Hungerford Footbridge

The Project

Bridging major rivers always presents a challenge. Using the SuperSTRESS frame analysis suite from Graitec UK; Norwest Holst Construction Ltd is building two multi-span cable stayed footbridges across the Thames in Central London. SuperSTRESS has provided a realistic modelling tool for the complex construction of the Hungerford Bridge Millennium Project.

Built in 1864, the nine-span iron Hungerford Bridge carries railway lines into Charing Cross Station. In early 1997, architects Lifschutz Davidson and consulting engineers WSP Group won a competition to design new footbridges on either side. Replacing an existing walkway, the project was funded by the City of Westminster, Railtrack and the Millennium Commission.

The £39.5 million construction contract was awarded jointly to Norwest Holst and Costain. Part of Vinci plc, Norwest Holst is a construction company employing around 2,000 people with a turnover of £370 million. The Civil Engineering Division of Norwest Holst has extensive experience of all forms of construction including the 200 metre span Flintshire Bridge, Ashopton & Ladybower Viaducts remedial works and the A12 Hackney Wick to M11 Link Road.

The Design Concept

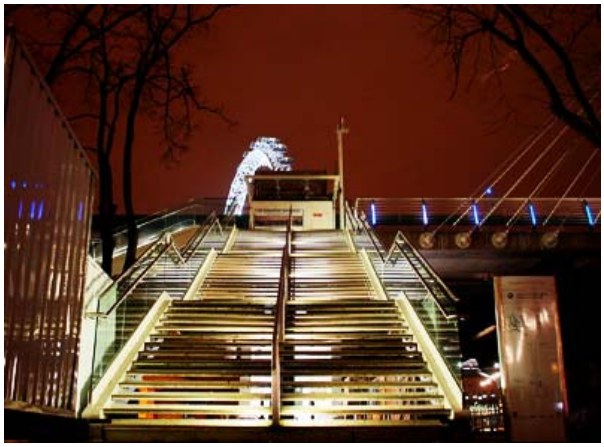
The new project meant building two 320 metre long by 4.7 metre wide multi-span cable stayed footbridges including 200 tonne precast concrete beams for ship impact protection. The bridge deck consists of reinforced concrete edge beams, structural slabs and ribs. The decks are suspended using cable stays from 25 metre high steel pylons constructed on piled foundations.

When presented with this challenge in late 1998, Norwest Holst decided to build the bridge deck and launch it from the bank in manageable 50 metre sections. As a change from the client's original idea of using smaller precast units, Marples says that larger sections were more economical to deploy from the temporary casting cell.

The Solution

"We had to design the temporary works for the incremental launching of the bridge across the river. We needed a frame analysis package to check stresses and strains in the permanent works and temporary works, which included the concrete bridge deck and the 300-tonne truss," explained Marples.

The work called for a reliable and easy-to-use software package to provide an accurate design in the minimum of time. Results were needed every five metres for each launch sequence and during critical phases such as the maximum cantilever or span. Marples says that SuperSTRESS had proved its worth on projects such as the Flintshire Bridge in terms of accuracy and productivity.



"We've used SuperSTRESS extensively for temporary works. This has included the complex trusses on the Hungerford Bridge Project where we've needed to understand the deflections and local bending effects," said Marples.

Using SuperSTRESS, a model was created for the bridge design in its final location and then broken down into individual construction elements. The project's overall complexity meant that many of SuperSTRESS' advanced features were essential for the analysis of one way acting supports, tension only members at deck hangers, compression only members at packs and releases in hangers/struts to prevent composite action. Each 50m long unit was theoretically launched in five metre increments before introducing the next elements. Extra modelling runs were done at critical locations with further output checking using Microsoft Excel.

"There was extensive modelling using SuperSTRESS before we got on site. It was powerful and easy-to-use with tabular or graphical output. We had good technical support from Integer when we needed it."

Project Results

Once the calculations were done, 11 coffer dams were built to enable shaft and bored pile construction for the pylon foundations. The bridge deck was constructed in 50 metre lengths using a fixed casting cell. A system of temporary piers, trestles and a launch truss then pushed completed sections outward. Once the cable stays were connected between pylons and deck, the deck was then lowered into place.