The new bridge goes through a nature reserve

STEPPING LIGHTLY

A viaduct is being built through the wetlands of a Colombian nature reserve with minimal disruption, report **Gilberto Dreas** and **Nicola Stefanutti**

The top-down construction method currently in use on the Gran Manglar Viaduct in Colombia, South America, involves the use of a launching girder to drive piles for the leading span with deck casting following on. The new highway bridge will cross the shallow lagoon of the Cienaga de Tesca near the Caribbean around 1,000km north of Bogota. It is a 5.4km-long structure which will form part of the 146km-long highway route from Cartagena de Indias to Barranquilla.

Colombia's National Infrastructure Agency – ANI – is building the highway to link the two cities with the aim of developing the Caribbean coast into the country's main logistics route as well as facilitating traffic flow.

Consorcio de Diseños Costera entered into a design, build and finance contract with ANI for the scheme, officially called Proyecto Cartagena-Barranquilla y Circunvalar de la Prosperidad. The contractor is MHC and Meco consortium, subcontractor is Rizzani de Eccher Sucursal Colombia and the designer is Deal.

Out of the ten groups that took part in the prequalification process only two submitted a tender in 2013 for the challenging design, construction and maintenance of the highway.

The alignment requires the route to pass through newly rehabilitated marshland that is now designated as a nature reserve; the call for tenders included a prerequisite for construction input for a cast-in-situ balanced cantilever bridge.

The construction method for this type of bridge presented two major issues that the main contractor had to resolve. First was installation of the foundation elements, which presented a challenge from an environmental perspective.

Piles are driven from above to minimise the impact at ground level

Approximately 792 hollow, 1m-diameter concrete piles are being driven to support the 129 spans

Secondly, there was a societal challenge, as the delivery of the project could potentially prevent local residents from fishing.

Rizzani de Eccher and Deal presented a solution that resulted in the team winning the tender as the project's strategic partner.

The top-down construction method is high-tech and requires minimum manpower and operations. It had already been developed by Deal and used on the Washington Bypass project in North Carolina in the USA where it enabled the construction of the whole viaduct, including foundations, by access from the previously-built section. A pair of specially-designed launching trusses was deployed to drive the precast piles, complete the setting of the precast pier caps and then launch and place the precast girders, in record time. The system reached an impressive monthly production rate of five spans - each typically 36m long - with minimal impact on the wetlands below.

Although this construction method is dramatically different from the original proposal envisaged by ANI, it resolves all the project's requirements and issues. It avoids the need for dredging, the placement of concrete slabs and the construction of access roads, which otherwise would have damaged the environment for years to come. In addition, the local population can continue using the wetlands for fishing and agriculture throughout the construction activities. The use of precasting and industrial processes on the project also allow the main contractor to maintain scheduled delivery times. It resulted in costs that were lower than the original tender estimates, thanks to the input from the companies involved in the process.

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The viaduct consists of 129, 37m-long spans and it is entirely made up of prefabricated, prestressed concrete elements, excluding the completion elements and the cast in situ slabs.

Fabrication of the elements is taking place in a precast yard adjacent to one of the abutments, where three production lines produce the pile caps, piles and girders.

The pile caps are cast on a long-line mould for the production of match-cast elements; three modular horizontal moulds are used for the piles, which vary in length between 30m and 58m.

Each mould is equipped with a fixed bulkhead that is used to install the mechanical connection devices that will connect the pile elements, and which must be installed with minimum tolerances to ensure their verticality. Girders are also cast in moulds, and all the sections are transported by gantry crane and straddle carriers that can be adjusted for the different elements.

The bridge is being erected using two 180m-long launching girders, with the equipment for driving the piles starting at each end of the bridge.

Each gantry consists of two parallel and connected trusses that are long enough to extend over four spans of the bridge. The gantry system begins at one end of the bridge and drives the piles for each pier.

The specialist equipment is able to lift, rotate and drive the piles; install the precast pile cap; and also lift the beam from the transporter and launch it into final position.

Approximately 792 hollow, 1m-diameter concrete piles are being driven to support the 129 spans, including both portions of the Y-shaped split at the ends of the bridge.

On typical spans, the gantry drives six piles and then sets the precast concrete caps in three pieces on the piles. The caps are post-tensioned and infill concrete is added. The concrete infill is loaded into buckets and transported to the leading end of the truss using the gantry trolley. The trolley then manoeuvres the bucket into the position required for the concrete. Next, three beams are placed by the gantry and the concrete deck is cast. Once the 28MPa concrete compressive strength is achieved, the gantry moves forward, and the cycle is repeated for the next span.

As *Bd&e* went to press, 320 beams had been prefabricated out of a total of 400, as well as 100 of the 132 pier caps, and 852 of the 1,490 piles. Erection was progressing apace with 44 spans in place out of 132. Construction of the entire viaduct is scheduled for completion by the end of 2018 ■

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