A European composite solution provides a viable and economical alternative to concrete girders for short-span bridges.

conference preview

# SHORT-SPAN SOLUTION

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**COMPOSITE BRIDGE DECKS** with steel girders and reinforced concrete slabs have proven their competitiveness over the years and have become the standard solution for medium-span bridges in Europe.

In the small-span range, however, traditional deck typologies (such as prefabricated prestressed concrete girders) have long been the most popular solution mainly on the basis of perceived economic, rather than technical, reasons.

In 2003, an effort was launched to change this perception. The main target of this effort, a European research project called Precobeam, was to develop a solution using prefabricated elements that would be price-competitive, durable, suitable for integral bridges and decks monolithically connected to a substructure (in order to minimize maintenance actions) and simple to erect.

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A conceptual Precobeam section.

The result is a composite beam with steel T-sections that act as external reinforcement to a concrete top chord. Steel parts are generally obtained from rolled steel profiles that are longitudinally cut, with a special shape, into two T-sections. The special shape of the cut allows for shear transmission between steel and reinforced concrete and is now standardized. It was tested at ultimate, serviceability and fatigue limit states.

This innovative construction method has garnered the interest of bridge owners as well as general contractors thanks to its easy but effective concept. Since it became available, about 20 bridges (roadway, railway and pedestrian) have been built throughout Europe, demonstrating its viability as an alternative for short-span bridge construction.

### Advantages Above and Below

The Precobeam concept combines the advantages of prefabricated prestressed concrete beams (the upper T of the section) with the steel girders (the lower T of the section). There are currently two assembly types: Duo-Precobeam and Mono-Precobeam. With Duo-Precobeam, two halved sections are positioned beside each other and filled with




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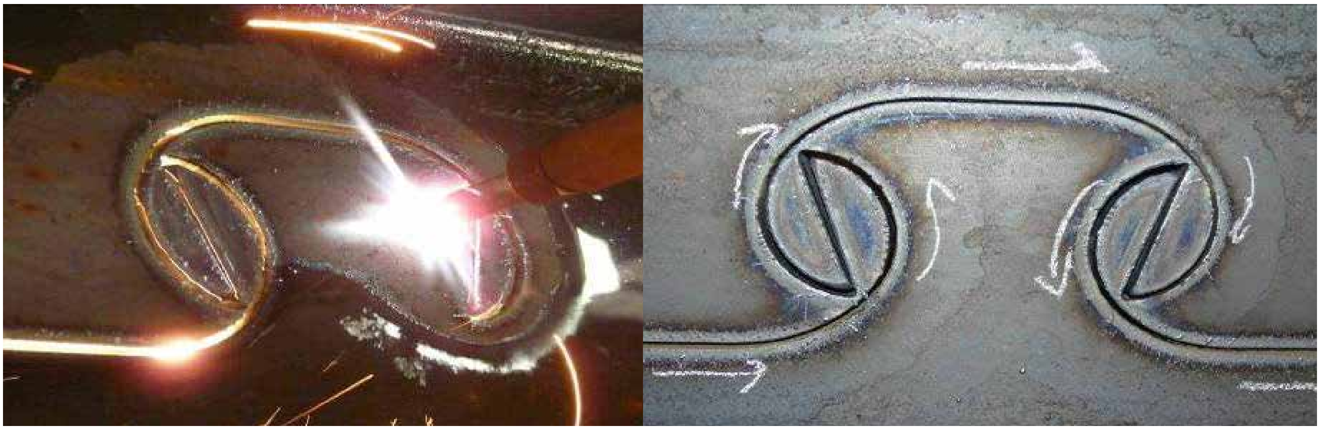
View beneath the Pöcking Bridge (Germany) with Precobeam elements.

concrete, which ensures a consistent torsional inertia, a more slender section and that the shear connection is nearer to the neutral axis. Mono-Precobeam uses only one halved beam and calls for a deeper reinforced concrete web. This option is more similar to a prefabricated concrete section, but with better bending moment resistance thanks to the steel acting as "external reinforcement."

## In Use

One such bridge is a 16.6-m-long (54.5-ft), two-span deck with abutments and one intermediate pier between the tracks. The total deck width is 10.5 m (34.5 ft). As the reconstruction was taking place over an existing railway line, a prefabricated solution to minimize trafic disturbance was essential. The entire deck width is supported by only three Precobeam elements. Rolled sections HE1000M in S460M steel grade (equivalent to W1000×300×350 in Grade 65) are cut into two halves and recomposed in small open box girders in full length of 32.5 m (107 ft), and the connection was ensured by composite dowels with puzzle shape.



The cutting pattern of the MCL composite dowel.

Steel fabrication of the Pöcking Bridge.

Finished Pöcking Bridge.

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Using Precobeam technology reduced the construction phase significantly, and the three elements were erected in one night. Next, 25 cm (10 in.) of concrete C35/45 was cast in-situ to solidify the three elements, and neither scaffolding nor formwork were needed.

The technology has been also applied to other bridges on Highway S7 in Poland between 2009 and 2012. Wide decks are realized as continous beams over three or four spans, with a maximum span of 18 m/59 ft) with a construction height of 83 cm/2.72 ft (slenderness L/22). Precobeam elements were made out of coupled HE1000A/B/M in S355 (equivalent to W1000×300×272/314/350 in Grade 50) with a slab width of 2.4 m (8 ft), and the prefabrication was done directly on-site by the general contractor. ■

*This article serves as a preview of Session B14, "New Structural Forms for Short-Span Bridges" at NASCC: The Steel Conference, taking place March 26-28 in Toronto. Learn more about the conference at* ***www.aisc.org/nascc****.*