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Autor: Smyth, W

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4. New Runnymede Bridge, Runnymede (England)

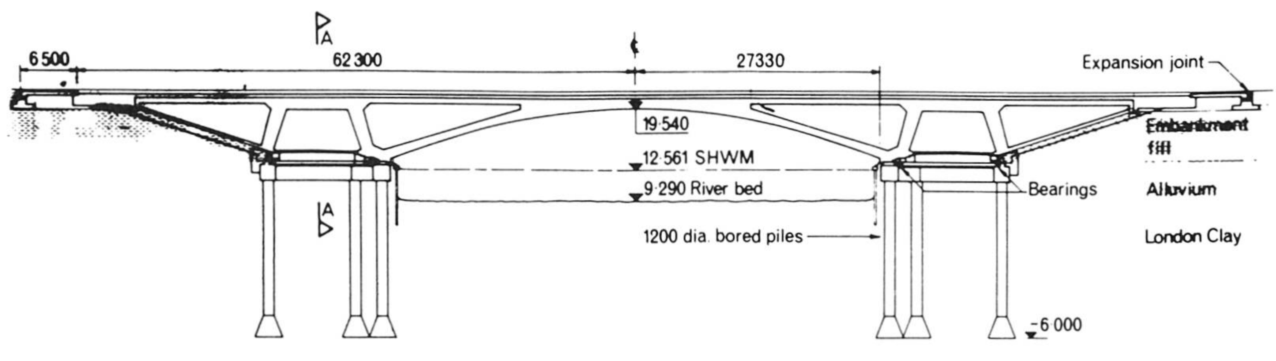
Owner: Department of Transport
Engineer: Ove Arup & Partners
Consulting Architect: Arup Associates
Contractor: Fairclough Civil Engineering Limited
Works duration: 32 months
Service date: 1980

The new bridge over the Thames at Runnymede sits alongside an existing bridge designed by a famous architect, Sir Edwin Lutyens, in 1939 and built in 1961/1962 (Fig. 1).

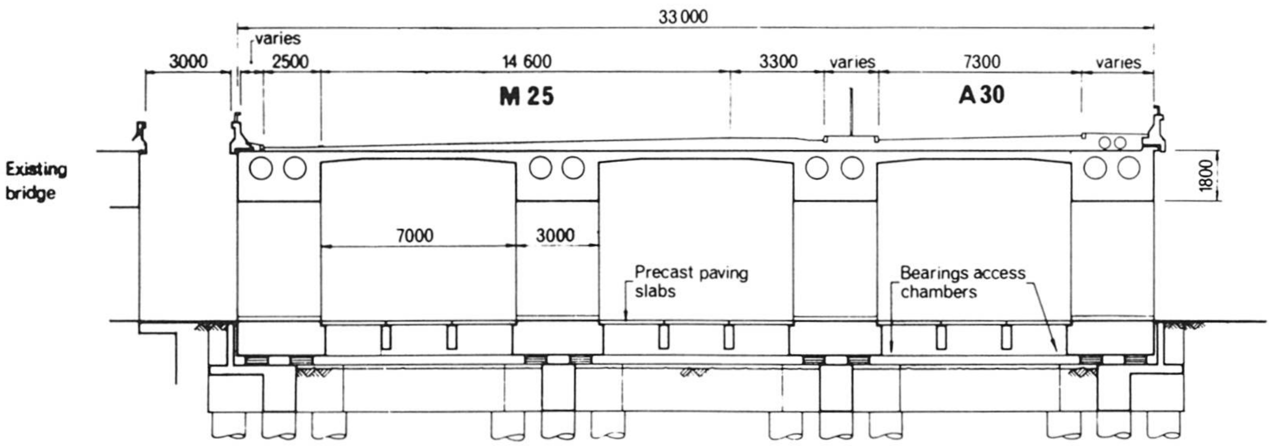
Fig. 1 Lutyens' bridge

Original bridge

Lutyens' bridge is a thin arch of white concrete spanning 56 m over the river and thrusting against cellular abutments founded in London clay. In the space between arch and deck are steel trusses transferring the loads to the arch and stiffening it. The bridge was constructed by cantilevering the trusses out from the abutments, and suspending the formwork for the arch from them. The spandrels are closed by brick panels which conceal the trusses, the abutments are clad with brick and the parapets are palladian balustrades of Portland stone. There are two towpath arches through the abutments and these are lined with brickwork and have Portland stone facings.



Longitudinal Section



Section A.A

Fig. 2 Longitudinal section and cross section of new bridge

New bridge

The Lutyens' bridge was designed for six lanes of traffic and two footways. The M25 motorway now crosses the Thames and requires four lanes and two hard shoulders in each direction and these are sandwiched between two lanes of the A30 and a footpath in each direction, so that a bridge of twice the original width is required.

Design

The new bridge is sited beside the older one with a gap of 3 m between them. It is designed to transmit mainly vertical forces to the ground so that it should not cause any additional spreading of the other bridge's abutments. It is also designed to be in sympathy with the older bridge without being a copy of it, and models of the two bridges were used during the project design to examine the visual relationships between them.

The bridge deck is carried by four concrete frames whose soffits over the river lie on the same surface as that of Lutyens' river arch (Fig. 2). Each frame is made up of two balanced half-frames which are connected over the centre of the river. The trapezoidal portal ring at the heart of each half-frame is supported by two sets of laminated rubber bearings and a simple truss cantilevers out on each side of the portal. The top members of the frames are prestressed and the other members simply reinforced. Foundation loads are taken into the clay by large diameter bored piles with underreams.

Construction

The half-frames of the superstructure were constructed on the banks and slid to their final positions (Fig. 3).

There were two sets of forms, one for each side of the river. The form and falsework were arranged so that after casting and the first stage of stressing the units could be jacked clear of the soffit shutter and slid sideways out of it. The skids were coated with PTFE, sliding on tracks which consisted of a thin layer of stainless steel fixed to mild steel plates on a concrete beam supported by piles. After the sideways move the unit was jacked up and the skids and track rearranged so that it could be slid forward to the river bank, again jacked and slid sideways to its final position. The two half-frames on the far bank in Fig. 3 are in their final positions. The one on the near bank has just been slid down to the river. The casting bays can be seen on both banks. The motive force for sliding was produced by hydraulic jacks pushing between the frame and nuts on Dywidag bars.

When the two half-frames of each pair were finally positioned, there was a 2 m gap between them. The second stage cables were placed, the gap concreted and the second stage stressing took place. The top members of each frame had sockets cast into the sides and rails were fixed to these which carried the travelling forms for the deck. When the deck had been concreted, the third stage cables could be threaded and stressed. The BBRV 55-wire system was used.

Finishes

The bridge superstructure is made of white concrete using a limestone aggregate and white cement, and the external concrete surfaces are bush hammered to expose the aggregate.

The elevation of the bridge structure is symmetrical about the centreline, but the road surface is not. The bridge deck is made up to the correct level with lightweight concrete, which helps to reduce the effect of differential temperature, with waterproofing and black top surfacing. The parapets are precast with the same finish as the rest of the bridge.

(W. Smyth)

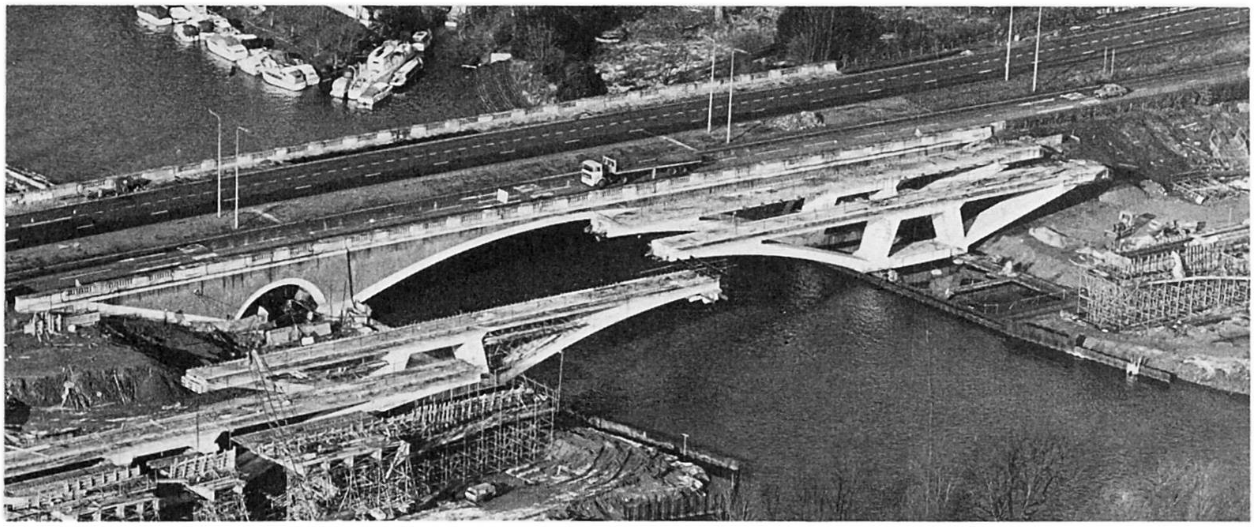


Fig. 3 The new bridge under construction