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BRIDGE DESIGN & ENGINEERING

Bridge
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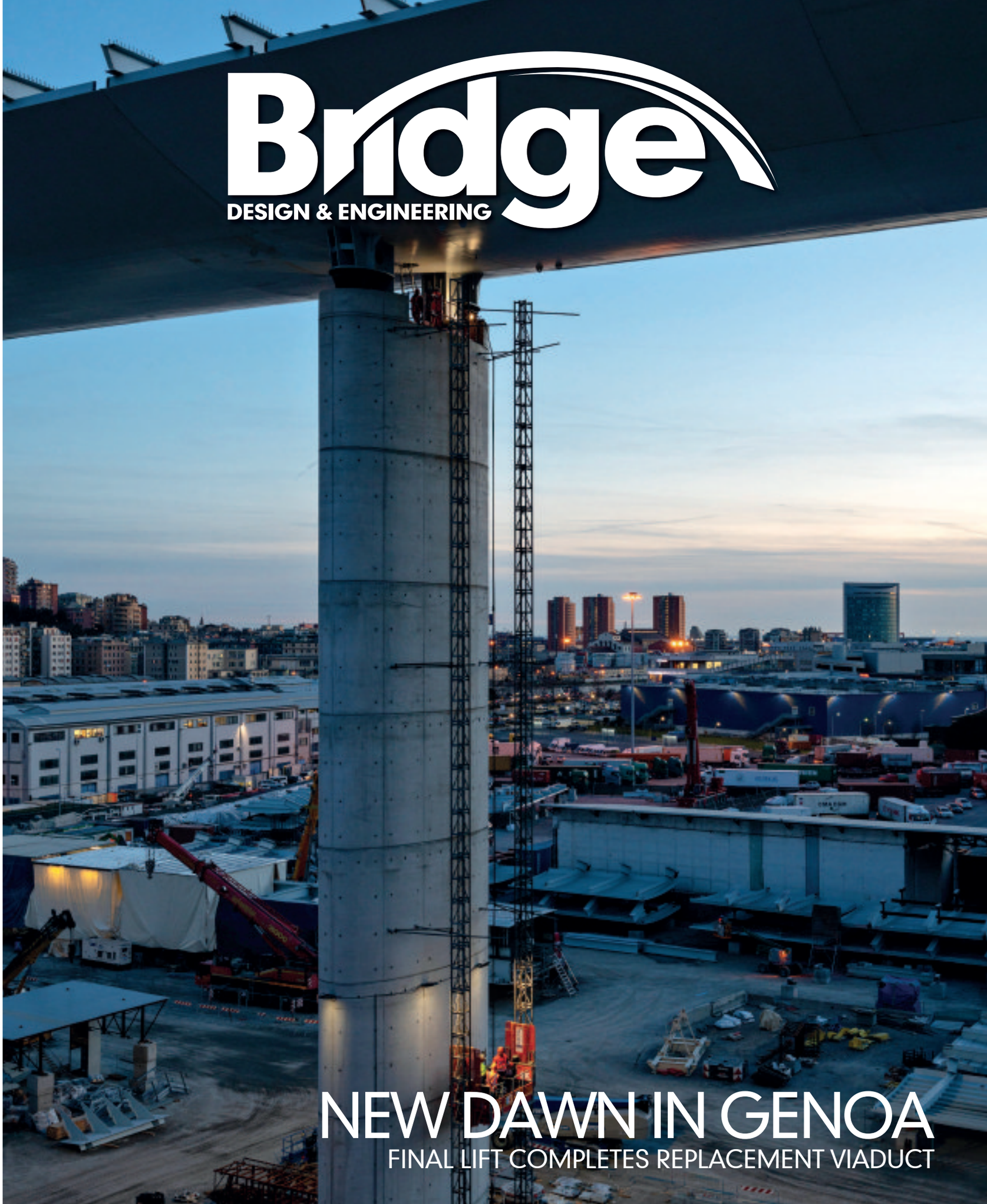

NEW DAWN IN GENOA
FINAL LIFT COMPLETES REPLACEMENT VIADUCT

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AHEAD OF THE CURVE

DUBLIN LINK — DUBLIN, OHIO, USA

Just completed, the Dublin Link Bridge provides a critical connection over the Scioto River with this dramatic crossing for pedestrians and bicyclists. T.Y. Lin International is the Engineer of Record, working with the architect and the City of Dublin to develop the unique bridge concept. The gracefully aesthetic, 760-foot-long Scioto River Pedestrian Bridge follows an "S" curve alignment providing an ever-changing view of the landscape as you cross. Without any vertical support, the steel deck passes through an "eye of a needle" concrete pylon tower, making the bridge structure intriguing from both the pavement and ashore. T.Y. Lin International is proud to make this landmark structure for the City of Dublin and its community into a reality.

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Overview of the refurbished swing bridge in Tilburg

LIGHTENING THE LOAD

The installation of an FRP deck on a historic swing bridge in the Netherlands shows that the design life of steel structures with timber decks can be extended, writes **Martijn Veltkamp**

Today, with increasing traffic volumes and design loads well above what structures were originally designed for, replacing bridge decks with a same-weight alternative such as FRP is a sustainable option that contributes to the structure's durability. With imposed load restrictions being difficult to manage, deck replacement is in high demand and much favoured over demolition and new-build construction, as 'new' is often uneconomical, unsustainable, too late or simply impossible in modern economic circumstances.

One such case occurred recently in the city of Tilburg, in North Brabant province, where the Oisterwijksebaan swing bridge carries two lanes of traffic over the Wilhelmina Canal. The 27.8m-long, 6m-wide bridge features a raised 0.9m-wide walkway and is owned by the national infrastructure authority, Rijkswaterstaat.

With the timber deck suffering from the heavy traffic, and with maintenance already scheduled to take place on the operating mechanism of the structure, the client decided to replace the deck as an add-on operation. The main contractor was Spie, and Fibercore Europe was selected as the design-and-build supplier of the FRP deck that was chosen to replace the timber deck located both on the road and pedestrian footway.

The FRP panels were factory-built and fully prefabricated to reduce the installation time. Production was based on three-dimensional site-measurements, with the curved 'nose' typical of swing bridges and a crowned profile structurally

Abutment detail showing the new FRP deck

built-in. The levels of the supporting beams were closely measured, since the deck had to span between the main girders, transversely to the direction of traffic.

To ensure the deck would not be sitting on transverse beams at the same level, the deck was slightly countersunk in those areas. As a logistic optimum, the decks covered the full width of the road while the length was split in two elements of 13.9m each. The FRP deck appears to be a sandwich structure with internal webs, but has continuous fibres inside running from the top to bottom faces.

For the works to be carried out on the bridge, Spie lifted the entire bridge out and shipped it on a pontoon to its yard. All works could thus take place on land, facilitating a fast turnaround. The FRP decks were clamped with bolts to the steel structure. Each bolt head was connected to clamping beams hooking below the girders' top flanges, while the threaded end connected in a steel insert, built-in during the deck fabrication. In this way no drilling was required into the existing steelwork, while at the same time the risk of mismatch between holes in the steelwork and bolts in the deck was avoided, as well as the need for corrosion-protection for the newly drilled holes.

The structural system of the bridge remains unchanged, as the deck does not act in a composite way with the steel girders. Being fixed with dowels at the curved end, the deck can move freely over the steel structure. Converting the structure into a steel-FRP composite structure would have generated additional strength and stiffness, but it would also have required a full analysis of the bridge, possibly local changes, as well as a much higher capacity of the connections, notably in shear. In contrast, the FRP-for-timber replacement is quick and straightforward, and provides a higher load-carrying capacity than its original timber deck while respecting the local constraints of available depth and similar self-weight.

The configuration of timber decks on a primary steel structure is common in other structures, not just the swing bridge in Tilburg. Timber was typically used as an alternative to concrete to keep the self-weight low, thus saving on material for the spans. However, as times have changed, maintenance has become a much more dominant cost factor than that of the load-bearing material of choice.

The bridge in Tilburg is not the first FRP deck replacement carried out by Fibercore, which has implemented its delamination-resistant Infracore deck on nearly 1,000 road and pedestrian decks, including the Klaffbron bascule bridge in the city of Malmö, Sweden. Although Klaffbron Bridge had received a new aluminium deck in 2004, it subsequently appeared unsuitable for road traffic, with cracks appearing on the wear surface at the joints between the aluminium plates.

The new deck on the Oisterwijksebaan swing bridge has a design life of 100 years and, in addition to protecting the steel structure from penetrating de-icing salts, it has also made the local residents happy, as they suffered from the noise that the detached planks created on the steel beams.

The timeframe of only five months from first contact to completion was remarkably fast and shows the versatility of FRP deck installations, ticking many boxes of today's client requirements ■

Martijn Veltkamp is design manager at Fibercore Europe