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MOVABLE BRIDGES AFFILIATE

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WORKSHOP NOTES

Session (6-10)
"A Four Lane Lift Bridge",Ulo S. Pessa,
Howard Needles Tammen & Bergendoff, NY.

A FOUR LANE LIFT BRIDGE

by

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General

The new lift bridge is located in the Borough of Point Peasant, New Jersey and crosses a portion of the Intracoastal Waterway known as the Point Pleasant Canal. The lift bridge replaced a smaller double-leaf bascule which was demolished after completion of the new bridge.

The Point Pleasant Canal carries heavy recreational marine traffic during the summer boating season and the minimal vertical clearance of the existing bascule span required openings for all but the smallest vessels, creating vehicular traffic backups on Rt 88. Mariners also experienced difficulties in navigating the small draw of the bascule which had its piers located in the middle of the fast flowing canal.

As a result of these shortcomings the existing bascule was declared an unreasonable obstruction to navigation by the United States Coast Guard and its owner, the New Jersey Department of Transportation, contracted with HNTB to design a lift bridge to replace it.

The parameters established for the lift bridge included a minimum vertical clearance of 30 feet over mean high water when the span is in the closed position, and a minimum vertical clearance of 65 feet with the span raised.

The new structure was to carry four lanes of vehicular traffic on a roadway width of 50 feet from curb to curb as well as two 6-foot sidewalks and parapets. This resulted in an overall width of the lift span deck of 64 feet from fascia to fascia.

Since It was necessary to maintain vehicular traffic on Route 88 at all times, the existing bascule had to remain in place until the new construction was completed. Consequently, the lift bridge was built on new alignment adjacent to the existing bridge, crossing the canal at a skew of about eleven degrees.

A primary design stipulation was the requirement that the piers of the new bridge be located behind the existing steel sheetpile bulkheads which line both sides of the Point Pleasant Canal. The normal width of the canal is approximately 135 feet. However, the skewed crossing and the need to locate the cofferdams for the new piers a reasonable distance behind the canal bulkheads resulted in a span length of the lift span of nearly 182 feet. The horizontal clearance for navigation provided thereby extends over the full width of the canal.

With these parameters established, attention could be focused on the design details of a lift bridge to meet them.

Lift Span Superstructure

Various framing systems and deck types for the lift span superstructure were initially considered. These included open steel grating decks which offered the advantage of light weight but were eventually rejected for poor riding surface and the potential for motorists to loose control of their vehicles, particularly under icy conditions. The superior safety and riding quality of a concrete deck was deemed very important on this project and the final selection was for a lightweight concrete deck with a latex modified concrete overlay.

Available structural depth for the lift span was limited by the required 30-foot vertical clearance in the closed position and the need to meet the grades of local streets in the immediate vicinity of the bridge on both approaches. As an answer to this problem, the structural system for the lift span consists of a composite design incorporating the concrete deck and relatively closely spaced steel girders spanning longitudinally between transverse lifting girders at both piers.

The concrete utilized on the lift span is "sand-lightweight" concrete weighing 115 pounds per cubic foot and having a minimum 28-day strength of 4,000 pounds per square inch. Lift span girders and lifting girders are of welded construction and fabricated from high strength steel conforming to ASTM A588. Lateral bracing in the plane of the bottom flange of the stringers is provided in the exterior bays.

The ends of the longitudinal girders frame into lifting girders, each of which is supported on three live load shoes on the pier. The ends of the lifting girders are fitted with castings to which the counterweight ropes are attached.

When the span is raised the lifting girders, carrying the dead weight of the span, act as simple beams supported at each end by the ropes. When the span is seated the lifting girders take the reaction of the live load on the span as a two-span continuous beam.

This system results in a lift span weighing approximately 2,100 kips, requiring a total of 56 counterweight ropes of 2-1/8 inch diameter.

The lift span is fixed at the east end and has a tooth joint to provide for expansion at the west end. A transverse alignment shoe on the west pier aligns the teeth of the expansion joint during seating of the span.

Piers and Towers

In order to construct the new piers behind the existing bulkheads, the tie-backs of the bulkheads had first to be removed to make room for new construction. They were later replaced and connected to the footings of the new piers. Permanent cofferdams for the new piers were driven to the same elevation as the bulkhead sheeting adjacent to the canal. This provides scour protection for the piers in case the existing bulkhead deteriorates in the future. The sides of the cofferdams away from the canal were driven only deep enough to anchor them.

Seals were used in the construction of the piers, which are founded on 45 ton steel friction piles. The concrete piers have solid footings and hollow pedestals with interior columns under the steel tower legs and thin walls around the perimeter. The north end of the west pier is extended to accommodate the control house built integrally with the pier.

Each pier supports a four-legged steel tower some 95 foot high. The tower legs are welded boxes with 3 foot by 4 foot outside dimensions. Except for some sections at the splices where access was needed in order to make the bolted connections, the boxes are sealed.

The towers were designed without diagonal bracing to eliminate the "cluttered" appearance often associated with this type of construction. Horizontal struts only at about mid-height are provided in the longitudinal direction.

The tops of the towers are connected with horizontal frames. A concrete deck poured at this level serves as the floor of the machinery house which is located at the top of each tower. The machinery houses have steel framing with metal clad insulated wall panels. Windows are provided for natural light and ventilation as well as for affording a view of the span during operation. A hatch in the floor of each machinery house allows for replacement of machinery.

The machinery houses are thus totally enclosed, hiding from view the mechanical elements of the bridge.

Access to the machinery houses is by means of exterior stairways. It is also possible to get from the stairway to the top of the counterweight both in its upper and lower positions. This would enable a person to ride the counterweight for most of the way up or down when an opening of the span can be tolerated.

Mechanical Features

Operation of the span is accomplished by two separate but identical tower drives. Four 125 horsepower A-C electric drive motors are provided (two in each tower). Only two motors will be required to operate the span at any one time. The extra motors are intended to provide for the possible failure of the motors normally used. Each set of two motors is controlled by an independent SCR system as further described below.

Reduction gearing in each tower consists of one main reducer and two secondary reducers. A final reduction is accomplished at the exposed racks and pinions of the sheaves. In addition to the motor brake two machinery brakes are mounted on the input shafts of the secondary reducers.

With a reduction ratio of 68 between the motor and rack pinion, the 675 RPM (fixed resistance operating speed) motors take one minute for the 35 foot lift.

The fourteen counterweight ropes at each corner of the span pass over sheaves with 6'-8" radius. The sheaves, supported by sleeve bearings have rack segments bolted to their perimeter around the full 360 degree circle. The 35-foot lift results in approximately a 300 degree turn of the sheave.

An adjustable coupling is installed in each tower for span leveling adjustments.

The counterweights balancing the dead load of the lift span consist of normal weight concrete enclosed in braced steel boxes. Four vertical pockets, located near the ends of the counterweights, are provided for balancing blocks. Provision is made to support the counterweights from the towers. Steel hangers for this purpose are stored in the machinery houses and special supports to permit jacking of the counterweights have been installed on the machinery floor.

Electrical Features

Normal operation of the bridge is by commercial electric service. A diesel engine generator is installed to operate the bridge machinery and essential services in case of power failure. The 600 KW generator is of sufficient size to operate the bridge at normal speed and supply lighting circuits. A 500 gallon diesel fuel tank is located under the west tower span.

Two bridge operating circuits are provided for redundancy. Power can be selected by the operator from the commercial source of power or the diesel engine generator and applied to either operating circuit. The automatic rate circuits (regulated speed control) for controlling the rate of acceleration and deceleration are from primary silicon rectifier control panels in the panel room of the Control House. Both of the two bridge control circuits are connected to their respective speed registers.

All bridge drive motors are identical, heavy-duty A-C wound rotor crane and hoist type, for maximum flexibility, interchangeability and simplified maintenance.

The electric bridge drive is a full-automatic A-C silicon-controlled rectifier type providing a stepless speed system. The control provides counter torque for overhauling loads, slowdown and leveling.

Once the operator instigates the span raise sequence, the span will rise and then stop automatically at the full open position without further operator action. The closing sequence will be similar. The operator has the capability to interrupt this sequence by activating either the stop switch or the emergency stop switch. The stop switch will stop the span in any position by normal deceleration using the span drive counter torque. The emergency stop switch will stop the span in any position by applying all brakes.

Control House

A three-story control house is located at the north end of the west pier. The entire house is reinforced concrete and built integral with the pier.

The first floor of the house is below roadway level and its floor is the top of the pier. This floor houses the diesel engine generator. Removable louvered panels serve as air intakes and will allow for replacement of the generator.

The second floor, approximately at sidewalk level, contains the toilet, electrical cabinets and work bench. The control house is served by insulated and heated water and sewer lines entering at this level.

The third floor control cab has insulated glass windows all around. Glass surfaces are sloped to reduce glare. This floor contains the control desk, personal lockers, a writing desk and the drinking fountain/refrigerator. The space is fully heated and air conditioned.

Traffic and Warning Gates

Warning gates and traffic gates, interlocked with bridge controls, are provided on both approaches. Traffic gates extend over the full width of the roadway and both sidewalks. They are aluminum box beams pivoted at one end and riding on a wheel at the other. They are driven by electric motor and reduction gears contained within the box structure of the gate.

Construction

In order not to interfere with navigation the lift span was erected in the open position with girders placed on temporary supports. The contract plans allowed two field splices per girder. However, the contractor elected to fabricate the girders in one piece. Transport of the 182-foot girders from the fabricator's plant to the site required careful planning. Once at the site, the one-piece girders enabled speedy erection as each unit was picked up by two cranes and placed on temporary supports.

After the deck was poured while the span was still on temporary supports, the counterweight ropes were installed, counterweights poured and the weight transferred to the sheaves.

Appearance

The design endeavored to achieve an uncluttered and clean look for the structure, which is a prominent local feature. The towers have few bracing members and are made up of 3-foot by 4-foot welded steel boxes. At the field splices of the tower legs, the splice plates are hidden inside the box section with only bolt heads visible from the outside.

The two sets of lift machinery, one on top of each tower frame, are totally enclosed in machinery houses which appear integral with the towers. The counterweights are enclosed in painted steel boxes which also blend into the towers when the bridge is in the closed position. The relatively shallow structural depth of the lift span contributes to the lean and functional appearance of the structure as a whole. Power cables and control wiring for the operating machinery are routed to the machinery rooms inside the tower legs to enhance the uncluttered look of the bridge.

Relevant Data

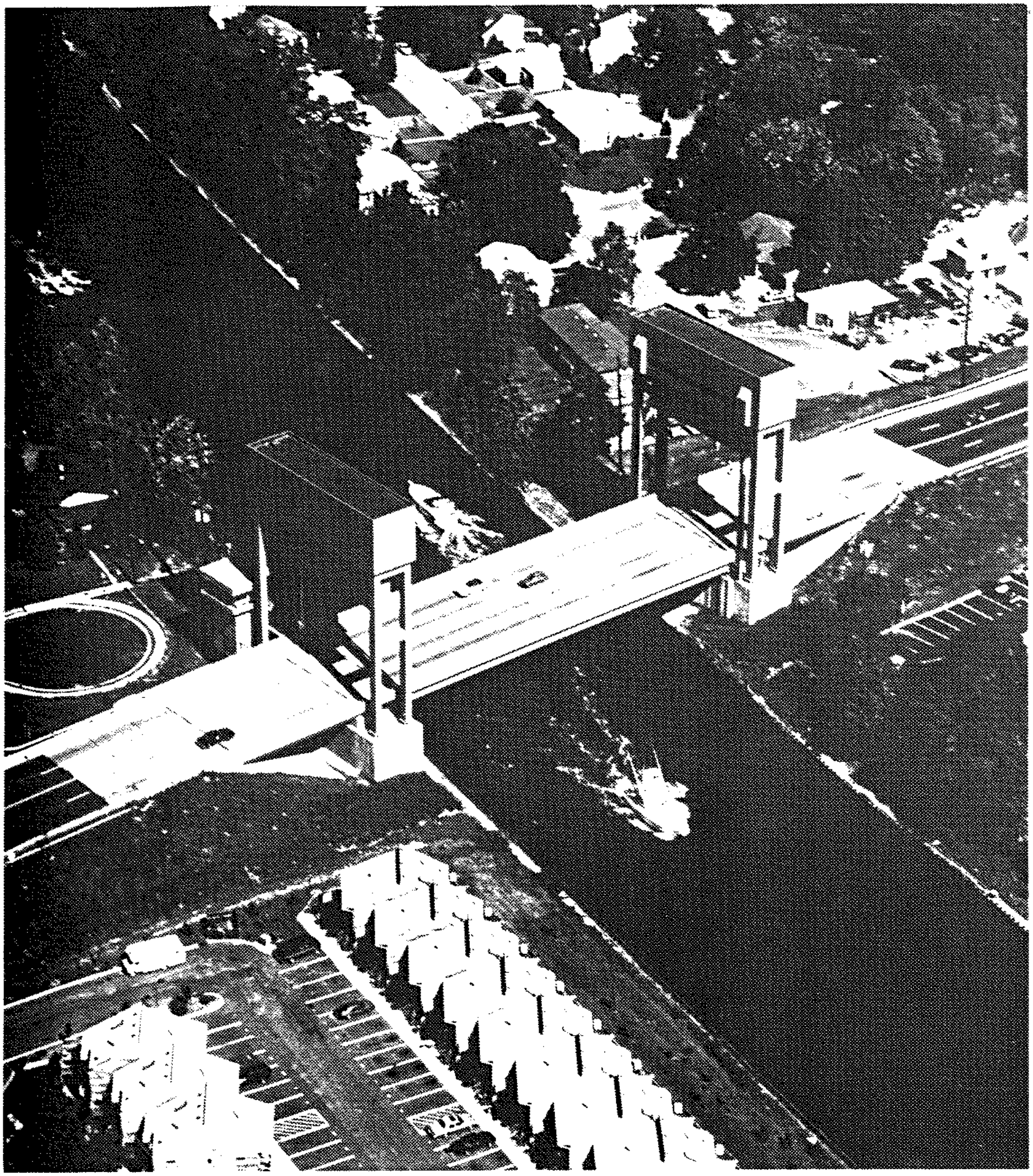
Owner of Bridge: New Jersey Department of Transportation

Contractor: Raymond International Builders, Inc.

Designer: Howard Needles Tammen & Bergendoff

Cost: $12.7 million

Completion Date: May 7, 1987 (Dedication)



A FOUR LANE LIFT BRIDGE

RT. 88 OVER PT. PLEASANT CANAL

BOROUGH OF POINT PLEASANT, NJ