HEAVY MOVABLE STRUCTURES, INC.

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"Irondequoit Bay Outlet Bridge - Not Just Another Pretty Fascia"

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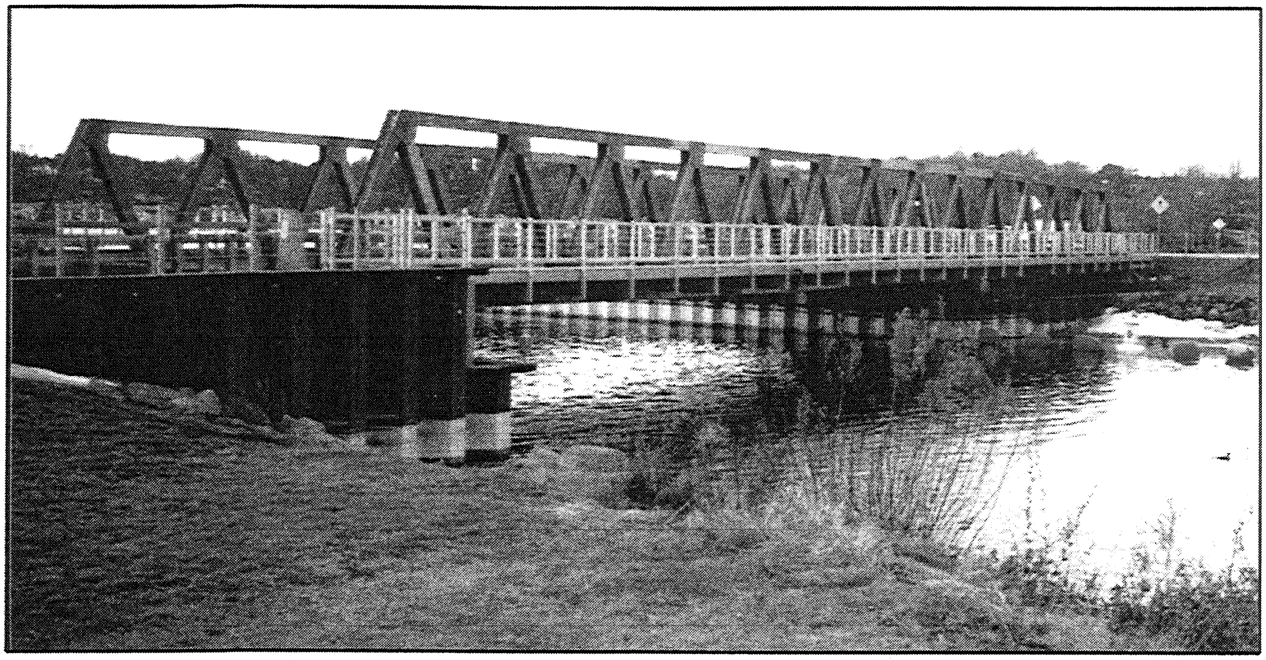

The Irondequoit Bay Outlet Bridge – Not Just Another Pretty Fascia!

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Abstract

In 1985, the United States Army Corps of Engineers (USCOE) removed a deteriorating timber bridge that spanned the Irondequoit Bay Outlet to Lake Ontario near Rochester, New York, in order to open the bay to lake navigation. For 10 years, the County worked to have the USCOE fulfill its obligation to span the outlet with a new bridge which would promote boating and once again permit travel across the north end of the bay. After the loss of federal funding in 1994, a study was commissioned to determine the feasibility of replacing the crossing using only 20% of the funds previously committed.

The solution developed was a "seasonal" swing bridge; one that is left in place for vehicular traffic during the non-boating season and can be closed to traffic and moved aside to open the channel to boats during the rest of the year. Operated twice annually, the bridge does not require full automatic operating machinery or a full time operating staff. The structure is also much lighter than a traditional moveable bridge because there was no need to severely limit deflection during bridge operations.

Because the seasonal bridge does not obstruct the navigation channel during the boating season, there was no Coast Guard requirement for under bridge clearance. This minimized the approach reconstruction and allowed much simpler substructures. Cost savings in the operating machinery, construction of approaches and substructures were substantial when compared to a standard moveable bridge, allowing the seasonal span to be constructed on a $4 million budget.

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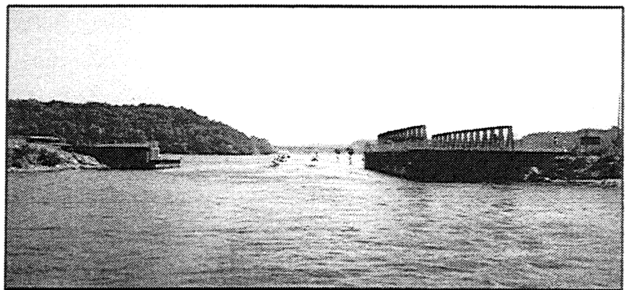
Introduction



View of the open bridge toward Irondequoit Bay

The Irondequoit Bay Outlet Bridge (IBOB) was built over the 100-foot-wide Irondequoit Bay outlet channel that flows into Lake Ontario. This seasonal bridge replaces a low level timber structure that was removed in 1985 as part of an Army Corps of Engineers project that opened Irondequoit Bay to marine traffic from Lake Ontario and created a state park at the bay outlet. In 1986, Monroe County authorized a study that concluded that there was a need for a replacement crossing. Monroe County obtained project approval from the New York State DOT to evaluate the various alignment and bridge alternatives, including a fixed, moveable, and seasonal bridge, as well as a tunnel.

Project Background

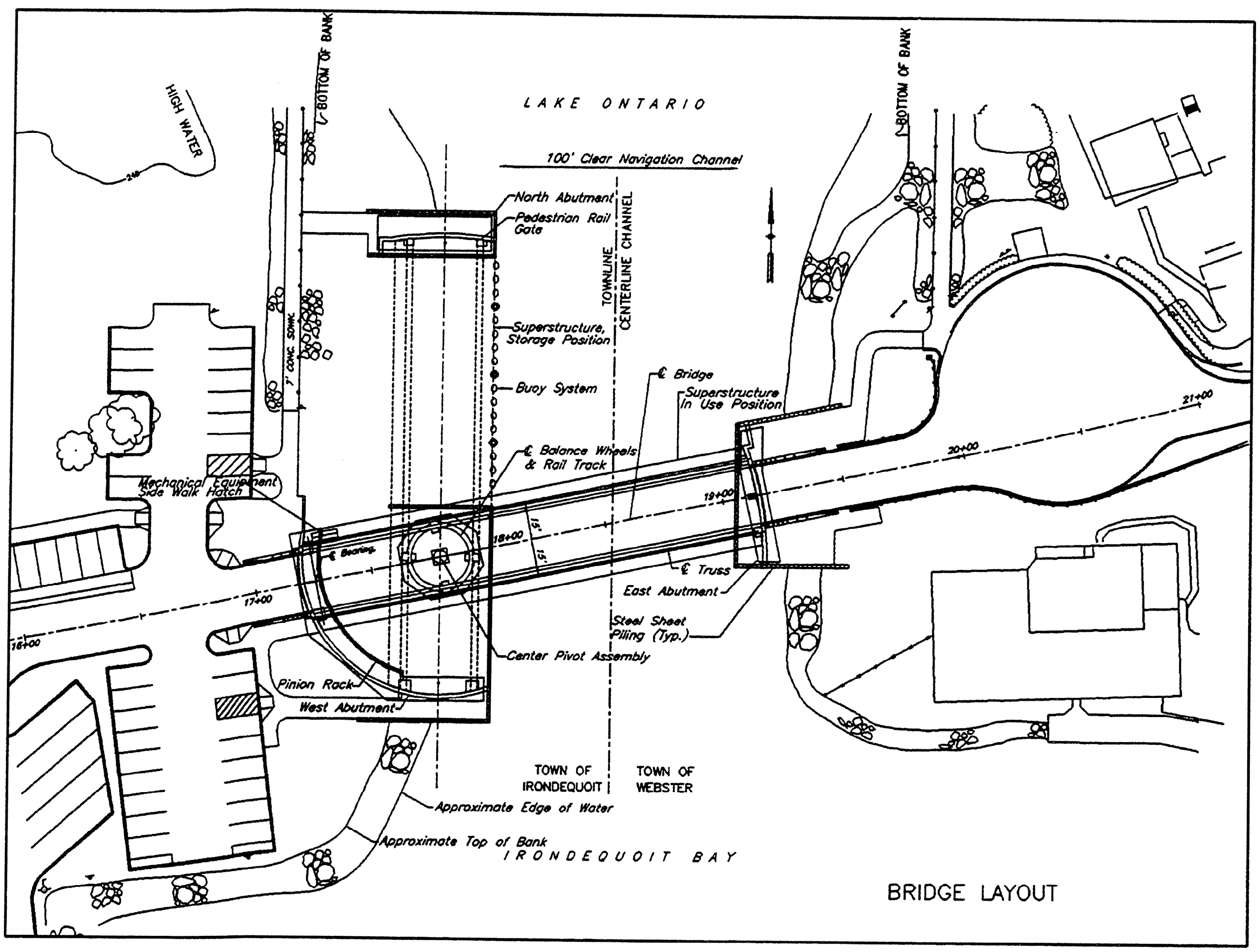
After 1985, when the original bridge was removed, federal, state, and local officials planned to build a permanent replacement. But when the federal funds were diverted for the 1994 Los Angeles earthquake relief, the outlook for a permanent bridge became bleak. Although it was determined that a moveable bridge was the best alternative to span the channel and met all project needs, it could not be constructed with the remaining available funds. The consultant determined that a low-level removable, or "seasonal", bridge spanning the channel four months of the year was the only viable alternative that could be constructed within the County's budget. The swing bridge plans were completed on a four month accelerated schedule during the early spring of 1997, and the project was constructed between January and December 1998 following a lengthy bid process.

Design Details

The final design parameters for the project were mainly governed by the requirements of the United States Coast Guard. These requirements were: 1) minimum channel width, 100 ft.; 2) the minimum clearance over mean high water, 4 ft.; and, the most challenging requirement, 3) the structure must be capable of being moved out of the channel within 12 hour's notice.

Cost savings for the project were realized with the reduction in approach work by changing the under-bridge clearance from 26 ft. to 4 ft. over Design High Water. The resulting profile eliminated all right-of-way takings and enabled expansion of the adjacent boat launch, and construction of rest room and parking facilities in the State's adjacent marine park. Bridge operations were not automated to minimize the cost of machinery, but this created a more labor-intensive effort to open and close the bridge.

Several methods were considered for moving the bridge. In order to meet the 12-hour bridge removal requirement, the design evolved from a single-span structure to be lifted from the foundations and moved on a barge, to the final design that employed a counter weighted swing span on a pivot and roller system. The final design is a two-span swing structure with a main span of 132 ½ feet and a counter-weighted back span of 53 feet, with the pivot on the west bank of the channel. Foundations consisted of concrete abutments and a pivot pier on concrete-filled displacement pipe piles driven to 90 ft. The abutments and pivot pier were constructed behind anchored steel sheet piling placed along the channel. A storage abutment was also constructed north of the west abutment for use when the channel is open to marine traffic.



BRIDGE LAYOUT

The superstructure is a galvanized pony truss with bolted connections. It carries two 12-ft. travel lanes and two 5-ft. sidewalks outside of the trusses. The use of full galvanization results in a structure that will be virtually maintenance free over its 50-year design life. The use of bolted connections eliminates the fatigue concerns common with welded truss bridge systems and allows full galvanization of the truss. The low depth-to-span ratio of the truss further decreased the amount of approach fill required, which minimized the disturbance to adjacent parklands. In addition, the truss has a high stiffness-to-weight ratio that reduced substructure costs, counterweight requirements, and the cantilever deflection of the main span during the pivot operation.

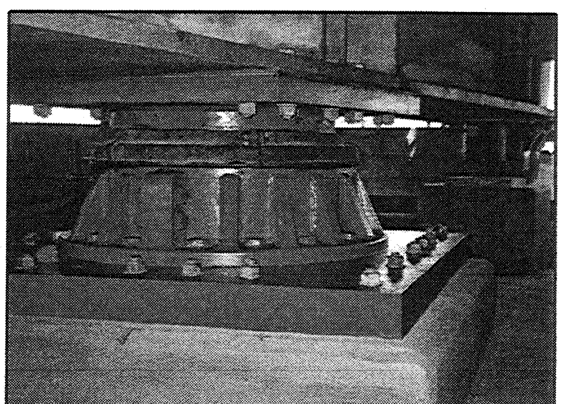
A drawback in the use of the truss superstructure is a considerable increase in complexity both in design and construction. The consultant's preliminary design included an evaluation of the truss to establish an initial working line geometry that would allow truss chords to be fabricated from standard rolled shapes. The preliminary design also verified that counterweight requirements and cantilever deflections would not be excessive.

Although a pony truss superstructure is stiffer than a comparable multi-girder system, it is more flexible than a typical through-truss swing bridge. Camber calculations had to account for this additional flexibility to assure that the pre-load introduced by lifting the ends of the structure exceeded the minimum required by temperature and live load uplift. In addition, it was necessary to adjust truss geometry in the field prior to torquing of splices to assure the truss geometry would match the geometry required for proper operations. Field measured truss stiffness was compared against computer models and used to refine the jacking procedure developed to remove and install bearings.

The final design included a three dimensional finite element analysis for the truss and floor system, an analysis of camber and deflections during erection and bridge operations, and full design and detailing of all connections. Thirteen load combinations formed from fourteen load conditions were used for design of the trusses, in accordance with the AASHTO Standard Specifications for Moveable Highway Bridges. Truss detailing accommodated cross slope of the floor beams, attachment of mechanical equipment and cantilevered sidewalks outboard of both trusses.

Operations

Traditional swing bridge machinery was adapted to accommodate the seasonal nature of the structure, providing a simple but effective operating system. A traditional pivot bearing and balance wheel ring were used to move the balanced structure.

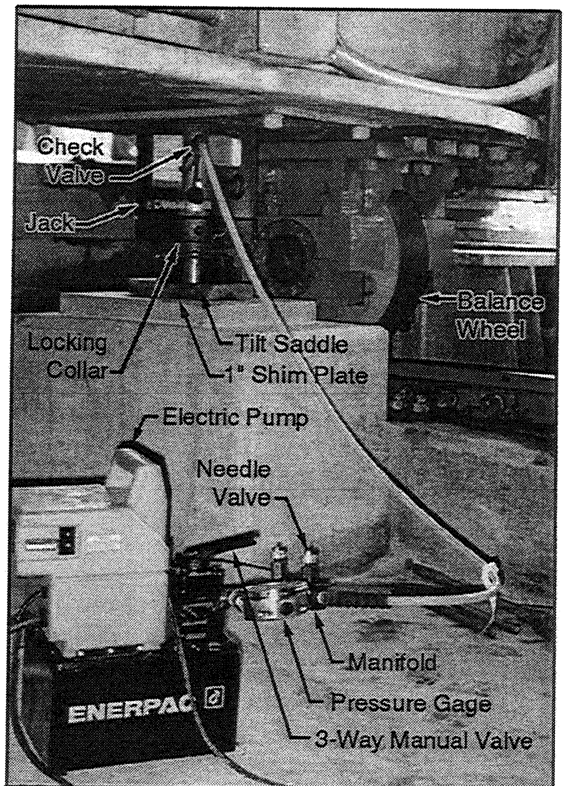


Center Pivot Bearing

The operating equipment consists of a single pinion mounted at the end of the back span beneath the outboard sidewalk and a rack mounted to the abutment footing. It was necessary to move the drive pinion as far from the pivot as possible to reduce the drive loads, since the single pinion acts eccentrically. One side affect was that this increased thermal movements at the pinion and complicated the assembly and alignment of the rack.

A portable electric drill drives the pinion through a pair of reducing gears. Standard portable hydraulic jacks are used to lift the structure in order to remove bearings at each end of the bridge, and two hydraulic jacks mounted to the underside of the pivot beam are used to lift the truss in order to remove the truss bearings at the pivot point.

The lifting operation is performed manually. The truss bearings are removed in the first lifting operation and the pivot beam is lowered onto the center pivot bearing. Then the end span is lifted, the end bearings are removed, and the truss is lowered to create a cantilever. In the final lifting operation, the bearings on the back span are removed and the truss is left supported on the center pivot bearing and the ring rollers. Total deflection at the end of each span is approximately 9 in. The bridge is then rotated using the drive pinion and drill system. The operation is reversed to place the bridge on the bearings in the stored position.



Jack Operation at Pivot Beam

Although the bridge can be removed in less than 3 hours to accommodate emergency marine traffic, the seasonal removal or installation of the structure takes a full day, including reconfiguration of barriers and signs in the approach roadways and securing railings.

Construction

To accommodate the accelerated design and construction schedule, the consultant prepared several bid packages, refining each one to add value to the design. The project was originally scheduled for a December 1997 completion, requiring separate bid packages for steel sheet piling, structural steel, and mechanical equipment to allow for long lead times necessary for fabrication. Budget concerns delayed the project to a December 1998 completion, allowing a single bid package. A subsequent bid package, including several cost/value alternatives and value engineering of some bridge components, was prepared after the initial bid costs exceeded the County's budget. The final bid package separated the park construction from the bridge work due to permit concerns, resulting in two separate contracts with different General Contractors.

Coordination between the consultants and contractors during construction was critical to maintaining the aggressive schedule. The consultant provided both inspection and technical support during construction to keep the project on schedule. This included actively assisting the contractor to obtain approval of shop drawings and detail and material substitutions. The Consultant also evaluated erection and fit-up procedures including balancing, leveling, connection, positioning, and adjustment of mechanical equipment.

Conclusion

The Irondequoit Bay Outlet Bridge was a $4.8 million project that included $4 million in bridge construction and $800 thousand in park improvements. The seasonal bridge span provides two 11-ft. travel lanes and 5-ft. sidewalks on both sides of the bridge during the winter months, and utilizes one of the sidewalks as a promenade along the outlet in the summer months. Although it was designed to have a minimum 4-foot clearance, very few boats use the channel when the bridge is open to traffic.

This seasonal bridge provides an alternative traffic choice to the NYS Rt. 104 Irondequoit Bay Bridge, located two miles to the south, by eliminating a seven-mile detour, and maintains greater recreational opportunities and development potential in the Bay. It also provides an additional emergency evacuation route for the nearby Ginna Nuclear Power Plant, a connection for mutual aid between the towns of Webster and Irondequoit, and a low-level bay crossing for times when winter weather affects the road surface on the Bay Bridge.

The bridge has connected Webster and Irondequoit consumers for the first time since 1985, and since the opening of the bridge, businesses on both the Irondequoit and Webster sides of the outlet have experienced anywhere from a 20% to 100% increase. The bridge was crossed by an estimated 5600 cars a day in its first four months of use.

A meeting of the minds between County engineers and the consultant resulted in an innovative design solution to meet the County's needs. By incorporating elements from a traditional swing bridge design, the final structure provided the County a simple, effective operating system that can be managed by County forces. At the same time, the project was delivered on both a tight budget and an aggressive schedule. In addition, this was a high profile project that was progressed under the careful watch of many diverse community groups. Through careful design and respect for the public, this project elevated the quality of life for both the local residents and the community as a whole. The Irondequoit Bay Outlet Bridge was a great addition to Monroe County. This unique bridge, the only one of its kind in New York State, and the adjacent park development represents a unique compromise between boating and motoring interests, and enhances the development and use of the Bay and boosts area businesses throughout year.