

Charleroi Lower Floating Guard Wall

Charleroi Lock, Pennsylvania

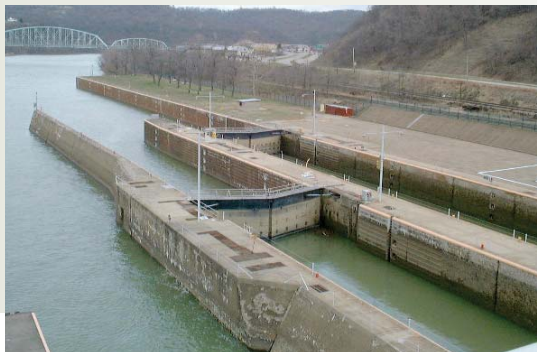
Owner: USACE, Pittsburgh District

Description: INCA Engineers, Inc., A Tetra Tech Company (INCA) worked directly with the Pittsburgh District and the contractor to optimize the design of a new floating guard wall for a new lock at Charleroi. The design for this wall is based on experiences gained from construction of the 4,000 foot of approach wall for the Olmsted Locks and Dam. INCA developed and led a brainstorming session with representatives from three Corps districts, the Olmsted Resident office, and Massman Construction, contractor. The combined expertise of this group led to improvements in design that are anticipated to provide a lower cost and a better performing structure. Some of these improvements included changes to rebar details to reduce installation time, changes in the concrete mix design to improve placement, revised ladder design, elimination of an intermediate joint to improve flotation and reduce cost, and simplification of wall armor embedments.

Unique hydraulic requirements at the site required that the pontoon be supported on landing piles if the lower pool is lost at Charleroi. This presented special design requirements to account for the significant hogging and sagging moments induced in the pontoon by the differential temperatures between the air and water as the pontoon sits on the bottom.

INCA was responsible for analysis of hydrodynamic loads on the floating guard wall and underflow cutoff wall. INCA developed a three-dimensional CFD model to simulate the forces on a proposed sheet pile wall beneath the floating guard wall, simulating the mass flow rate from the propellers of a design tugboat, having engines capable of providing 4,000 horsepower and generating 100,000 pounds of thrust. INCA calculated the forces on the cutoff wall within the model for different design conditions: low water level, high water level, and landward river cross currents. INCA provided design parameters for the design of the cutoff wall.

The lower guard wall will be composed of post-tensioned concrete pontoons with intermediate transverse bulkheads, fabricated at a dry dock facility, and floated to the project site. A drilled shaft supported nose pier will be constructed at the downstream end of the wall, and the pontoon will be installed between the nose pier and the new river wall. The nose pier and new river wall will act as both guide and support structures. The nose pier will protect the pontoons from longitudinal barge impacts. The pontoons are locked in position with removable closure blocks and locking keys so that they can be conveniently towed away for maintenance purposes. The entire wall is designed to be constructed in-the-wet (without a cofferdam).



Special Features:

- ▶ In-the-wet construction
- ▶ In-the-wet drilled pier design
- ▶ Prestressed, post-tensioned concrete design
- ▶ Floating concrete structure design
- ▶ Vessel impact and mooring loading
- ▶ Hydraulic CFD modeling; analysis of prop wash loading
- ▶ Hydrodynamic analysis
- ▶ Frequency and stability calculations
- ▶ Finite element analysis of concrete structures
- ▶ Contractor mooring and anchorage to facilitate construction
- ▶ Constructability analysis of graving facilities to determine the feasibility of the proposed design
- ▶ Seismic analysis
- ▶ Electrical and lighting analysis and design
- ▶ Motorized cable reels
- ▶ Fiber-optics
- ▶ Development of a construction system that allows the facility to remain operational throughout construction
- ▶ Engineering services during construction