

## Walton Bridge – a new arch bridge over the River Thames, UK

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### Abstract

Walton Bridge comprises a steel thrust arch with pad foundations supporting a steel-concrete composite ladder deck. The arch ribs have parabolic profile and varying hexagonal cross-section, tapering from springing points to crown, and span 96.1 m. The total rise of the arch is 14.77 m with a span to rise ratio of 6.5. The bridge deck is suspended from the arch by bar-type hangers. Continuous end spans carry the bridge deck between the arch and end abutments, which are full height reinforced concrete. This paper discusses the method of design employed, including the impact of construction methodology and environmental constraints, together with analysis of aerodynamic effects. It focuses on a number of innovations that were introduced and challenges that were resolved. Two key issues were:

- Arch design utilising plastic section properties with reductions to account for the continuously curved steel plating making up the arch ribs;
- Design and specification of bar-type arch hangers for brittle fracture and fatigue, noting that there was insufficient industry guidance on either subject.

**Keywords:** Steel, arch dge, non-linear analysis, design, bar toughness, fatigue testing, curved plates.

### 1 Introduction

A new bridge over the River Thames was promoted by Surrey County Council (SCC) as a major improvement scheme to replace two existing temporary bridges over the river at Walton-on-Thames, UK. In 2005 SCC awarded the Early Contractor Involvement contract to Costain with Atkins as designer. The proposed crossing was to carry the A244 over the river with a single 114 m span arch. The type of arch and the choice of material were to be developed by the contractor, but the arrangement of two hexagonal shaped arch ribs inclined by 5° was fixed as an important aesthetic parameter. The deck was to be kept as slender as possible with clean lines on the outer edge.

In 2006, a public inquiry concluded that the proposed road re-alignment incorporating a twin

arm junction and a loop road beneath the new bridge was not in-keeping with the existing recreational use of the riverside. The scheme was subsequently revised and granted planning approval in 2008 and governmental approval to proceed in 2010 following its comprehensive spending review. The revised scheme retained a requirement to span the River Thames without piers in the channel, but the span could be reduced to 96.1m between springing points by not having to cross the loop road. The arch crown was lowered by 5.8 m to a level of 18 m above the river so that it was less dominant over the nearby flats. This increased the span to rise ratio from 5.5 to 6.5. Two back spans were provided on each side increasing the overall length to 148 m and creating a more open aspect for visitors on the river and on foot. A general arrangement of the final design is shown in Figure 1, a photomontage in Figure 2 and a cross section in Figure 3.