THE NEW RIVER BRIDGE
Ft. Lauderdale, Florida

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Bascule Bridge Owner:
Florida East Coast Railway Company
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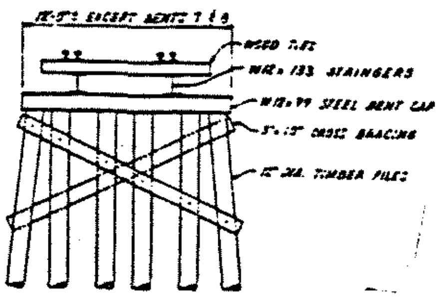
Since 1912, the Florida East Coast Railway Company (FEC) has continuously operated a railroad bascule bridge over busy New River in downtown Ft. Lauderdale. The original single-track bascule bridge, designed for E-40 and up-graded through the years to E-50 live loading, was requiring excessive efforts to maintain its operation by 1973.

At that time FEC engaged Greiner to develop a scheme for a replacement structure with the charge to:

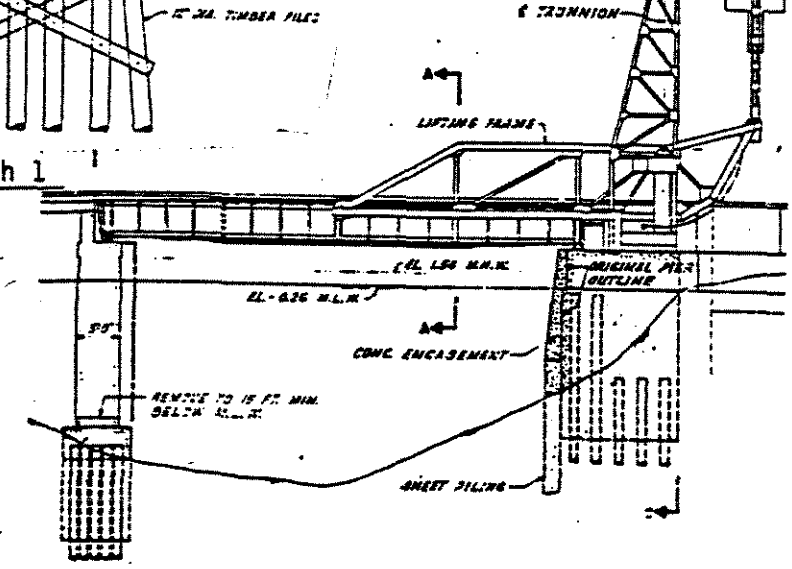
1. Minimize disruption to rail and boat traffic.
2. Minimize maintenance costs.
3. Up-grade to E-80 loading.
4. Double-track the crossing.
5. Create a design compatible with the adjacent historical buildings.
6. Provide for construction within the confined R-O-W area.

The successful solution was designed in 1974 and constructed in 20 months between November 1976 and July 1978 for a total construction cost of $3,000,000. Greiner provided complete engineering services from concept development through construction completion. The general contractor was Powell Brothers, Inc., Ft. Lauderdale. All approach track-work was constructed by FEC's work crews.

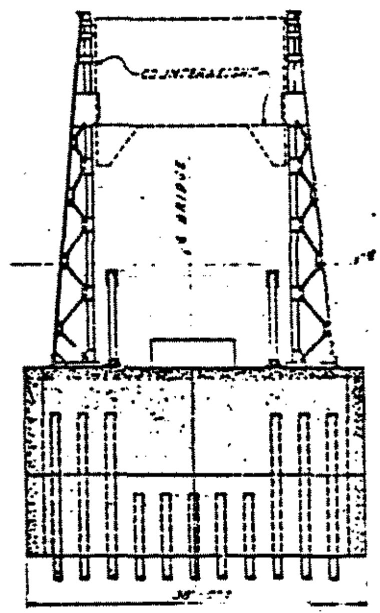
The existing bridge, 188 feet in overall length, provided 48' horizontal navigational clearance with a main span of 58' and had 8 approach spans on the north side at 15± each and 1-16' closure span to the south bank abutment. Both the main bascule pier near the south bank and the rest pier were founded on sealed footings, timber-pile supported. The trestle approach bents were constructed of timber piles supporting steel bent caps which in turn carried the two WF steel stringers. (See Sketch 1). The 58' bascule span consisted of two riveted plate girders with floor beams and stringers, lifted by a trussed lifting frame which rotated on the elevated trunnion. The twin-trussed counterweight towers provided support for the movable concrete counterweight and its frame. (See Sketch 2 and 3).



Sketch 1



Sketch 2



Sketch 3

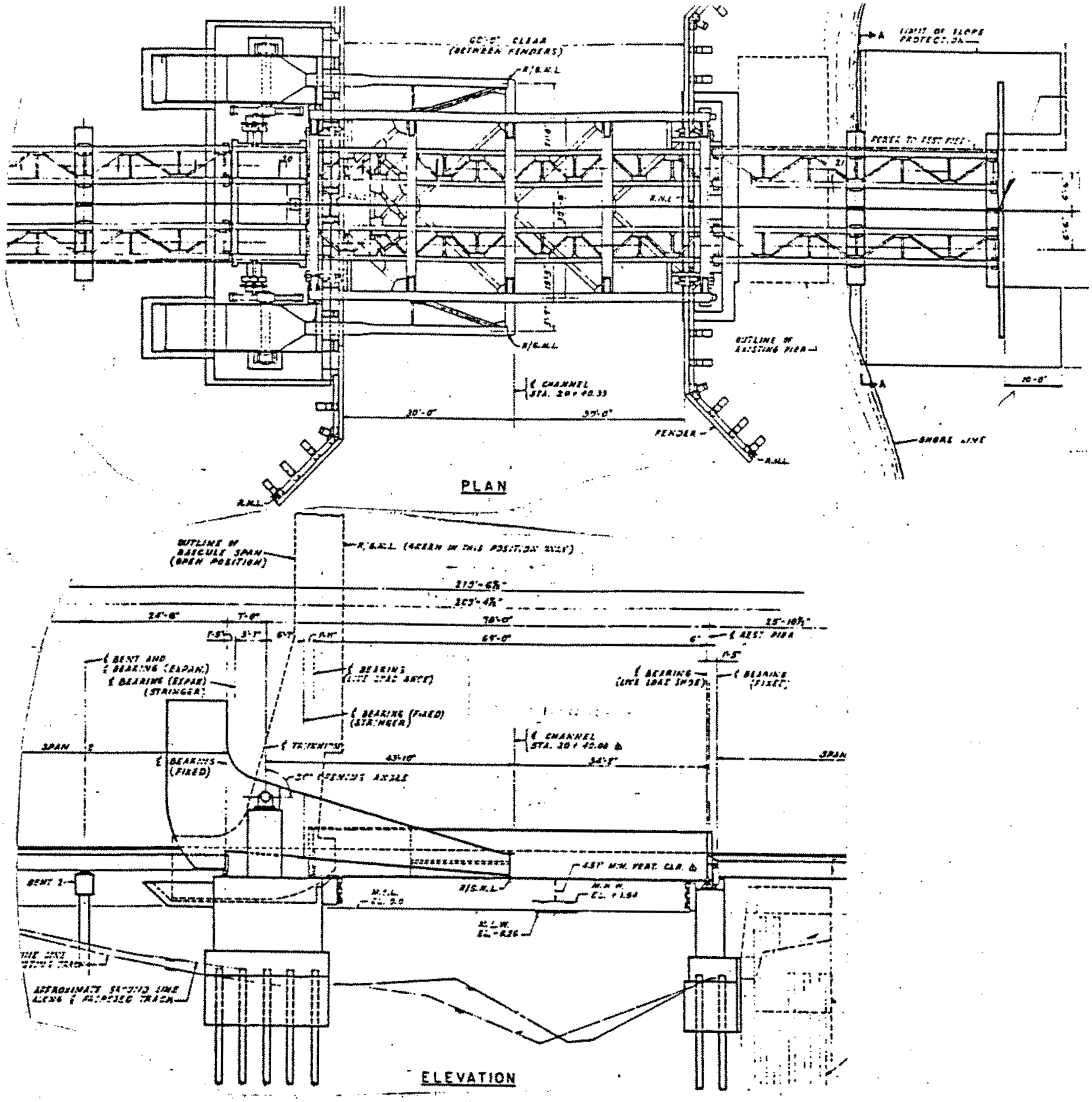
A normal design for replacement of an active railway bridge on the same alignment entails construction of a "shoo-fly," structure. This is not an economical solution with bascule bridges. The proposed double-track system, however, permitted split bridge construction of the parallel approaches up to each end of the bascule span with later removal and replacement of the old approaches after shifting the railway traffic over. The split bridge concept was not, however, economical for the bascule span.

The solution developed for this site placed the large bascule pier on the opposite (north) side of the channel and placed the rest pier just channel-ward of the existing large bascule pier. This rest pier placement temporarily reduced the horizontal boat clearance from 50' to 40' but the new bridge would provide 60' clearance, after completion. Coast Guard permits were obtained with these constraints and for the future improvement.

The bascule pier was constructed beneath the existing bridge and surrounded Bent No. 7. Steel cofferdam sheet piling was installed by use of a vibrating hammer. 60 ton prestressed concrete piling (20") were installed by driving with a McKierman Terry DE-40 hammer. The foundation piling layout was developed to avoid, as much as possible, effecting the existing timber bent. When construction of the footing had been completed, the timber bent was replaced by a temporary steel bent which was encased as concrete lifts progressed.

The rest pier was similarly constructed but without the interference of the fixed bridge overhead, being on the channel side of the existing bascule pier. Interruptions due to train transiting (bascule closures) were minimized by coordination of efforts around the train schedules.

The final bridge concept had three 25' approach spans from the north, a 14' machinery room span, a 70' main span, and two 25' approach spans on the south, for a total bridge length of 210'±. The approach spans were simple span and two span continuous designs consisting of two track girders with top and bottom lateral bracing. They, along with all other spans in this system, were erected with ties and rails in place. Final rail installation and adjustments were performed by FEC track crews.



The main bascule span, a through plate design designs used 8'-5" deep plate girders on 30'-6" centers with 4'-0" deep plate girder floor beams at 17'-3" spacing and W 30 x 124 track stringers at 5'-3" centers. Plate girders were welded and connections were bolted with 7/8" and 1" Ø A 325F bolts. The designs were prepared under

AREA specifications for E-80 loading using ASTM A-36 steel, painted. An alternate bid was allowed to permit unpainted A-588 steel in the same sizes as detailed for A-36. The low bid utilized the allowed alternate which eliminated initial and future environmental painting concerns. At last report the weathering steel has performed in a satisfactory manner. The bridge is located in a slightly brackish water area, being 2 1/2 miles upstream from the bay with an average tidal range of 20".

The bascule operational system designed was similar to the original bascule bridge's concept. The concept is dictated to a large degree by the lowness of the railroad's grade, resulting in an elevated trunnion location. The use of a trunnion bascule bridge, as opposed to a rolling lift bascule, simplifies the rail connections at the main bascule and rest piers and, we believe, allows closer alignment tolerances.

The main bascule span is lifted at its mid-point by extensions to the center floor beam which are bolted to the outboard lift girders. These lift girders are connected to the counterweight boxes by use of 1" Ø A 490 bolts. The box, internally braced and partially filled with "balancing" concrete, is supported on an 18" Ø trunnion shaft. Trunnion bearings are split block types with bronze bushings resting on an outboard concrete column and an inboard steel column. The inboard face of the counterweight box is used for mounting the drive rack, a cast steel gear with an 11'-3" pitch radius. The rack arc length provides for 90° operation of the bascule span.

The operating machinery consists of the following basic elements:

1. Primary Span Motor (25 HP @ 720 rpm).
2. 40:1 Speed reducer.
3. 11.33" Diameter bull gear pinion.
4. 56.67" Diameter bull gear.
5. 15.00" Diameter rack pinion.
6. 270" Diameter rack gear.

All gear teeth are 20° involute stub cut and all shaft bearings are split block with bronze bushings. Ancillary equipment included are a 5 HP emergency power gear-motor, machinery brake, emergency drive clutch, couplings, and span limit switches. Additional equipment mounted on the span are 2-10" diameter buffers at the toe and 2-span locks at both the toe and heel of the span. The adjacent bridge control house has an engine-generator for emergency power plus all span control wiring for connection to the railroads central control board at New Smyrna Beach. The operation is fully automatic with certain over-rides.

The normal position of the bascule is in the open position, allowing boat traffic complete access freedom. When trains approach, a horn blows and a timing board with neon numerals visible to boaters, is activated with a 5 minute countdown by seconds to span closure. Additionally, electric eyes scan the channel to assure clearance before closing. Machinery will not operate automatically until all systems are cleared. Trains are warned when bascule operations are interrupted and begin slowing for a stop until fully cleared to transit the bascule bridge. In principle the operation can be automatic, however, a full-time bridge tender is provided to observe and alleviate the boater-railroad conflicts.

The erection of this superstructure was unique considering the maintenance-of-traffic requirements. The 8 hour railroad and 24 hour boating downtime on B-Day (Bascule Erection Day) was met in the following general manner.

Construction of the parallel western track proceeded to basic completion short of the bascule span. Construction of the bascule and rest piers, as earlier stated, was basically completed under and out-board of the existing bridge. The bascule span with lift girders attached were completed with track work installed and mounted on a barge. Previously the counterweight boxes had been attached to the span and alignments checked in the fabricating yard. Counterweight boxes were installed on their trunnions plus temporary supports and counterweight concreting had been completed. All machinery was installed with their operating controls completed in the bridge house.

As the last train transited the original span on B-Day the demolition and removal of the original bascule span began. The rotating counterweight's upper connection was simultaneously burned away allowing the counterweight to drop on "cushioning" barrels and the existing track. The towers were then removed and the old span floated out by barge. The upper portion of the bascule pier was jack-hammered down to clear the new span. The rest pier, located within the new span area had to be removed completely to provide not less than 15 feet minimum under-water clearance. After removal of the old span, blasting charges were detonated to break-up the rest pier below water. Debris was "clammed" out assisted by divers with burning torches for the reinforcing steel.

Once sufficiently cleared, the new span was brought into position, bolted to the counterweight boxes and its barge flooded to off-load the span. The span was first connected in a partially (2°±) open position then lowered by machinery to engage the live load shoes. Track work was completed and aligned for the first train at 8 hours, on schedule. The remaining time in the 24 hour window was spent in clearing the channel, realigning the machinery, the spans and the connecting elements.

Completion of the eastern track was performed at a normal pace with all traffic shunted to the new western track. Fendering systems, embankment slope protection and the boat warning system were also installed in this completion phase.

No specific or other than normal problems were encountered during this construction. Only alignment adjustments of the machinery and the main span of the live load shoes were necessary.

Project Specifics:

A. Structural Steel Quantities
   1. 111,800 lbs. - Approach Spans
   2. 377,000 lbs. - Bascule Span
   3. 21,000 lbs. - Shoes and Bearing Supports

B. Concrete Quantities
   1. Bascule Pier - 600 c.y.
   2. Rest Pier - 120 c.y.
   3. Approach Bents - 65 c.y.
   4. Counterweights - 140 c.y.

C. Seal Concrete
   1. Bascule Pier - 357 c.y.
   2. Rest Pier - 80 c.y.

D. Reinforcing (A-615 Grade 40)
   1. Bascule Pier - 36,000 lbs.
   2. Rest Pier - 8,200 lbs.
   3. Approach Bents - 6,700 lbs.

E. Prestressed Concrete Piling (20" - 60 ton)
   1. Bascule Pier - 2,000 L.F.
   2. Rest Pier - 1,000 L.F.
   3. Approach Bents - 2,000 L.F.

The bridge has given satisfactory service since opening in 1978 and the weathering steel is described to have reached a stable condition in that environment.