Bhima Aqueduct, Maharashtra, India

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Bhima Aqueduct is part of a major irrigation scheme comprising a gravity dam, reservoir, canals and distributories. The 947 m long aqueduct is designed to carry 42.5 cumecs of water across Bhima, a perennial river in the State of Maharashtra, India.

To maximise hydraulic and structural efficiency, a truncated circular cross section was chosen over the conventional rectangular section. This choice resulted in the following advantages:

- The hydraulic mean radius of the section was increased to 1.43 m compared to 1.0 m in the original design.
- This resulted in a reduced waterway of 13.80 m^2 compared to 18.0 m^2 in the original design, the discharge and slope remaining the same.
- The reduced waterway section decreased the water load by as much as 23 %.
- Transversal effects were reduced mainly to membrane forces easily taken care of by transverse prestressing.

The spans were made continuous over 4 or 5 supports achieving substantial reductions in design moments.

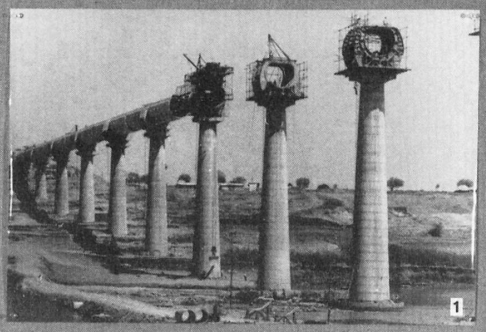
The efficient cross-section, continuity of the structure and use of longitudinal and circumferential prestressing resulted in a reduction of the concrete section by as much as 55 %. This led to a reduction in dead load on the substructure which enabled use of tapering hollow R.C.C. piers filled with plum concrete, instead of solid concrete piers.

The use of scaffolding was not desirable due to the presence of running water and the height of some of the piers which rise to over 40 m. Therefore, the cantilever construction method using precast matchcast voussoirs was applied. The voussoirs in 3.26 m length were produced in a casting yard located at site. Specially designed shuttering was used consisting of trolleys, external side shuttering and internal shuttering. To facilitate early release of voussoirs from the casting yard, 50 % of the transverse prestressing force was applied at the end of 3 days. Special equipment was designed to handle the voussoirs in the casting yard. After curing, the voussoirs are taken to the site and lifted with specially designed cantilever lifting equipment which has cradles to facilitate application of epoxy glue and prestressing force to the aqueduct.

A steel gangway is utilized to shift the cantilever lifting equipment from a completed span to the next span to save the time taken in dismantling shifting and subsequently reassembling the equipment on the next pier. The key segment of 1.9 m length is cast-in-situ for which the shuttering is supported from the already constructed arms of the tube.

This project serves as an example of the application of advanced technology, suitably adapted to the environment, to create an efficient, economical and aesthetically pleasing structure.

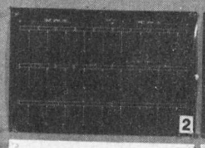
BHIMA AQUEDUCT, MAHARASHTRA, INDIA



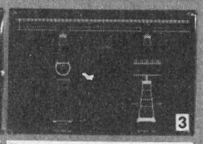
42.5 cumecs; 947 m long, 41.5 m continuous spans, 3.75 m roadway. Truncated circular cross section 4.8 m dia. Constructed by cantilever technique using epoxy glued precast matchcast voussoirs prestressed longitudinally and circumferentially.

Efficient, economic aesthetic structure integral with environment achieved by appropriate design and specially devised construction techniques and equipments.

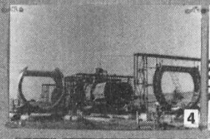
1 Piers with saddles and external diaphragms
—Cast in situ segment on pier-second from right
—Cantilever lifting equipment.

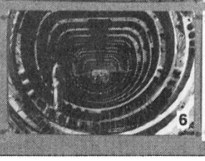


2 Sequence of establishing continuity

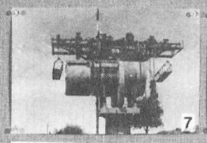


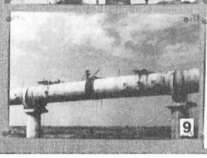
3 Salient dimensions, cross section and longitudinal elevation

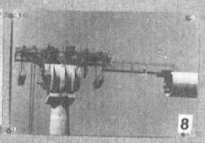




4 Shuttering for Voussoirs
Voussoir partially prestressed to release trolley
5 Specially designed equipment for handling voussoirs
6 Stacked Voussoirs







7 Cantilever lifting equipment cradles and walkway
8 External diaphragms at supports. Walkway to transport material
9 Key Joint concreted in situ. Prestressing of continuity cables.

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