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BIM graphics reveal HS2 bridge build sequence

CGI representation of what will become the UK's longest railway bridge (Illustration courtesy of HS2)

Following our look at Building Information Modelling (BIM) in the last issue, Nick Johnson reports on the plans for what will be the UK's longest railway bridge.

Construction of the new HS2 high speed railway line in the UK is now well underway. It is said to be largest infrastructure project in Europe and, to aid construction, its contractors are making good use of the latest computer modelling techniques.

The first phase between London and Birmingham involves the construction of more than 300 bridges and 70 viaducts. The largest of which is the Colne Valley Viaduct (CVV) that will carry trains at speeds of up to 200mph for 3.4km across waterways, four lakes, two roads and four footpaths.

Straddling the environmentally sensitive border between London and Buckinghamshire on the northwest outskirts of the capital, it will be almost a kilometre longer than the Forth Rail Bridge, and as such is set to become the longest railway bridge in the UK. It will weigh some 116,000 tonnes and have a total of 57 spans ranging in length from 45 to 80 metres. The concrete structure will be supported by 56 piers, with the widest spans reserved for where the viaduct crosses the lakes, and narrower spans for the approaches.

Set low in the landscape, its design was apparently inspired by the flight of a stone skipping across the water, with a series of elegant spans carrying the railway around 10 metres above the surface of the lakes, the River Colne and the Grand Union Canal. As the railway passes through the picturesque Colne Valley Regional Park, the structure will incorporate sound absorbing, two metre high acrylic panels either side of the tracks.

The original concept design was produced by Knight Architects, working with Atkins, in consultation with the Colne Valley Regional Park panel, as well as members of the independent HS2 design panel. This design formed the basis for the HS2 C1 contract that was won by joint venture consortium Align JV - comprising the contractors Bouygues Travaux Publics, Sir Robert McAlpine and VolkerFitzpatrick.

Align's project director Daniel Altier says: "Once complete the viaduct will become one, if not the, most striking element of HS2 Phase 1.

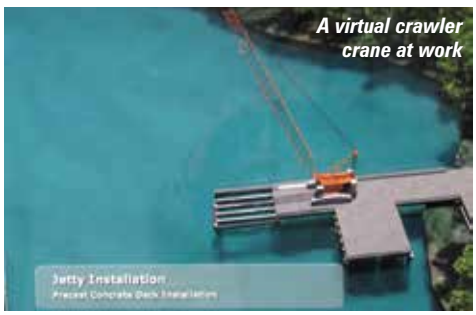
A launching girder/crane will install deck segments for the HS2 Colne Valley Viaduct

The way it will be constructed is going to be equally fascinating for engineers young and old. The sections for the deck will be fabricated at our main construction site to the west of London just inside the M25 and using a huge launching girder/gantry/crane, the deck will be formed from north to south, along the line of the route, thereby keeping unnecessary construction traffic off the roads."

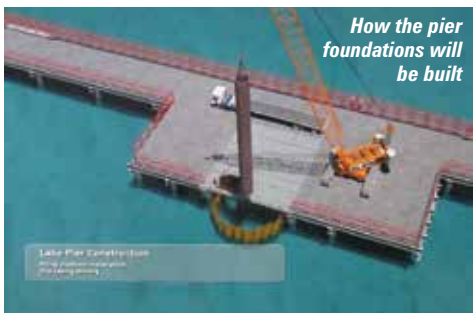
To help plan the work and to show interested parties such as local residents how the CVV will be built, good use has been made of the latest computer modelling techniques. Clever animations and digital images reveal the construction sequence and provide an indication of the type of equipment that will be used.

Construction animations were provided by Sigma Bear, working in close cooperation with Align's construction methods team. The CAD models came from a variety of authoring tools including Autodesk and Bentley. They were then integrated into a game engine called Unity to add the cranes and other equipment, along with the animations.

The digital illustrations accompanying this article show how the CVV will be built across the lakes. An important preliminary job is to construct a steel jetty across the water along the route of the viaduct to provide a temporary



A virtual crawler crane at work



How the pier foundations will be built

Tower cranes will be used for the lake piers

road for equipment and materials. The jetty will have 12 metre spans made up of four longitudinal beams carried by piers of driven tubular steel piles. It will also incorporate side extensions to create working areas either side of the sites of the viaduct piers.

Once the jetty is complete, construction of the main bridge piers will commence by installing a steel pile cofferdam around the base of each pier location. Excavators will then dig out the internal area to the base foundation level, with the excavated material removed by trucks travelling along the jetty. Vibratory bored piling rigs will then drive cylindrical steel castings into the lake bed which will be filled by tremie concreting using equipment on the jetty.

After the base of each pier has been completed, tower cranes will be used to help construct the 11 V shaped piers. A number of tower cranes will be progressively erected and dismantled along the line of the viaduct along the lakes. The BIM illustrations show a saddle jib tower crane but Align has also been evaluating the use of luffing jib tower cranes, because they will take up less space in the air above the jetty, thus aiding the use of other cranage in the vicinity. The land based piers on either side of the lakes will be constructed with crawler cranes due to their flexibility to move heavy loads further distances.

As piers are completed, the concrete deck sections above them will be progressively installed using a launching girder or crane (dubbed The Traveller). It will be 160 metres long, 18 metres wide and weigh 700 tonnes. It will be able to lift and install two deck segments weighing up to 133 tonnes simultaneously. The precast deck segments will be constructed in a temporary factory nearby before being assembled on the viaduct from north to south starting in the Spring of next year.

This specialised lifting machine is being supplied by Italian company Deal, which has provided equipment on prestigious projects around the world, including the East Tsing Yi Viaduct in Hong Kong, viaducts on the Messina to Palermo motorway in Italy, the Confederation Bridge in Canada and the Chung San Bridge in South Korea.

Work is now progressing with the jetty construction and the first piles. As the project progresses we plan to bring you reports highlighting the actual equipment in use.

Close-up of the launching girder lifting the first two segments

(All other photos courtesy of Align JV - unless mentioned)