All Aboard!!

New Life for a Ferry Ramp

By Benny K. Louie, P.E.

The Oxford Bellevue Ferry is believed to be the nation's oldest privately operated ferry service. The ferry is located in the Eastern Shore portion of the state of Maryland and crosses the Tred Avon River between Oxford and Bellevue, which are quaint, friendly small towns nestled along the coastline.

On November 20, 1683, Talbot County authorized the establishment of a ferry service for the use of "horses and men". Richard Royston was paid 2,500 lbs of tobacco per year, which translates to approximately $25, to operate the ferry. Today, Tom and Judy Bixler, who purchased the service in 2002, operate the ferry. The ferry service consists of a boat capable of carrying nine vehicles, bikes and motorcycles. The trip from Oxford to Bellevue is ¾ of a mile and takes 7 to10 minutes.

In 2004, the Maryland State Highway Administration (MDSHA) slated the ferry ramp and approach roadway on the Oxford side for rehabilitation (*Figure 1)*. MDSHA called upon the engineering consulting firm of Parsons Brinckerhoff Quade & Douglas, Inc. to assist in the effort. Construction took place during the months of November thru March of 2004-2005 and 2005-2006, when the ferry service was closed for the season. A ferry ramp may be considered a movable bridge due to the machinery used to adjust the level of one end of the ramp in order to seat it on an incoming ferryboat or unseat it from an outgoing ferryboat.

Figure 1: Ramp and approach after reconstruction (May 2006). Inset - Ramp and approach before reconstruction (October 2004)

Existing Condition

The 22-foot long by 15-foot wide ferry ramp, composed of steel, exhibited signs of heavy corrosion. The ferry ramp was fairly low to the water, and during very high tides it would be in the splash zone. Inspection of the mechanical and electrical components of the hoist system revealed that they required replacement.

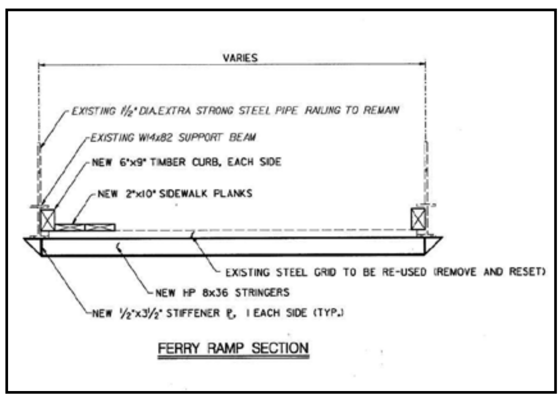

Figure 2b: As-Built Steel Ramp Section

The existing approach roadway pavement was in good condition, but the back-to-back timber sheet piling was visibly worn and needed rehabilitation. A scuba diver investigated the extent of structural deterioration in the water. The end wall of the approach roadway, which consisted of sheet piling with tiebacks, had experienced moderate movement. The timber bumping dolphins and several other timber dolphins, which formed the channel into the Oxford approach, required replacement due to the deteriorated condition of the timber.

Although the ramp and approach had been previously rehabilitated many times before, it was apparent that the next major storm event could cause serious repercussions for the ferry, the ferry ramp and the towns it served. The project team was unable to locate drawings of the previous rehabilitations. However, calculations and drawings were available for the ferry ramp at Bellevue, which was rehabilitated in 2003 and was similar to the ferry ramp at Oxford. In addition, a 1985 survey of the Oxford ferry ramp and approach turned up halfway through the design process. Unfortunately, there was no information available concerning the elevation and range of low and high tides.

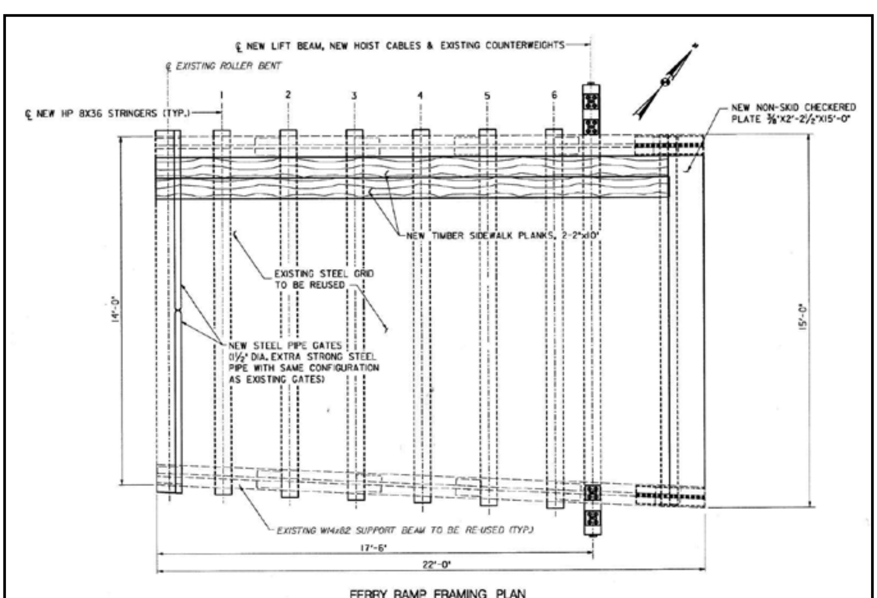

Figure 2a: As-Built Steel Ramp Framing Plan

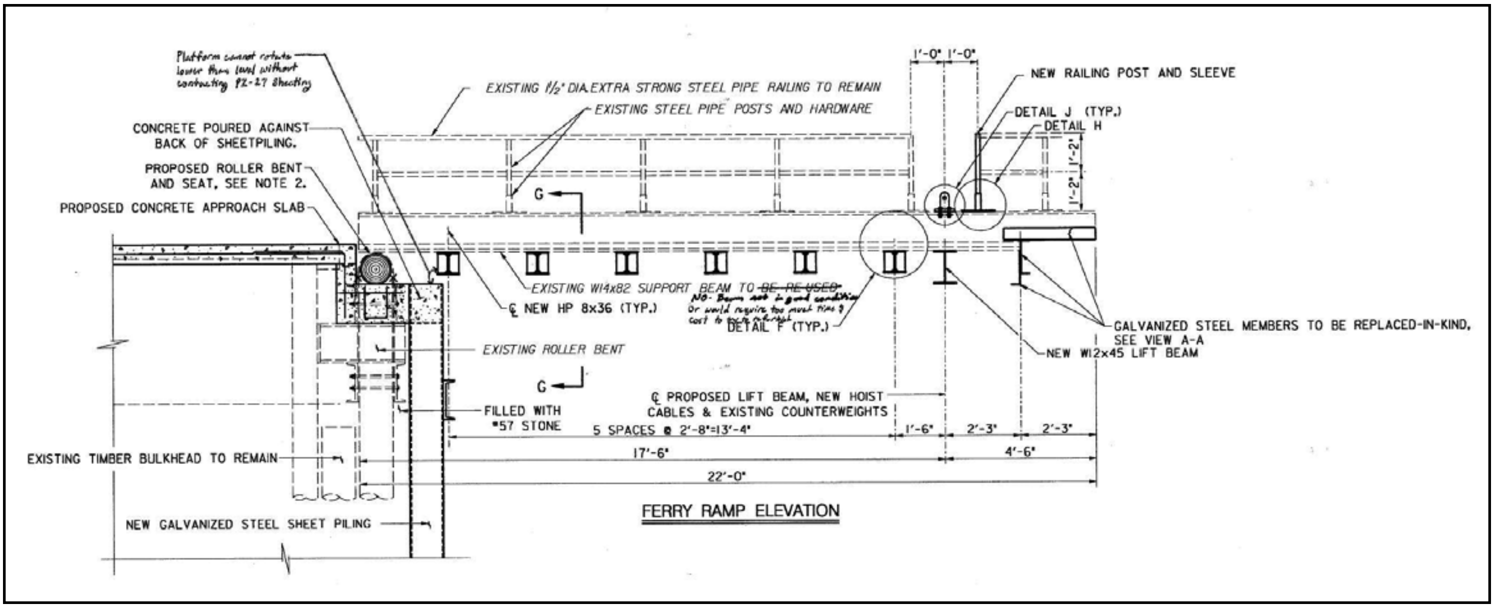

Figure 2c: As-Built Steel Ramp Elevation

Due to the limited budget of the project, the project team used the 1985 survey in conjunction with current field measurements, and tidal benchmarks calculated using regional information from the National Oceanic and Atmospheric Administration.

Ferry Ramp

The ferry ramp is a movable steel superstructure composed of W14 through beams, HP8 stringers, a W12 lift beam and miscellaneous steel members. The rehabilitation project replaced all of these members in-kind and re-galvanized and re-used the existing steel grid deck that they supported. See *Figures 2a, 2b* and *2c* for the as-built framing plan, section, and elevation. The project also replaced a 9-inch-diameter timber roller at the pivot end of the steel ramp and 2-inch x 10-inch timber planks on top of the grid deck, while reusing existing hand railing on top of the W14 through beams. All structural steel on the ramp was galvanized to resist the corrosive environment to which it would be exposed.

Hoist System

The project replaced the electrical service and mechanical equipment for the ramp hoist systems with new components in order to better serve the ferry boat (*Figures 3 and 4*), including counterweight sheave supports, electric chain hoists, manual chain hoists, wire rope and shackles. The new configuration utilizes a safer, more redundant system with two synchronized chain hoists, whereas previously a single electric chain hoist was in service. The wire rope and sheaves, which previously ran under the ferry ramp, are now connected at the top of the W14 through beams, making them more accessible for inspection and maintenance and less susceptible to the corroding effects of being in the splash zone.

The project replaced the existing timber bracing on the hoist towers with galvanized steel members. The only components reused in the hoist towers were the timber piles of the towers and the steel counterweight boxes, which received a new coat of galvanizing.

Approach Roadway

Timber sheet piling on the north, south and east sides supported the existing approach roadway. The excavation of the existing roadway revealed that the existing tie rods behind the timber sheet piling were in relatively good condition, considering the constant exposure to local tidal effects. The east side, which was the ferry approach side, had a moderate 5-foot to 7-foot-deep scour hole in front of the sheet-

Figure 3: New components on north hoist tower

Figure 4: New components on south hoist tower

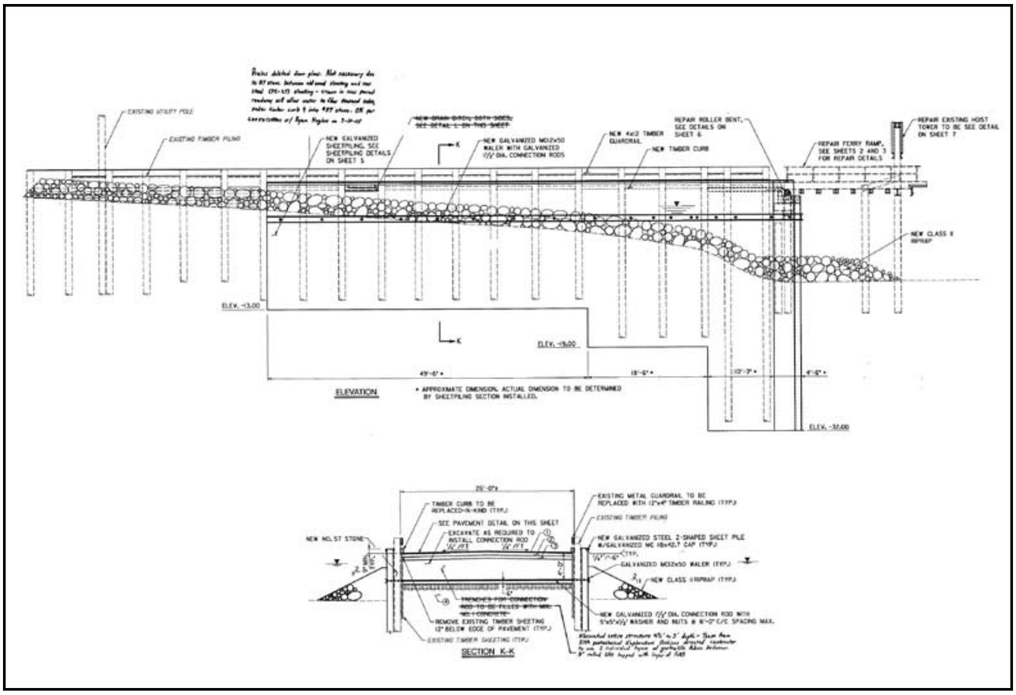

Figure 5: As-Built Elevation and Section of Approach Ramp

ing and directly beneath the steel ramp (*Figure 5*). The scour was due to the wake caused by the propeller of the ferryboat as it backed into the steel ramp to unload passengers and automobiles. The scour hole was the main reason for the observed movement in the pile bent supporting the timber roller.

The project team performed a geotechnical analysis, considering the scour before deciding to install steel sheet piling with back-to-back tiebacks in front of the timber sheet piling (*Figure 6*). The back-to-back tiebacks consisted of 1½-inch-diameter rods and turnbuckles connected to MC12x50 walers. In addition, a team from the MDSHA Geotechnical Explorations Divisions provided direction on how to backfill the approach roadway. Large riprap placed in front of the steel sheet piling will prevent future scour or erosion.

Changes to the sheet piling were necessary during construction. For example, a 6-inch x 6-inch corner of the sheet piling at the top of the east face had to be clipped to allow the ferry ramp to be properly lowered during very low tide conditions. This field adjustment may have been foreseen if additional research and a survey of the local tidal conditions had been performed. In addition, the tie rod configuration at the east face had to be revised due to the existing pan sheeting. As-built drawings of the existing configuration of the east face could not be located.

Conclusions

On such a project, it is of great importance to obtain as much preliminary information as possible. On this project, a more recent survey of the approach roadway and more exact information about the limits of high and low tides would have reduced some of the design time and construction problems encountered. Preliminary research and findings greatly reduce the time spent in design and may resolve some of the construction difficulties that could arise. Hindsight is always 20/20; on this project, a slight increase in the budget spent in preliminary research would have probably saved approximately three to four times that amount when re-evaluating details and making last-minute changes during construction. The lessons learned in the design and construction of this ferry ramp and approach roadway can be applied to practically any project.▪

Figure 6 : Back-to-back tiebacks for steel sheet piling on approach roadway

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