and the pathology of the bridge, the structure was considered inapt for widening and therefore its substitution was decided.

The new structure, with a total length of 197,0 m comprises five spans varying between 27,0 and the 57,0 m of the central support. The deck is composed of a mixed solution with pre-cast 1,5 m metallic beams on the extreme spans and 2,0 m on the central one and a slab of 0,35 m of reinforced concrete



On the adjacent spans to the central one, the beams have a variable height between 1,5 and 2,0 m in order to make a transition between the central and the extreme beams.

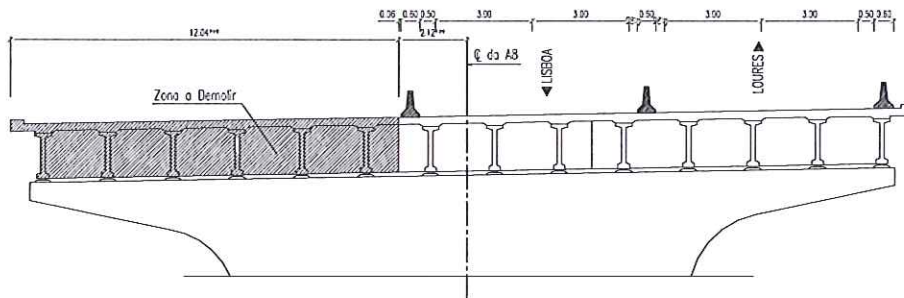
The slab is supported by pile piers of circular section and 1,8 m in diameter.

During the demolition of the existing bridge and the construction of the new one it will be necessary to guarantee two traffic lanes in each direction, thus the contract will be executed in phases, which are explained in the following general terms:

**Phase 1** (page 11) – redirection of traffic to the S/N lane and central reserve and partial demolition of the existing roadway (the corresponding width of the N/S lane), involving the following tasks:

- demolition of the slab

- removing of the 6 west beams
- demolition of the top of the existing piers to enable the placement of pre-fabricated beams for the new slab.



**Phase 2** (page 12) – Construction of part of the N/S slab, involving the following tasks:

- execution of the 1,8 m diameter pole beams;
- placement of the pre-fabricated metallic beams;
- placement of the pre-fabricated slab panels;
- concreting of the N/S slab;

This slab will be 15,0 m wide, a further 2,0 m wider than necessary at the end of the Works in order to support the 4 traffic lanes during the next phase.

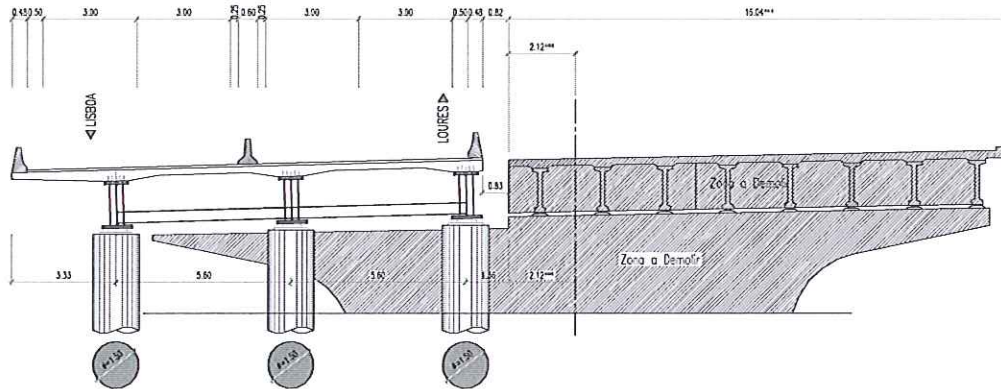
**Phase 3** (page 13) – Moving the traffic to the N/S lane and demolition of the remaining part of the old structure, the one corresponding to the execution of the following Works:

- demolition of the existing slab;
- removing of the 8 remaining beams;
- demolition of the piers.

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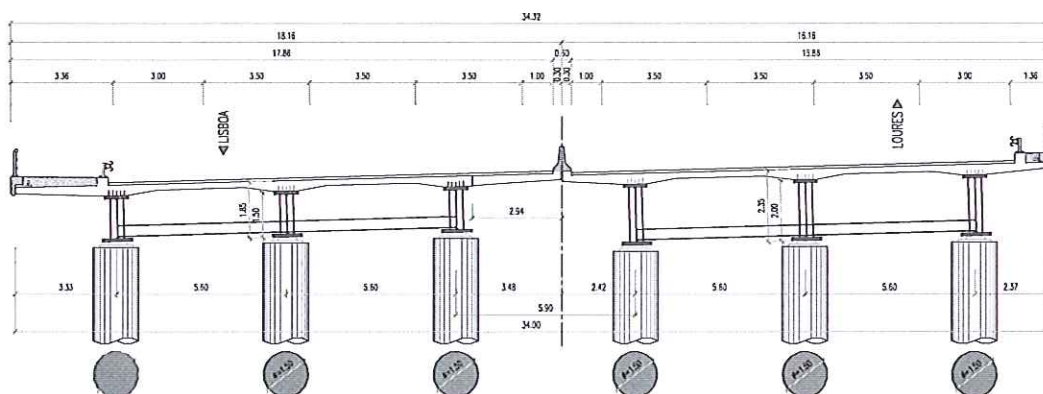
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**Phase 4** (page 13) – As the traffic is circulating on the N/S lane, the slab S/N will be built involving the following jobs:

- building of the pole pillars of the S/N slab;
- placement of the following metallic pillars;
- placement of the pre-fabricated slab panels;
- concreting of the S/N slab;

**Phase 5** (page 14) – Returning of the S/N traffic back to the respective slab in order to enable the closing of the central zone and finishing.





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### Loures / Malveira

The contiguous road section is Loures/Malveira, with a total extension of 10.750 metres.

At this site the interventions to be made (on the Engineering Structure), 2 Viaducts and 14 Current Engineering Structures) also stand out.

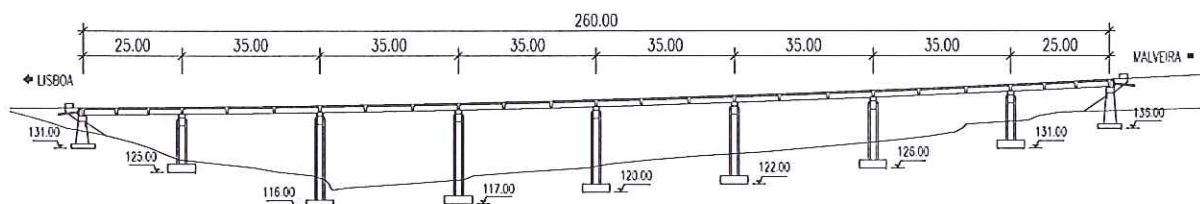
The layout of this road section goes through a rough terrain, on a zone of margot, clay and limestone formation, made up of materials of weak geotechnical characteristics, high heterogeneity and great constructive complexity; factors that add more difficulties to the works, in particular the level of foundation excavation and the core of the embankment and cut, where the worsening of the characteristics of the longitudinal section is justified (high gradient slopes)

The information resulting from the exploitation of this road section confirms the problems of instability in the area comprise in the engineering structure, which recommend the avoidance of intervention that might interfere with the present balance, as much as possible

Thus more adequate solutions specific to each zone of the engineering structure where developed, trying by the displacement of the highway axis, prevent the increase number of lanes from interfering with conditioned areas, maintaining when possible the existing slopes and structures.

### Murteira Viaduct

The Murteira Viaduct is at km 10+666 of the A8. It shows a structural solution composed by two decks of 13,50 m and 14,50 m width respectively, in pre-stressed reinforced concrete, each one of them being constituted by six 35,00 m spans and two extreme 25,00 m spans, totalizing the length of 260,00 m.



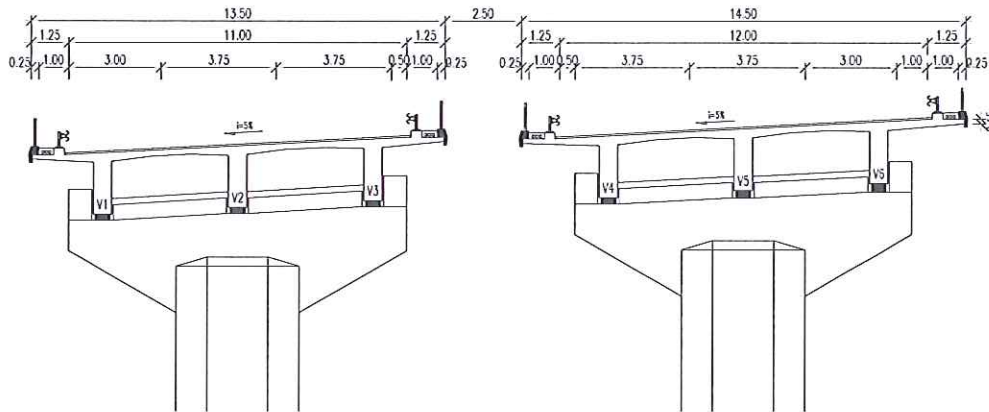
Longitudinal cut of the engineering structure

The transversal section is materialized by a slab supported by three 2,00 m high beams, again supported by joints of the abutments and on seven intermediate piers topped by a capital.

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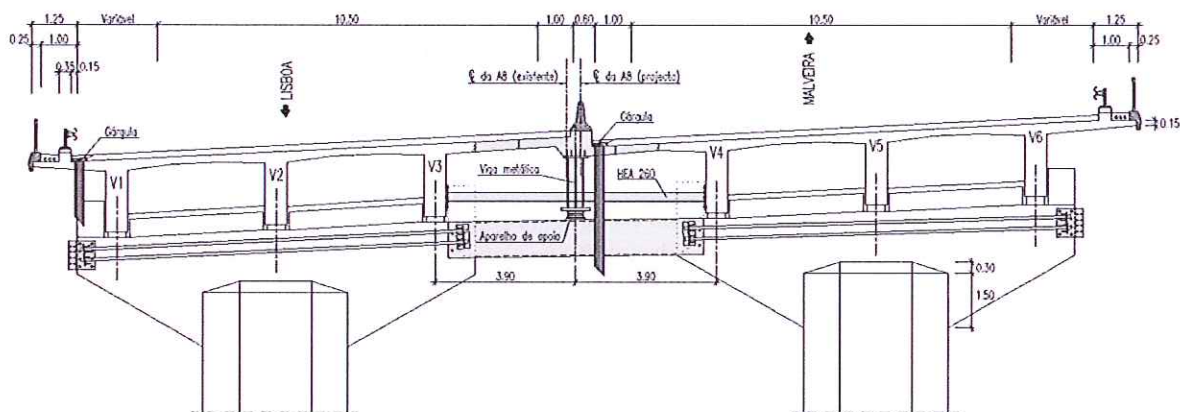


Transversal cut

Due to the innumerable conditional factors under the viaduct (roads and buildings), the solution adopted for the widening avoids the construction of new piers, supporting its extra weight on the existing ones through the connection of their capitals.

The use of a pre-cast metallic pier avoids the use of high and narrow scaffolding in the execution of the widening of the deck. These measures enable increasing the safety and swiftness of the works without raising the costs.

The widening of the deck will be achieved through the introduction of a 1,5 m high metallic beam equidistant from the beam on the internal extremities of the decks, which will support the reinforced concrete slab of variable thickness concreted on site.



Solution of widening – Transversal cut ove the P1 support

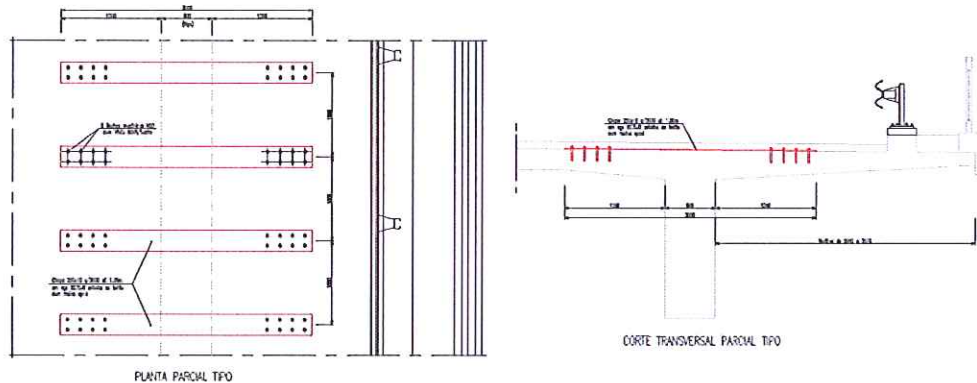
In order to meet the new road demands it was necessary to reinforce the structure.

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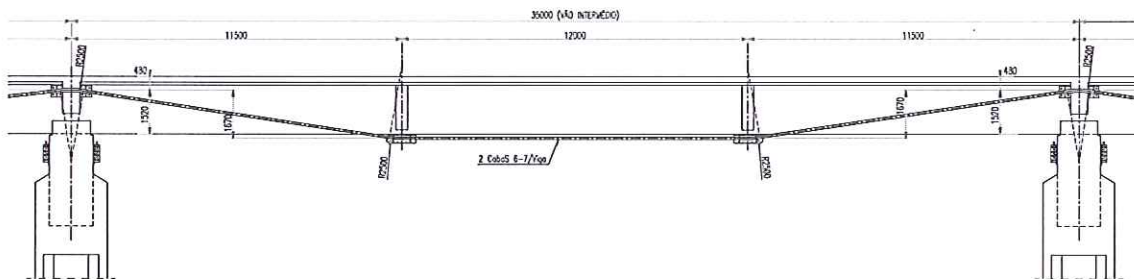
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Thus, the brackets were reinforced with metal plates of 250 x 10 and 3,00 m length of transversal section, space by 1,0 m.



A longitudinal external pre-stressed reinforcement of the deck will be necessary, by using 6 cables (of 7 strands each).



The widening of the engineering structure to the inside of the decks will provoke an increase of weight on the capitals for which they are not dimensioned. In fact this increase of charge will derive not only by the permanent increase in weight of the decks, but also by the alteration of the distribution of charges on the capitals, as the charge of the "I" beam will discharge on their extremities.

In order to balance this increase in charge all the capitals will be reinforced with 4<sup>o</sup> Dywidag bars.

The deck is fixed on the central piers. However, with the increase in its own weight provoked by the widening of the structure, some pillars will cease to have the sufficient resistance to absorb the horizontal actions imposed upon them.

In this context a seismic action reinforcement solution was studied, which consists on the building of a reinforced concrete of 30 cm width up to 3,00 m high and a reinforcement of the foundation by means of 14 micro-piles with a traction charge and compression of 500 kN/micro-pile capacity.