Petra Tou Romiou Viaduct, Cyprus

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Introduction

The Petra Tou Romiou Viaduct forms part of the Limassol-Paphos Highway in the south of Cyprus. It has a total length of 422.6 m, divided into eight spans (45.25 + 6 × 55.35 + 45.25 m), and a maximum height of 60 m. The twin structures are curved in plan (R = 1250 m) and have a longitudinal slope of 2.25% (*Fig. 1*). Each of the two decks is composed of a continuous post-tensioned mono-cellular concrete box girder (*Fig. 2*), constructed by the incremental launching method.

That the viaduct is located in a area seismic of high seismicity (peak ground acceleration of 0.21 g) was taken into account in its design, and for this reason the deck is linked to the abutments and to some of the piers by means of a system of dampers. The nature of the terrain presented problems for the foundation works due to the presence of expansive bentonitic clays and fractured chalks.

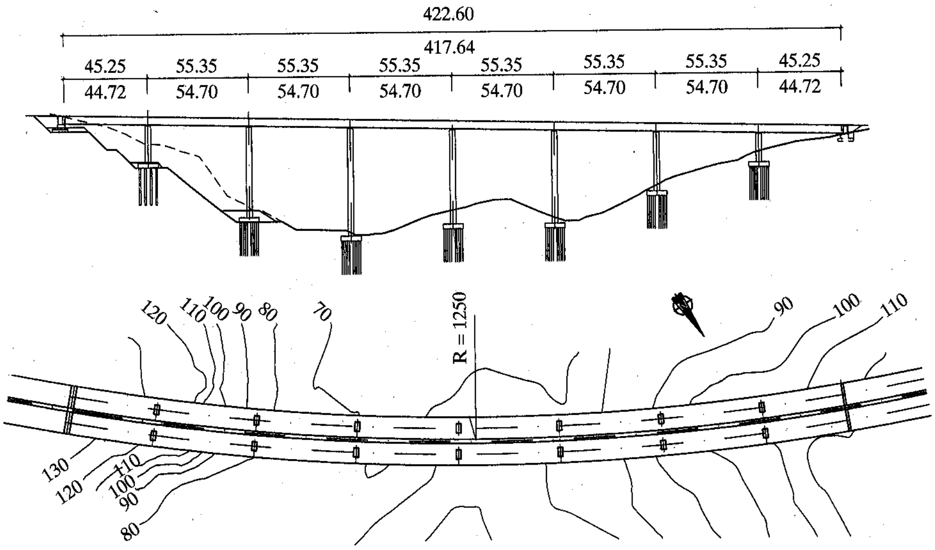

Fig. 1: Plan view and elevation

Structural Design

One of the geometrical characteristics is the differences in the heights of the piers, ranging from 16 m to 60 m. As a result, there are large relative differences in their stiffnesses of the piers.

The deck is linked horizontally to the shorter stiffer piers by means of buffer devices arranged in an X pattern, and to the abutments by means of dampers arranged longitudinally (*Fig. 3*). These measures ensure a suitable distribution of horizontal loads (due to seismic action, wind and vehicle braking), and avoid overloading of the abutments and the shorter piers. On each abutment, there are two dampers, each with a working load of 1000 kN.

The deck bearings can slide in both directions. On the higher piers (without the buffer devices), fixed bearings have been placed to support the deck. This has led to favourable results in terms of stability conditions, while the restrictive criteria with regard to the maximum admissible slenderness have been met.

The cross dampers on top of the shorter piers are elastic and pre-stressed and can act as stops for moderate loads, as springs for higher loads, and as buffers capable of dissipating energy for rapid loads. Each of these dampers has a loading capacity of 3000 kN.

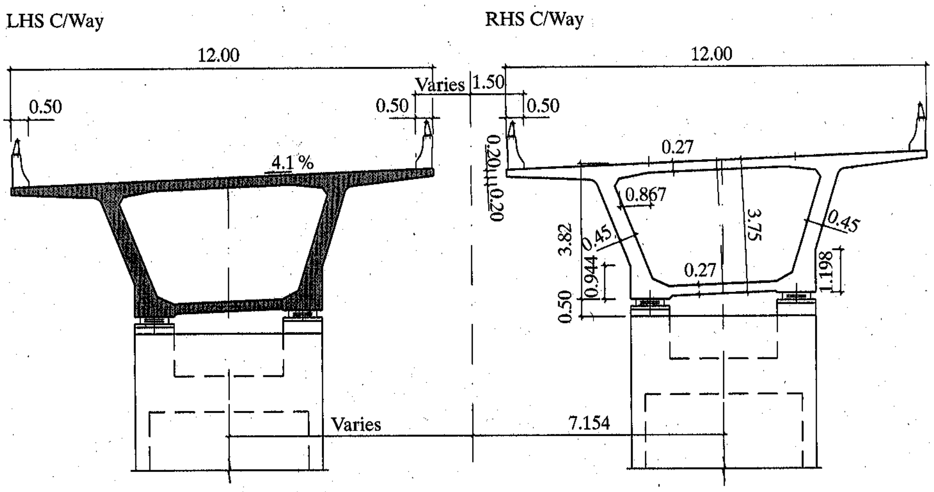

Fig. 2: Cross section of the decks

Construction

The incremental launching method is used to construct the bridge with a planned rate of one segment per week (*Fig. 4*). The lengthwise displacement of the deck is driven by means of threaded bars, powered by hydraulic jacks. The traction system is made up of a set of six 50-mm-diameter bars with a characteristic failing load of 1960 kN. The maximum planned launch force is 7500 kN. The bars are provisionally anchored to the deck by means of removable launching pins, composed of two vertical girders, lodged in the openings in the upper and lower slabs.

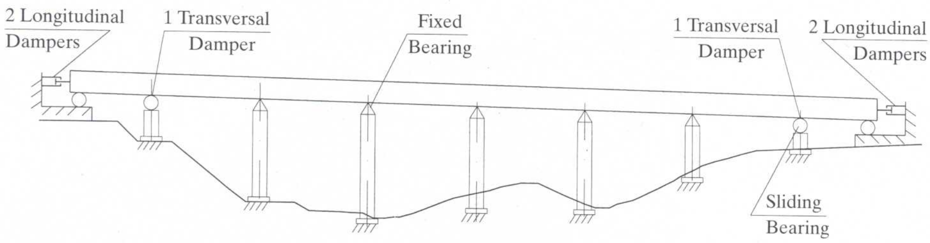

Fig. 3: Static system and positions of dampers

A launching nose (*Fig. 5*) has been assembled at the front of the deck, joined to the concrete by means of high-resistance bars. The nose is made up of two steel girders, linked by a series of bracings. It is 34 m long with a variable height of between 2.00 m and 3.75 m. The two main girders of the nose have a polygonal shape in plan, with a single twist in order to adapt to the curve of the viaduct. Each of these girders, constructed in Spain and shipped to Cyprus, is made up of five modules, joined by high-strength friction-grip bolts. This makes it easier to transport, assemble and move the girders from one viaduct to the adjacent one.

There are two pot-type bearings on each of the piers, which act as vertical supports for the deck during launching and remain in place when the deck has reached its definitive position. The sliding of the deck over the bearings is achieved by placing neoprene-Teflon pads between the concrete deck and each bearing device. A stainless steel sheet was assembled on the pads, and then removed when the launching was completed.

During the launching stages the deck is guided transversally by means of a number of steel beams assembled on top of the piers.

Deck

The deck is made of post-tensioned concrete with a resistance of 45 MPa. It is composed of a continuous monocellular hollow box beam, with a depth of 3.80 m. The webs are 0.45 m thick and inclined such that their axes cut the axis of the bearings and that of the lower slab at the same point, thus avoiding transversal bending of the section during launching or in service. In the bearing area, their thickness increases to 0.90 m in order to enable them to serve as a pier diaphragm and to provide enough space for anchoring the second-stage tendons. The deck is constructed from 18.45-m-long segments (equivalent to one third of the central span length).

The pre-stressing of the deck consists of two systems. The first is formed by thirty 9T15 tendons that run straight along the upper and lower slabs, anchored to every other segment, which provides prestressing during launching. For service loads, a second prestressing system was used, made up of eight 12T15 profiled tendons anchored through the webs to every other span.

Piers

The piers, with a maximum height of 58 m, have a 5.30 m × 3.00 m hollow rectangular section with 0.40-m-thick walls, and were constructed with self-climbing formworks. The upper parts of the piers contain enough space to perform the raising and guiding of the deck during launching. The foundations are laid with caps on micropiles with a bearing capacity of 780 kN. This foundation system was selected because of the morphology of the terrain, in which bentonitic clay strata alternate with chalks, basalts and sandstones.

A common footing has been placed to support the two adjacent piers of the two causeways. Each footing is supported by a set of 195 micropiles, 25 m deep.

SEI Data Block

Owner:
Republic of Cyprus, Public Works Department

Structural design:
EIPSA, Madrid

Contractor:
China Wanbao Eng. Corp., Bejing; MeKano4, Barcelona

Steel (t):	
Prestressing	340
Reinforcing	810
Concrete (m^3):	7300
Total cost (USD millions):	10
Service date:	2001

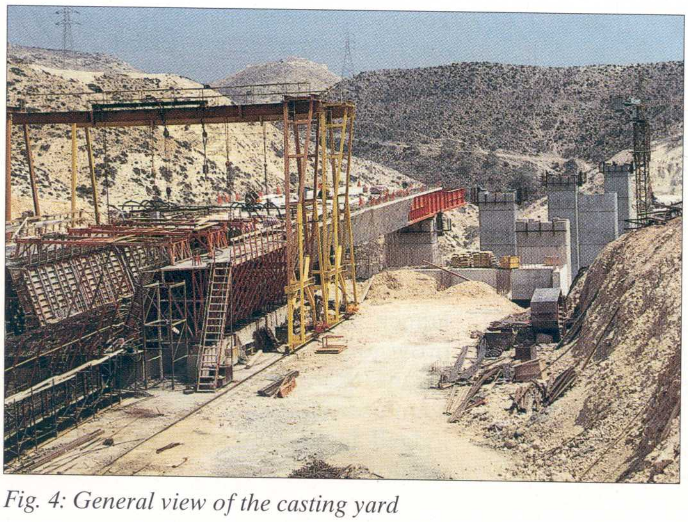

Fig. 4: General view of the casting yard

Fig. 5: Steel launching nose