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13. Bowen Bridge, Hobart (Australia)

Owner:	***Joint Committee on Second Hobart Bridge on behalf of Department of Main Roads, Tasmania***
Architect:	***Richard Gray (Dec'd), Holford and Partners***
Engineer:	***Maunsell and Partners Pty. Ltd., Melbourne***
Contractor:	***Leighton Candac Hobart Bridge***
Works duration:	***42 months***
Service date:	***1983***

The major benefit of Bowen Bridge will be insurance against the massive economic and social disruption caused by any future Tasman Bridge closures, (*, **).

Site constraints and functional requirements resulted in a bridge length of 976 m, a deck width of 21.4 m and a deck area of 21,000 m². To simplify the construction the bridge was made straight both horizontally and vertically. The economy of the design arises from the cantilever method of construction which avoids use of falsework in the river and the adoption of match casting of segments which permits the deck to be cast whilst the massive foundations were being built.

The stratigraphy of the site is shown in Fig. 1 and consists of a dolerite cap steeply sloping on the western shore with gently rising triassic mudstone over the eastern part of the site. At the deeper piers foundations are characterised by shallow water, depth of up to 40 m of soft estuarine silt and then an abrupt transition to hard bedrock which slopes at up to 1 in 3. In all cases suitable founding rock is within 2 m of the geological interface.

The foundation design is dominated by the requirement that all river piers are capable of resisting impact from 5,000 d.w.t. paper barges travelling

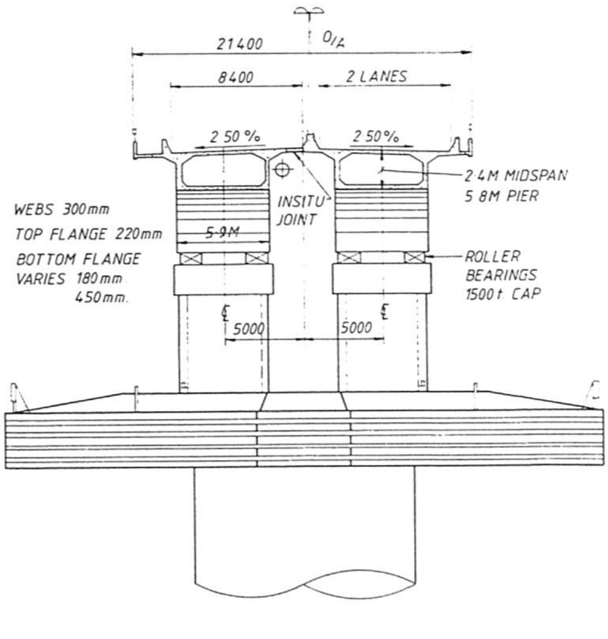

Fig. 2 Typical cross section

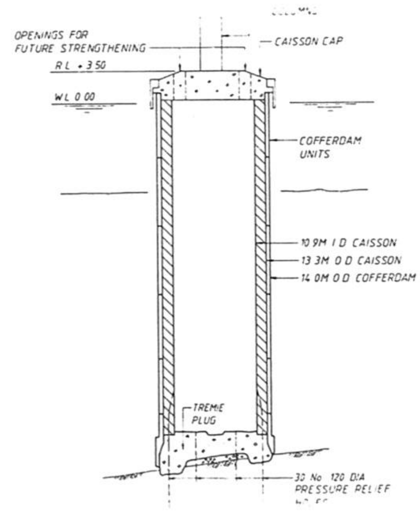

Fig. 3 Pier 2 Caisson

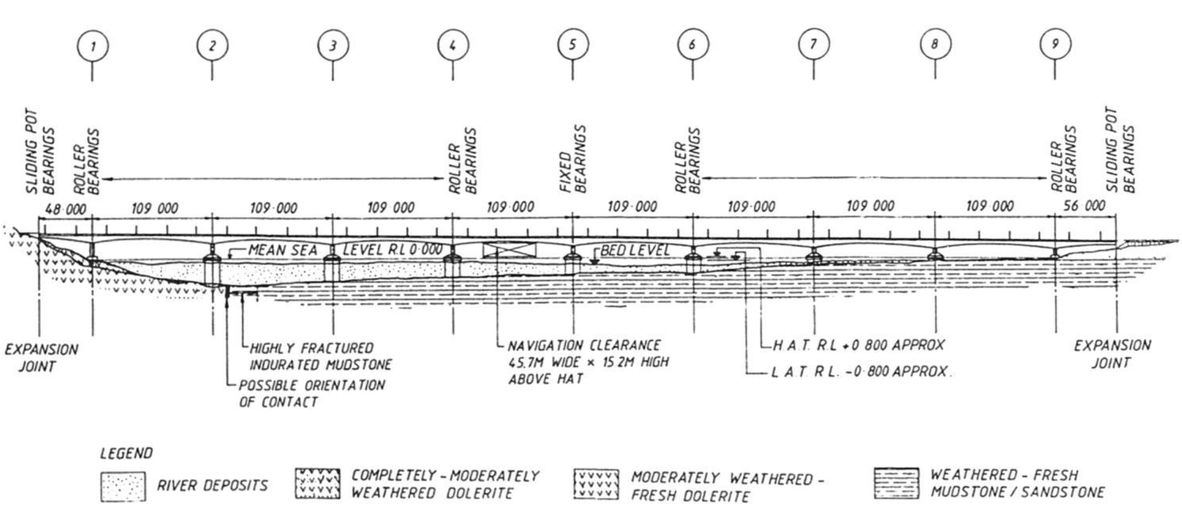

Fig. 1 Elevation of bridge

at 7 knots. Resistance is provided by a massive gravity foundation structure capable of generating the 1600 tonnes force which is sufficient to crumple the bow of the paper barges. The massive reinforced concrete caisson structures are shown in Fig. 3. Forces are transmitted to the foundation rock via a 40 MPa concrete tremie plug of maximum volume 800 m^3. This is cast on to excavated rock trenches of predetermined width and depth. The caisson structures were designed to be built in the dry on a "bottom up" basis using a cofferdam. The Contractor proposed an alternative reinforced concrete cofferdam consisting of 7.3 m high precast concrete units stressed together vertically. The problem of seating of this precast cofferdam on the hard rock faces was overcome by using a stepped cutting edge built to match the rock profile which was predetermined by probing at 4 m intervals. This produced a maximum gap of 0.5 m and an average gap of 0.25 m between the cofferdam and the rock face. This gap was sealed as necessary by grouting.

The massive caisson cap, 40 m long, has sharp ends (boat shaped) to provide maximum opportunity to deflect errant vessels. The ends are designed to break off under angled impact without damaging the main bridge foundation structure.The columns are reinforced concrete and have a stop block at the top which is designed to transmit a portion of the ship impact forces into the superstructure by bypassing the bearings.

The bridge cross-section is shown in Fig. 2. As match cast segmental cantilever construction was new to Australia the design was made as simple as possible and twin boxes were selected to restrict the maximum segment weight to 65 tons. The superstructure is prestressed longitudinally transversely and vertically within the webs.

The cofferdams were lowered under their own weight within a steel jacket as in Fig. 4. They were hung from external Dywidag rods connected to a hydraulic jacking system which enabled the forces in the hanging rod to be controlled by sequential excavation and lowering. The hydraulic system also permitted the cofferdam to be steered. In the stiffer silts near the geological interface, the cofferdams were jacked down by means of jacking down trusses. After pouring the tremie plug the pressure

Fig. 4 Lowering first segment Pier 2 Cofferdam

relief holes were drilled through it and piezometers installed prior to dewatering the cofferdams.

Deck erection was basically from the water using small erection gantries as shown in Fig. 5. The first five segments (325 tonnes) of a double cantilever were stressed in the casting yard and erected in one piece using the Contractor's large derrick barge.

Construction of the bridge has now been completed successfully with very few technical problems.

(J. A. Leslie)

* LEE D. J., and CROSSLEY B. K. G., "Restoration and Widening of the Tasman Bridge" in IABSE Bridges Symposium, Zurich, September 1979.

** LESLIE J., CLARK N. and SEGAL L., "Ship and Bridges Collisions – The Economics of Risk", in IABSE Ship Collisions Colloquium, Copenhagen, June 1983.

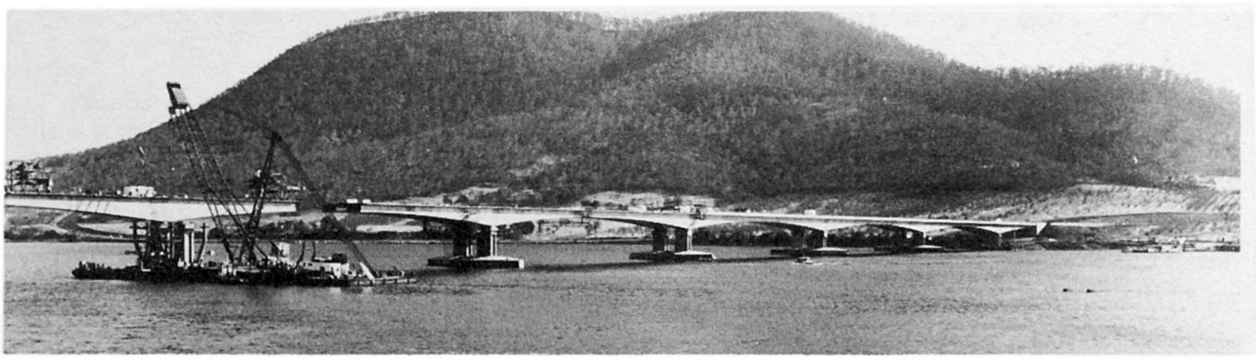

Fig. 5 Cantilever erection of deck