



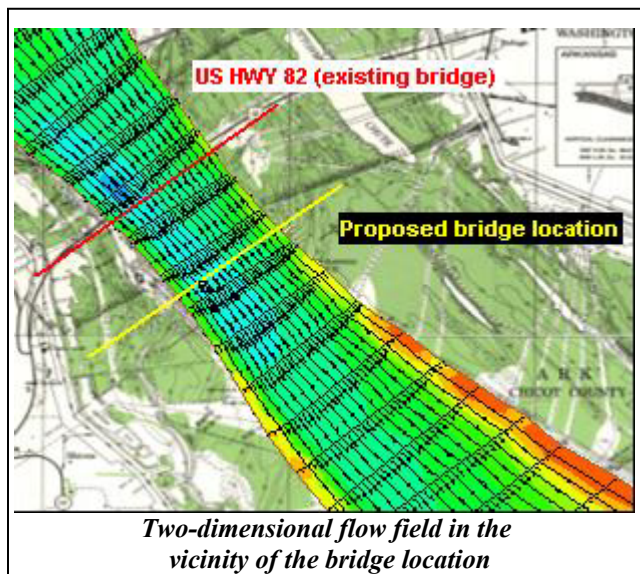
Greenville Bridge Construction Plan Hydrodynamic and Scour Potential Analysis

The Mississippi Department of Transportation (MDOT) has constructed a new bridge (Greenville Bridge) across the Mississippi River to provide a four-lane crossing for relocated U.S. Highway 82. The project is located in Chicot County, Arkansas and Washington County, Mississippi, at Mississippi River Mile 530.8 near Greenville, Mississippi.

Massman Construction Co/Traylor Bros., Inc. (MT), a joint venture, was contracted to build two large piers (piers 37 and 38) in the river. The piers were constructed utilizing floating caisson and open caisson construction methods. To create a favorable working environment in the river by minimizing the effects of the river currents and floating drift, a sheet pile breakwater (deflector) was installed immediately upstream of each floating caisson. Each 100 feet wide breakwater was designed to resist river flows of up to 10 feet per second, and to limit drift buildup that might occur. The chief purpose of the breakwater was to redirect the river flow around the floating caisson structure to minimize drag that might otherwise be imposed upon it. However, the breakwater raised some concerns such as eddying, drag on the downstream surface of the caisson, and river bottom scour during the critical caisson sinking stage.

WEST conducted a multi-dimensional hydrodynamic and scour potential study to address in detail the aforementioned concerns, and to provide design guidance for the alternative scour protection methods (a rock riprap blanket and/or cabled concrete blocks). Comprehensive modeling techniques and theoretical concepts were used to analyze hydrodynamic aspects of the proposed caisson construction process. The one-dimensional HEC-RAS hydraulic model was utilized to estimate the flow distribution between the main channel and the overbanks. The two-dimensional finite-element RMA2 model of the Mississippi River main channel was used to determine the free-stream local velocities upstream of each pier. For the detailed flow investigation around the sheetpile breakwater and below the caisson, a two-dimensional finite-difference numerical model was developed based on inviscid, incompressible (potential) flow theory.

Within a very limited time frame and budget, the innovative analytical-numerical approach enabled the estimation of the maximum velocity around/below the caisson and the hydrodynamic forces on the sinking guide structure. Scour potential on the river bottom around the sheetpile breakwater and below the caisson (as it approaches the final touchdown during construction) was also evaluated, based on the predicted hydrodynamic parameters. A rock riprap blanket design specification was provided, including scour protection at various river stages, adequate vertical and horizontal coverage, and the appropriate stone gradation. As an alternative to the rock riprap blanket, a standard U.S. Army Corps of Engineers articulated mattress consisting of cabled concrete blocks was also considered. The stability analysis of concrete blocks to resist the hydrodynamic forces provided an optimized design specification and resulted in significant project cost reduction.



Two-dimensional flow field in the vicinity of the bridge location

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