Steel-FRP hybrid

An FRP-steel hybrid bridge halfway during installation across the A27 motorway near Utrecht, the Netherlands.
Design and construction of InfraCore® Inside-deck: FiberCore Europe.

Combining two materials and making them work in hybrid combines the best of both. Reinforced concrete is a prime example. In a much more lightweight-way, steel can be combined with fiber reinforced polymers (FRP, or composites), in the way of a primary structure in steel, with a lightweight deck of InfraCore® Inside. Combining the stiffness of steel with the low self weight of InfraCore® Inside gives a solution that is better than the sum of parts.

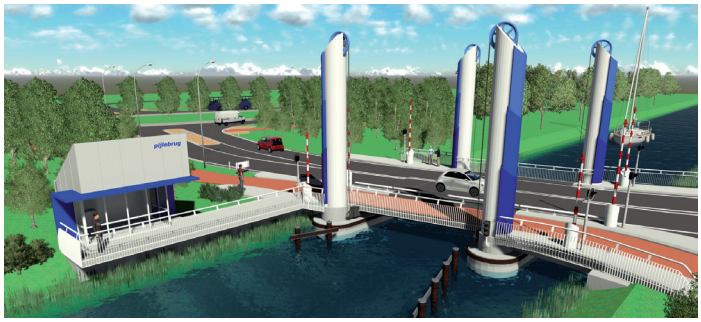
InfraCore® Inside is FiberCore Europe's proprietary technology to construct strong, lightweight and durable structures in FRP. It is a proven technology with significant advantages over conventional materials:

- Low-maintenance and long design life → beneficial Life Cycle Costs (LCC)
- Prefabrication → high quality, fast construction and low disruption
- Lightweight → easy transport
- Strong, safe and inflammable
- 50 year warranty

Completed	2012
Length x width	142 x 6,20 meter (continuous girder with two equal spans of 71meter)
Loading	Eurocode / 60 tonnes vehicles
Self weight	Total 400 tonnes, deck 140 tonnes
Foundation	Shallow foundation on grout injection
Client	ProRail (government body for railway infrastructure) upon completion handed over to Rijkswaterstaat (government body for roads and waterways)
Main contractor	Heijmans
Steelwork	Hillebrand
Lead consultant	Movares

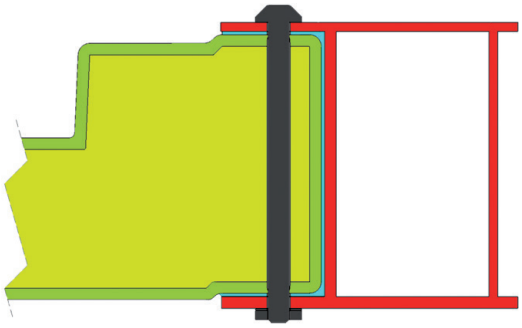
Since its market introduction in 2007 in the Netherlands, InfraCore® Inside has established itself as an accepted major new construction material for infrastructure and marine construction. More than 250 projects have been realised in the Netherlands, UK, USA, China, Belgium, Italy and Surinam. InfraCore® Inside meets the loading requirements from the Eurocodes.

Hybrid movable bridge with an InfraCore® Inside deck, fitted in between steel beams connected to the operation mechanism.



The lifting cables of this hybrid lifting bridge are attached to a steel beam integrally connected to the InfraCore® Inside deck.

On the bridge across the A27.



Joining of the FRP deck with a bonded connection, together with stainless steel pins. Also note the detailing of the InfraCore® Inside bridge deck which includes curbs and chamfers. Also ductwork can be integrated in the deck.

Advantages of hybrid structures

Hybrid structures are advantageous where low self weight, low maintenance of low disruption are desired, for instance in movable bridges and bridges that need to be prefabricated off-site. Lightweight movable bridges require lighter engines, less foundations and operate faster

Hybrids have a very good weight-to-stiffness ratio because they are mechanically efficient. But they also allow eliminating a layer of secondary steelwork, since InfraCore® Inside is self-supporting. This saves weight and costs.

Advantages of InfraCore® Inside bridge decks are that they are closed, watertight, resistant to de-icing salts and not sensitive to fatigue.

Design and engineering

InfraCore® Inside is a standard technology that is customised to each application by FiberCore Europe's in-house engineering department. Its strength, stiffness, depth and weight can be manipulated for the best results per project. For instance the coefficient of thermal expansion can be tweaked to match that of steel. This avoids thermal stresses and enables structures of virtually any length.

Construction and installation

Like steelwork, InfraCore® Inside is a factory-made prefabricated product. They are factory-finished and come to site with the epoxy-bonded gritted wear surface already applied. On site, InfraCore® Inside can easily be connected to steel. It can be shaped to obtain a matching geometry. Subsequently it can be drilled in, bolted and bonded, also to join multiple segments.

Given the low self weight, hybrid construction allows off-site prefabrication and off-site assembly. The completed bridge can then be rolled, lifted, or shipped in place, thus causing minimal disruption to the ongoing traffic.

The hybrid bridge across the A27 motorway was awarded with the InfraTech halftime-award for its positive impact on hindrance-reduction.

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