PRESS RELEASE

MD 214 BRIDGE OVER PATUXENT RIVER

2009 ACEC/MD Engineering Excellence Honor Award

This project, designed by ***Alvi Associates*** with Irfan A. Alvi PE as Project Manager, involved comprehensive rehabilitation for an existing historic steel truss bridge built in 1935. The bridge carries heavy traffic with about 15,000 vehicles per day (including many trucks), and spans 200 feet over the Patuxent River. The rehabilitation included replacement of the bridge deck; repairing and replacing many deteriorated steel members and connections; concrete repairs; and cleaning and painting of the entire bridge. The rehabilitation involved many challenges and resulted in a wide variety of benefits, as described below.

Complexity

We juggled an unusually large number of issues which made the project quite complex:

- To precisely map all deterioration, we completed a thorough hands-on bridge inspection using specialized access equipment, including a barge-mounted scaffold positioned in the river.
- We performed a comprehensive structural analysis to determine the load capacity of the bridge considering various rehabilitation scenarios. This analysis exposed "weak links" needing special attention, and thus enabled efficiently increasing the bridge load capacity by 62%.
- The bridge was originally designed as a non-redundant structure, which means that failure of any of its many primary members would collapse the entire bridge. Several steel members to be repaired and replaced were of this failure-critical type, resulting in the need to take great care in the design.
- Like the I-35W truss bridge which recently collapsed in Minnesota, the primary members of this bridge are connected with failure-critical gusset plates. Making matters worse, major build-up of rust between the gusset plates had pried the plates apart and strained the connecting rivets. Replacing these gusset plates was mandatory and required spelling out a very specific step-by-step construction sequence to make sure there were zero mistakes in the field.
- After the construction contract had already been awarded, a large vehicle hit one of the critical truss members and badly mangled it. Fortunately, the bridge didn't collapse, but we had to urgently design a replacement member, working in close partnership with the contractor. Again, replacing this failure-critical member without causing collapse of the bridge required spelling out a very specific construction sequence.

Original or Innovative Application of New or Existing Techniques

A key innovative aspect of this project was in the development of deck replacement alternatives, driven by the need to minimize both cost and traffic impacts. One alternative had innovative precast concrete deck panels to be rapidly installed as modular units, and then longitudinally post-tensioned to tie them

into an integrated system. Another innovative alternative was an extra-lightweight fiber-reinforced polymer (FRP) deck developed under the aegis of the Federal Highway Administration's *Innovative Bridge Research and Construction* program.

The method used to address the truss member damaged by vehicle impact was also innovative. Typically, the damaged portion of the member would be strengthened or replaced, keeping the overall member in place. We instead designed a complete replacement of the member, using a parallel temporary member capable of carrying the full load imposed by the truss. Although a complex undertaking, the worthwhile result was a complete "good as new" solution to the problem.

Social, Economic, and Sustainable Design Considerations

This project provided several key social and economic benefits:

- A substantial detour of 11 miles was unavoidable, so it was imperative to re-open the bridge before school started. Moreover, several businesses were located next the bridge. We therefore developed the design to keep the detour duration down to only *18 weeks*, thus greatly reducing hardship and economic impact on the local communities and businesses.
- In designing the replacement of the truss member damaged by vehicle impact, we coordinated with the contractor to use materials he already had on hand, thus reducing time and cost.
- Having been designed to older standards, the bridge had too little vertical clearance and its overhead members had been hit by taller vehicles. We therefore designed an extra-thin replacement deck which – though adding to the project complexity – increased both the bridge vertical clearance and load capacity, thus substantially improving the safety of the bridge.

Sustainability was achieved through attention and sensitivity to several environmental concerns:

- Impacts were avoided to adjacent Park properties, Nontidal Wetlands of Special State Concern, and potential endangered plant species and blue heron colonies.
- The contract included containment provisions to ensure that existing lead-based paint would not contaminate the river and site during cleaning and painting operations.
- The bridge was eligible for the National Register of Historic Places. Its historic integrity was preserved by coordinating with the Maryland Historic Trust to develop special curb and railing details which meet modern safety requirements while preserving the original bridge aesthetic.

Exceeding Client/Owner Needs

Successful completion of this complex project required close coordination among many parties, and we took the initiative to play an active role in that effort. Moreover, several key project elements were not in the original project scope and needed urgent response, and we fully met this need every time. All of these efforts led to a project which went smoothly during both design and construction, with associated cost savings and an end product which will serve the owner and public well for future generations.

Future Value to the Engineering Profession

The unfortunate collapse of the I-35W bridge has focused valuable attention on the needs and issues of historic older bridges, especially non-redundant bridges such as trusses. While rehabilitating such bridges can involve a host of challenges, this MD 214 project demonstrates that these challenges can be met very effectively, and we hope that it will serve as a model for similar future projects in Maryland and beyond.