Concrete Box Girder Bridges built by Balanced Cantilever

Ponts à poutre-caisson construits en encorbellement

Betonhohlkasten-Brücken im Freivorbau

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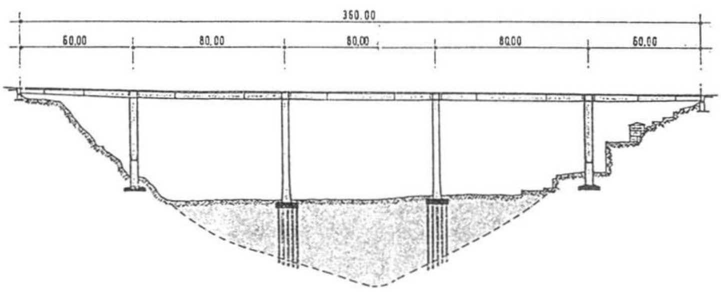
1 . INTRODUCTION

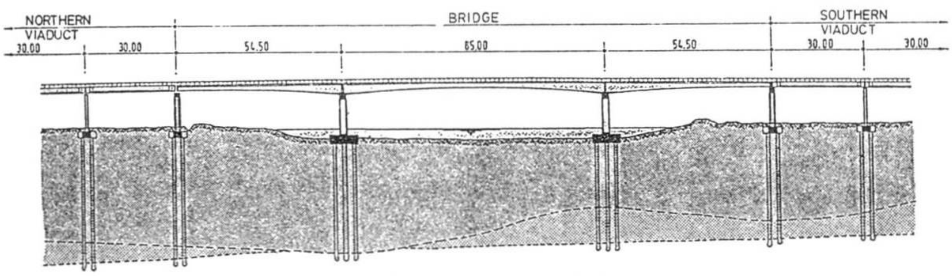
Prestressed concrete box girder bridges built by balanced cantilever with cast in situ segments, has been one of the most successful solutions in bridge construction . Single cell box girder has prooved to be a very competitive solution even for very wide bridge deck say up to 25 to 30 m.

This paper reflects the authors experience, in the last few years, in the design of several roadway box girder bridges in Portugal. Among several designs, four cases were selected in order to reach a comparision between bridges with similar spans but designed with different concepts.

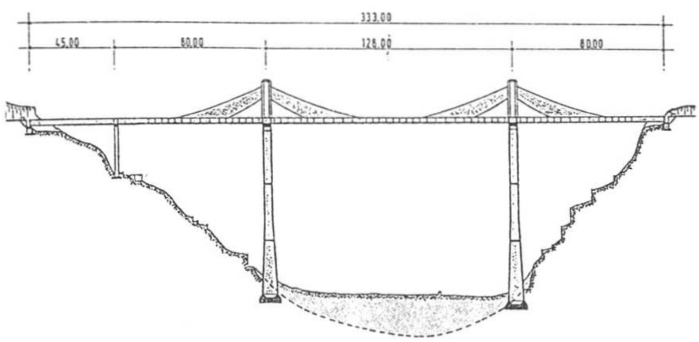
2 . CASE STUDIES



PORTO NOVO BRIDGE



ALCÁCER DO SAL BRIDGE

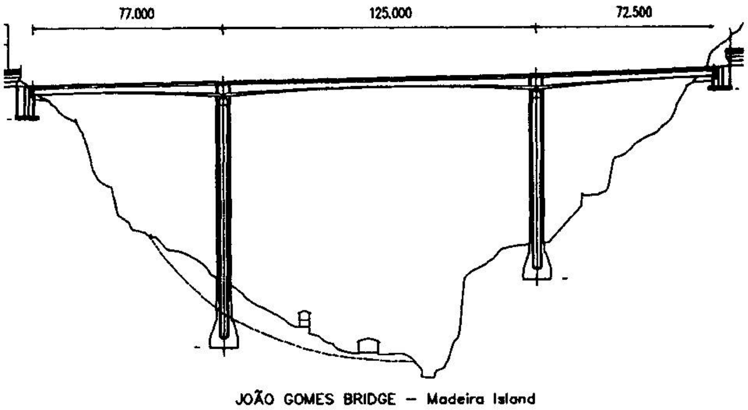


SOCORRIDOS BRIDGE

Four case studies were selected. "Porto Novo Bridge" is a frame bridge, completely built by the time of the present Congress, where a constant depth box girder was adopted in the 80m spans.

"Alcácer do Sal Bridge" is located in a seismic zone where deep foundations were required along the 1 200m lenght of the bridge and its access viaducts. A variable depth 3 span box girder was chosen with a central span (85 m) similar to the "Porto Novo Bridge" but the superstructure is a continuous beam instead of a frame.

"Socorridos Bridge" and "João Gomes Bridge" are bridges with similar main spans (128 m and 125 m) and very tall piers. The



JOÃO GOMES BRIDGE – Madeira Island

last is a classical variable depth box girder bridge, while in the former a new concept was introduced by adopting a constant box girder with a central suspension through "sail" type pre-stressed concrete thin walls. Wind tunnel tests were performed to analyse wind effects on the bridge deck on vehicles as also aerodynamic stability studies for the construction phase were carried out and some results are shown in the poster.

3 . INFLUENCE OF DESIGN CONCEPTS ON MATERIAL QUANTITIES

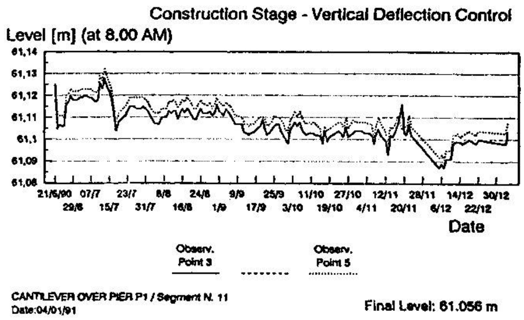
All the bridges referred to above were designed on the same basis, i.e. with the same actions and load combination according to the portuguese design codes (RSA 1986 and REBAP 1986) . Frequent load combination were required for decompression limit states. Linear thermal gradients with a total variation of about 10°C (frequent value) between the upper and lower flange were considered. Bending moment redistribuition of dead loads, namely at the centre of the main spans, due to change of statical system and creep were taken into consideration by a numerical viscoelastic (viscoplastic) time dependant model where construction sequence was introduced.

		DECK SLENDERN.		TYPICAL MAT.QUANTITIES	
	WIDTH	At Sup.	At Span	Concrete	Long.+ Transv. Prestressing
PORTO NOVO	17.85	1/18	1/18	0.70	44
ALCACER DO SAL	14.50	1/22	1/38	0.67	57
SOCORRIDOS	20.00	1/37	1/37	0.74	53
JOAO GOMES	19.00	1/20	1/33	0.83	59
	[m]			[m3/m2]	[kg/m3]

TABLE 1

In table 1,bridge deck slendernesses and typical material quantities are compared.The use of variable depth girders, tend to increase the continuity prestressing although some savings are obtained in the upper prestressing required by the construction phase. Thermal gradients play a significant role in the required continuity prestressing.

4 . CONSTRUCTION CONTROL



A detailled construction control programme for these bridges was defined. Deflections, strains and temperatures as also creep and shrinkage effects were recorded and typical results are shown. In Porto Novo Bridge the horizontal deflection of the top of the piers were controlled, in order to adjust, by imposed displacements, the stresses in the end piers which are of the flexible type (each pier consists of two independent thin walls) to accommodate long term deformation of the deck.