



Avonmouth Bridge



The Project

Implementing highway improvements for increased traffic intensities is a complex task. With the help of Graitec UK's SuperSTRESS and H-LOAD, Hyder Consulting recently won an Institution of Structural Engineers award for the strengthening of Avonmouth Bridge. During the five-year construction programme, Graitec UK's technology helped to maintain safety, plan work and increase productivity.



Opened in 1975, Avonmouth Bridge is a twin steel box girder structure carrying the heavily-used M5 motorway over the river Avon west of Bristol.

Before the £125 million strengthening project, the 1,400 metre long bridge carried six lanes of motorway plus cycle tracks and footways. The longest span is 174 metres.

The Concept

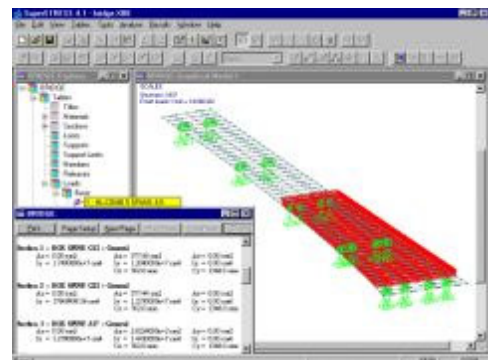
Faced with new BD37/88 traffic loading standards, the Highways Agency asked Hyder Consulting for advice. Employing 2,500 people, the firm provides infrastructure consultancy services to water, transportation, structures and telecommunications industries. Notable recent projects include the 335 metre Emirates Towers in Dubai.

According to Project Manager Craig Burrell, all options were carefully examined. Increasing traffic intensities called for a radical solution as any long-term lane closures during the strengthening works were unacceptable.

"We found the most economic option for increasing traffic capacity was to strengthen the bridge, taking the opportunity of adding two extra lanes at the same time," said Burrell.

The Solution

The bridge assessment and the strengthening design to BD37/88 bridge loading, was originally carried out using a non-graphical FORTRAN program. However, once the works started in 1996, the decision was taken to move to a user-friendly graphical input package. This allowed the contractors' preferred sequence of construction to be modelled to ensure bridge integrity whilst maintaining six lanes of traffic.



Graitec UK's PC-based graphical analysis solutions, SuperSTRESS and H-LOAD, proved an effective answer.

Over the last ten years, Hyder Consulting had used other Graitec UK products too. For this challenging project, engineers built a 3,945-member SuperSTRESS model, which closely

correlated with the original computations. By using H-LOAD, the highway loading pre-processor, traffic loadings were applied to BD37/88 standards. This helped plan difficult work sequences as Burrell explains. "The software is very versatile and easy to use. Although six lanes meant many different traffic arrangements, H-LOAD sorts it out for you. You can put a complex load on the bridge and fully analyse it in just one day."



Throughout the next five years, Graitec UK's technology helped maintain relationships between traffic, materials, equipment storage, temporary props and newly-fitted strengthening. By analysing proposed schedules, the engineers choreographed complex yet safe methods of working.

"Graitec UK's software helped us give the contractor guidelines and answer questions. We could quickly see the solutions and pinpoint problem areas."

To understand the issues, adds Burrell, different standard load cases were combined into an envelope and, in some instances, the results from SuperSTRESS were exported for further spreadsheet analysis. Everything revolved around pre-stressing; structural ties inside the main span boxes and temporary trestles. These techniques ensured

that as much of the existing dead load as possible was carried by the new steelwork, giving minimum extra weight for maximum effectiveness.

Perhaps the most remarkable achievement was to keep the traffic flowing. H-LOAD applied standard (HA) and heavy (HB) loads to the bridge model to balance traffic and construction weight for safety.

"H-LOAD and AutoLoader make it simple to obtain accurate and fast results for BD37/88 loading by quickly working out the worst loading positions for you," explains Burrell.