AMERICAN CONSULTING ENGINEERS COUNCIL'S

HEAVY MOVABLE STRUCTURES
MOVABLE BRIDGES AFFILIATE

3RD BIENNIAL SYMPOSIUM

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ST. PETERSBURG HILTON & TOWERS
ST. PETERSBURG, FLORIDA

SESSION
WORKSHOP NOTES

Session (6-1)
"Rehabilitation of Two Railroad Swing Bridges for Amtrak", Craig J. Rolwood, Hardesty & Hanover, NY.

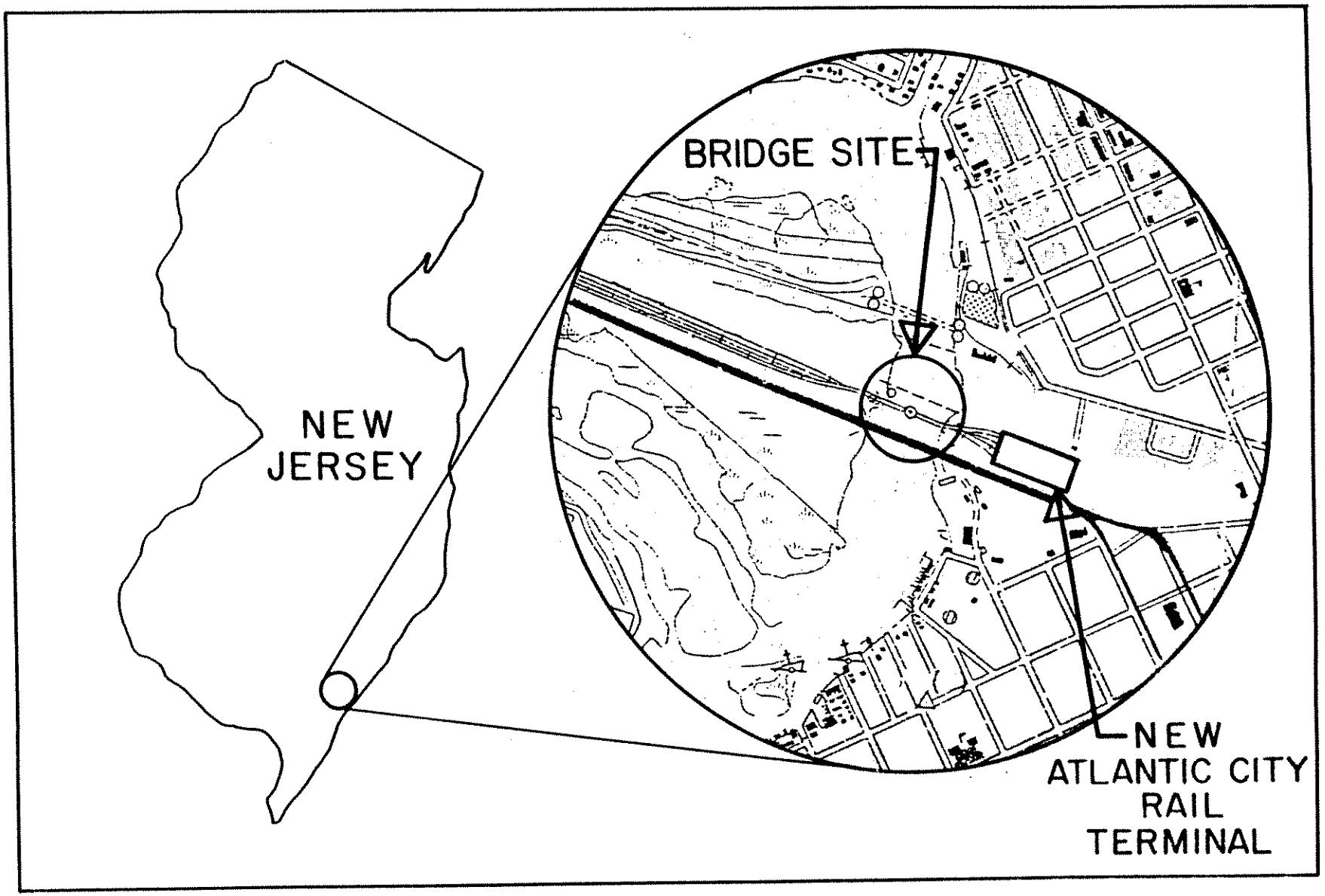
REHABILITATION OF TWO RAILROAD SWING SPANS FOR AMTRAK

Introduction

Our firm recently completed the design and construction support services related to the rehabilitation of two double-track truss swing spans. Each of the rehabilitation projects are part of larger works involving the reopening of old rail lines.

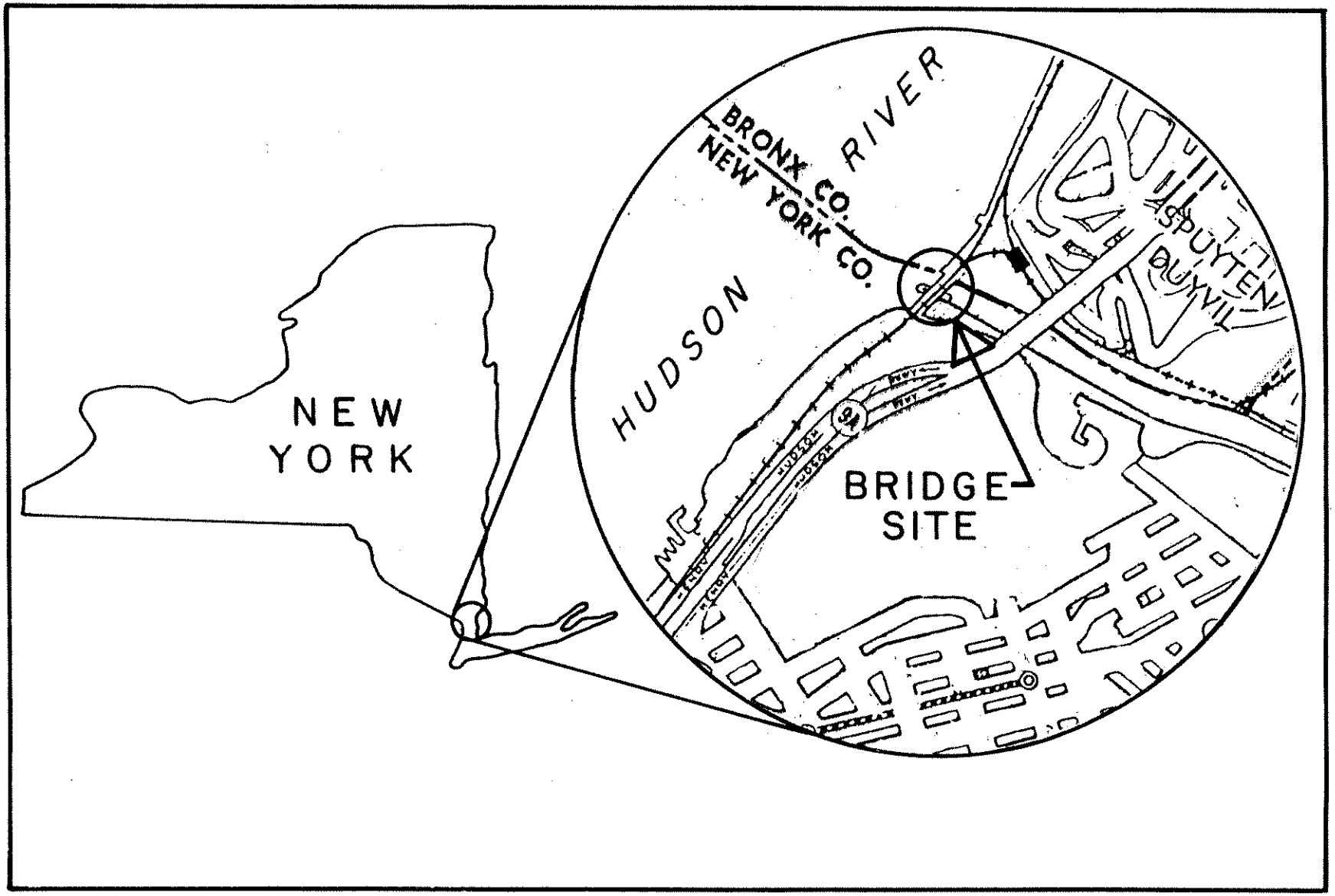
The first rehabilitated bridge is the Atlantic City Swing, and it is the final link between Atlantic City and points west along the newly reconstructed Atlantic City Passenger Rail Line. One unusual aspect of this project is that the Contractor proposed to replace the existing truss swing superstructure with a new through-girder swing superstructure for an increase in contract price of less than 7 percent.

The second rehabilitated bridge is called Spuyten Duyvil, and is located at the northern tip of Manhattan along the former westside freight line. This unused line is being reconstructed so as to permit AMTRAK to consolidate all its operations in Manhattan at one location - Penn Station - and to facilitate passengers travelling between upstate New York and other points north of New York City and points south, east and west of New York City.



ATLANTIC CITY BRIDGE

LOCATION PLAN



SPUYTEN DUYVIL BRIDGE

LOCATION PLAN

Atlantic City Swing Bridge

Description - Situated both literally and figuratively in the shadow of the high-level Atlantic City Expressway bridge, the Atlantic City Swing was the last remaining railroad draw bridge crossing of the Beach Thorofare waterway on the "backside" of Atlantic City. At the time of its construction in 1923, there were no less than three railroad draws crossing the Beach Thorofare representing the lines of several competing railroad companies.

Prior to reconstruction, the 423 foot long bridge consisted of five open-deck girder approach spans and one, 152 foot Warren truss through swing span of the center bearing type. The substructure consisted of concrete piers. A central timber fender system and two side timber fenders delineated the navigation channels while providing some protection to the piers from collision.

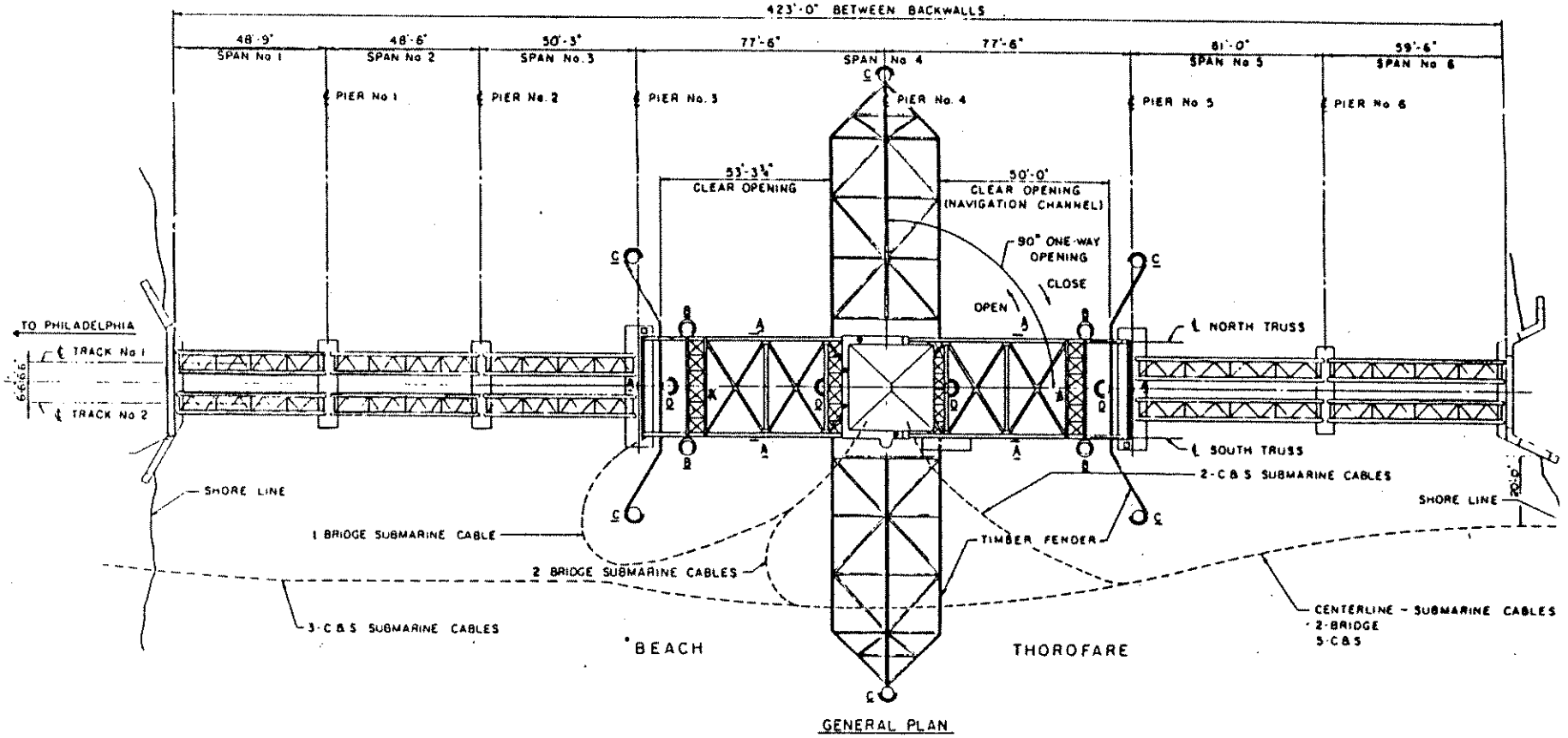
Rail traffic on the line having been halted in the early 1980's, the bridge was abandoned and left in the open position.

A new bridge - The plan for the reconstruction of the Atlantic City Swing was as follows: repair and rebuild the existing piers to raise the bridge two feet. Rehabilitate the existing steel deck girder approach spans. Demolish and reconstruct a new, timber fender system. Replace those structural and mechanical components of the swing span which were beyond repair and fix the rest as necessary. Provide a new electrical operating system. Clean and paint the bridge, lay down new track, and run a railroad.

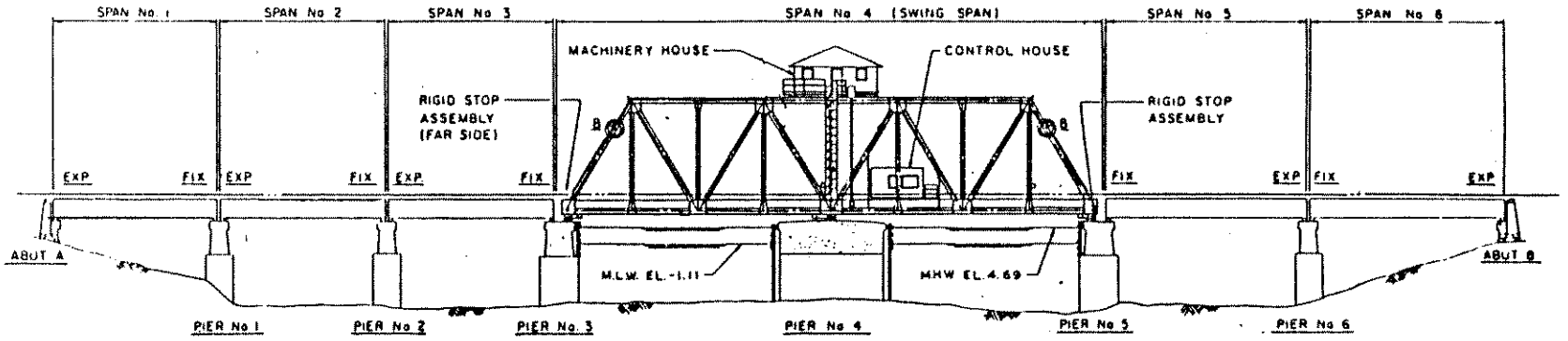
After bids were received and the Contract for rehabilitation was awarded for $6,211,000, the Contractor made a novel proposal: for an additional price representing an increase of less than 7 percent of the contract price, the Contractor would fabricate and erect a new through-girder swing superstructure to be designed by the original designer of the swing span rehabilitation work. Included in the new design would be two new 9-foot high through-girders to replace the existing through trusses, new pivot girder, new floor system, and new tower to house the machinery above the track level. It should be noted that in the original rehabilitation plans, a new pivot girder and substantial replacement of the floor system was called for, as well as numerous repairs and modifications to other structural portions. In the new structure, parts of the existing machinery would be refurbished for reuse, as was the plan for the rehabilitated structure. However, some additional new machinery parts, mostly notably the four end wedges, would be necessitated by a new design.

The acceptance of the Contractor's proposal and go-ahead for the new design were given in early February, 1988, with the stipulation that the bridge would still be ready for rail service in the Spring of 1989 as originally called for in the rehabilitation contract documents. Thus, the new design and accompanying revised contract documents were required in eight weeks. This deadline was met.

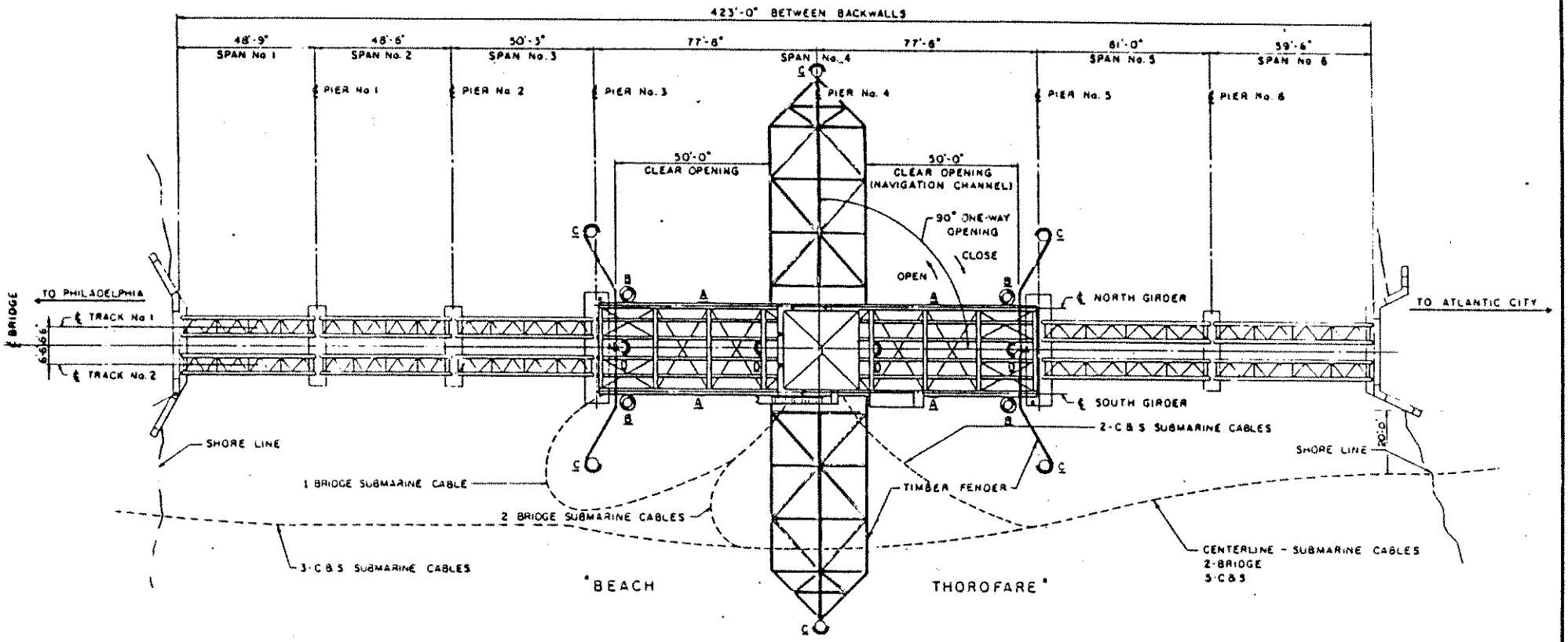
As with any movable bridge construction, close coordination of the structural, mechanical, electrical and building trades was paramount to the timely opening of the bridge to rail service. For this project, the bridge construction work also overlapped with the railroad forces trackwork, making for a very busy construction site in the weeks leading up to the May 23, 1989 opening. Nevertheless, rail service was begun on the line as scheduled.



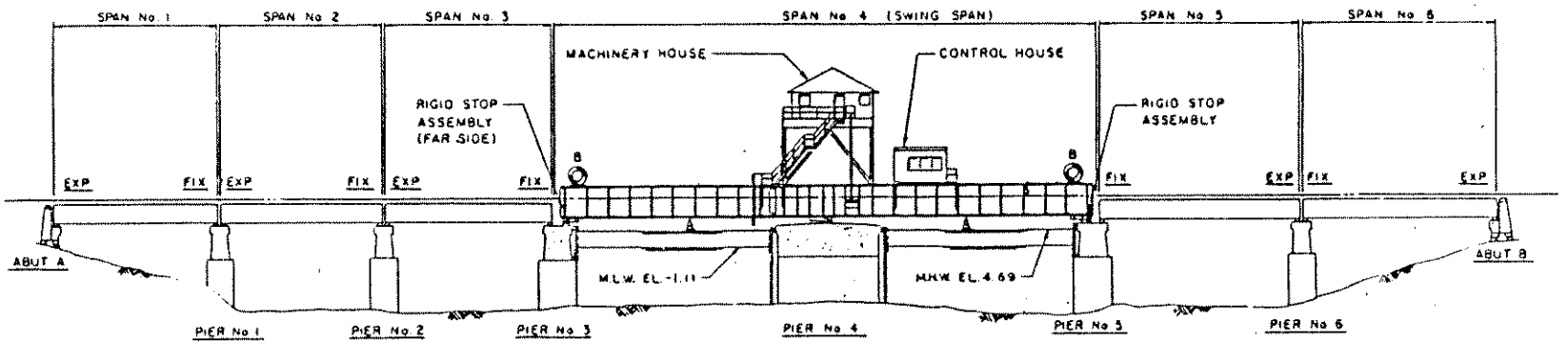
GENERAL PLAN



OLD ATLANTIC CITY SWING BRIDGE



GENERAL PLAN

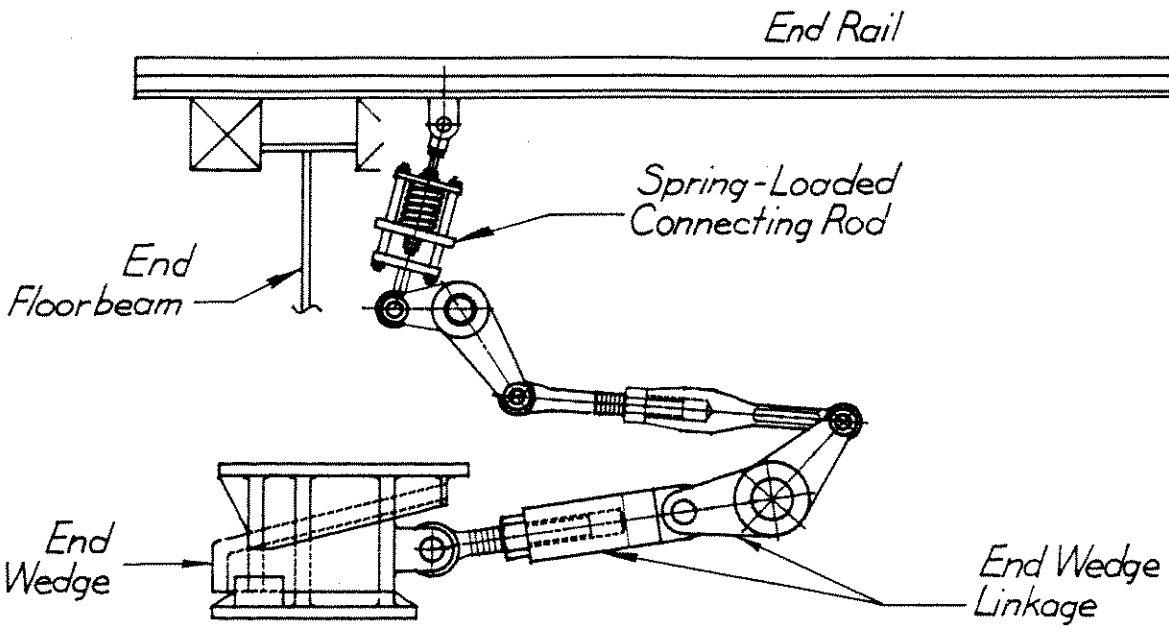


NEW ATLANTIC CITY SWING BRIDGE

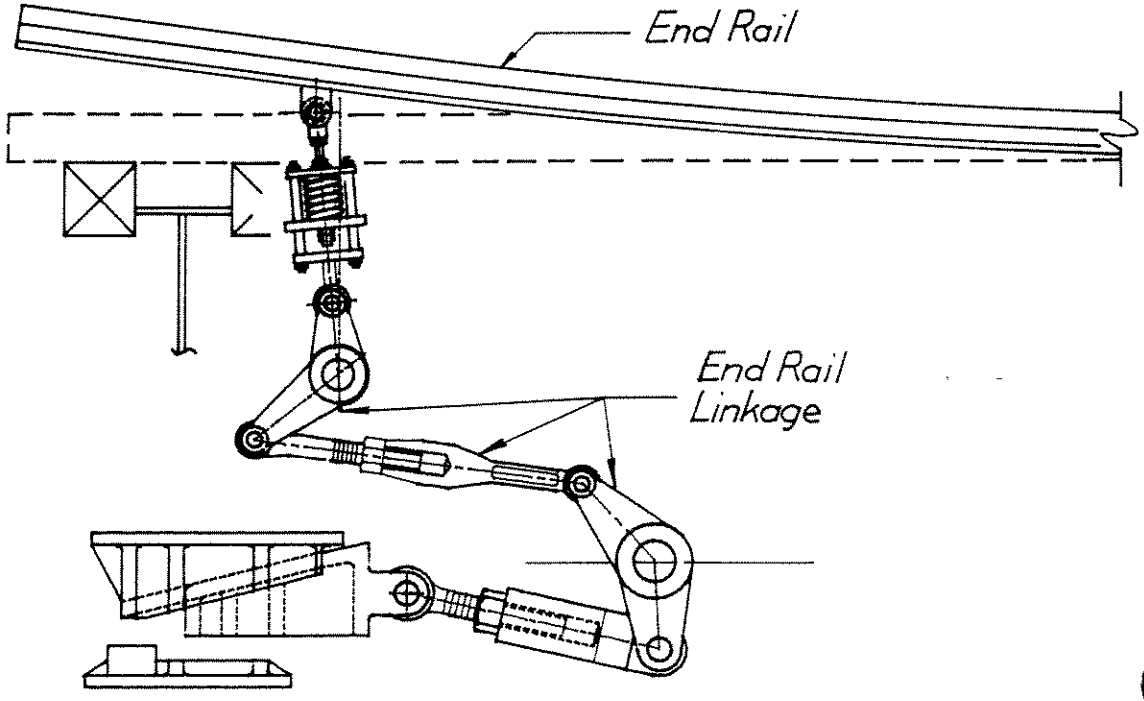
The intensive effort resulting in the timely opening also had its downside. Along with other normal start-up "bugs", difficulties related to railroad signals along the Atlantic City Rail Line and bridge operating problems related to construction material getting caught in the bridge machinery resulted in some delays and round-the-clock work effort to straighten out the problems. Continued progress of work and dedication to solving the start-up problems eventually resulted in smooth rail operations on the line and across the bridge, as well as proper operation of the bridge for navigation openings.

Rail Lifters - One mechanical device especially designed for AMTRAK at both the Atlantic City Swing Bridge and Spuyten Duyvil Bridge is the rail lifter devices for the AMTRAK mitre rails. The rail lifter devices consist of cranks, adjustable arms, adjustment nuts and a special spring loaded connecting rod, designed to bend the end mitre rails upward simultaneously with the operation of the swing span end wedges and center wedges, thus allowing clearance at the track level for the swing of the span.

The main features of the rail lifter device are shown in the accompanying illustrations. The interaction of the end wedge machinery and end mitre rails along with the vertical displacement which the cantilevered swing superstructure undergoes during wedge operation all add to the intricacies of the design. The spring loaded connecting rod provides a hold-down force which anchors the rails when in the seated position.



Wedges Driven Rails Seated



Wedges Withdrawn Rails Lifted

Spuyten Duyvil

Description - Originally constructed by the King Bridge Co. in 1899, the two track railroad bridge at Spuyten Duyvil is at the northernmost tip of Manhattan Island. The bridge is parallel to the wide Hudson River, spanning the northern end of the Harlem River at the cove at Spuyten Duyvil, connecting the New York City Boroughs of Manhattan and the Bronx. The low profile of the crossing coupled with the repeating patterns of the subdivided Warren trusses lend to the attractiveness of the structure.

The four spans of the crossing consist of a 286 foot long swing span centered on a large, circular stone and concrete masonry pier, and three additional 106 foot truss spans, two south of the swing span and one north, resting on stone masonry piers in the water and stone masonry abutments at the shores. A large, timber fender system at the center and additional timber pile dolphins offer some protection to the piers and swing span from boat collisions.

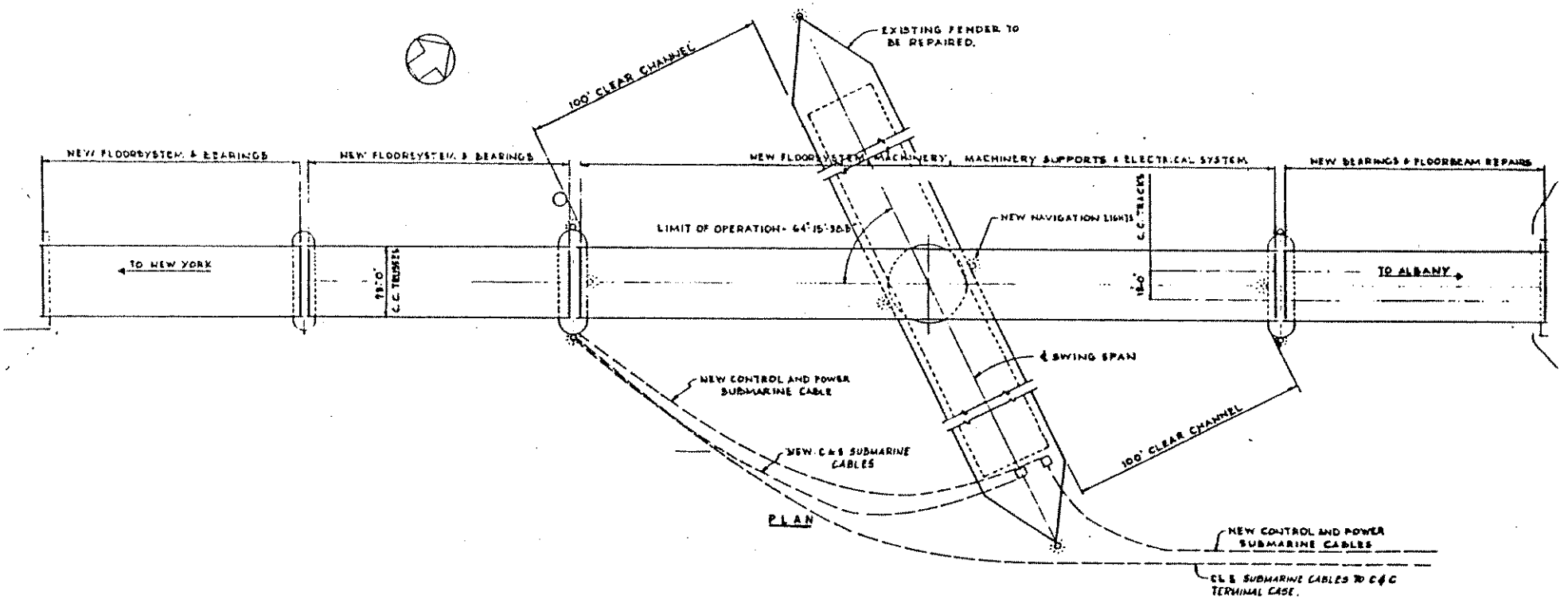
New life for an old bridge - The plan for rehabilitation of the Spuyten Duyvil Bridge was as follows: Replace large portions of the floor system and repair extensive portions of the trusses. Totally replace the center pivot and turntable structure. Rebuild the tops of the existing river piers, and repair the existing timber fender system. Provide new electrical and mechanical operating systems. Clean and paint the bridge, lay new track, and open the line to rail traffic.

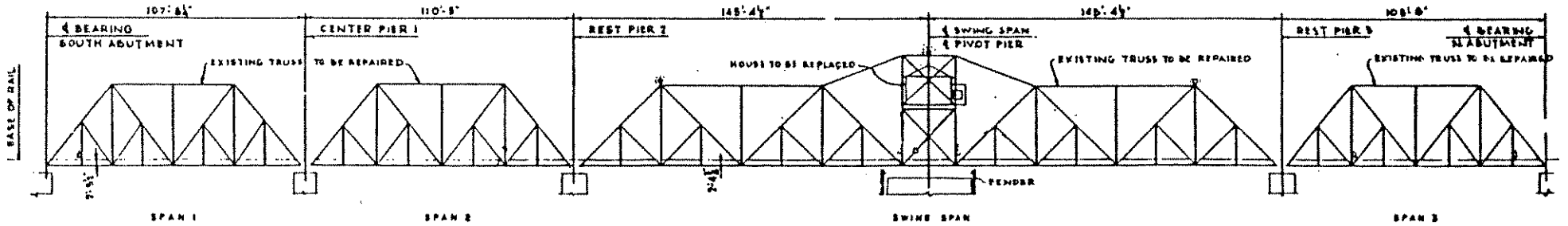
The Contractor opted to perform much of the repair and replacement work off-site. Early in the Contract barges were brought to the site and the truss spans were removed from their piers and loaded onto the barges for shipment to a work yard in Kearny, New Jersey. The swing span was split into three pieces for shipment - two end trusses and center tower. Most of the steel repairs and new steel replacement parts were made in the Kearny work yard, and the cleaning and painting of the structures was also accomplished prior to re-shipping the structure back to the site.

The Contractor also arranged for some of the major mechanical components, such as the end wedges, to be mounted in the shop on the new structural steel supports. This certainly reduced some of the potential for coordination problems between mechanical and structural trades which often times develop in movable bridge construction jobs.

Turntable - Perhaps the turntable for the 286' long rim bearing swing span is among the most complex type of structural mechanisms used in movable bridges. Just a list of the components, each of which require exacting fabrication procedures and tight tolerances, conveys a sense of the complexity involved:

- Two 30 foot diameter sloped cast steel tracks, upper and lower segments, set to tight vertical and horizontal alignment tolerances on the concrete pier.
- One 16'-8" pitch radius cast steel operating rack.
- 64 tapered cast steel rollers in 30' diameter steel assembly.



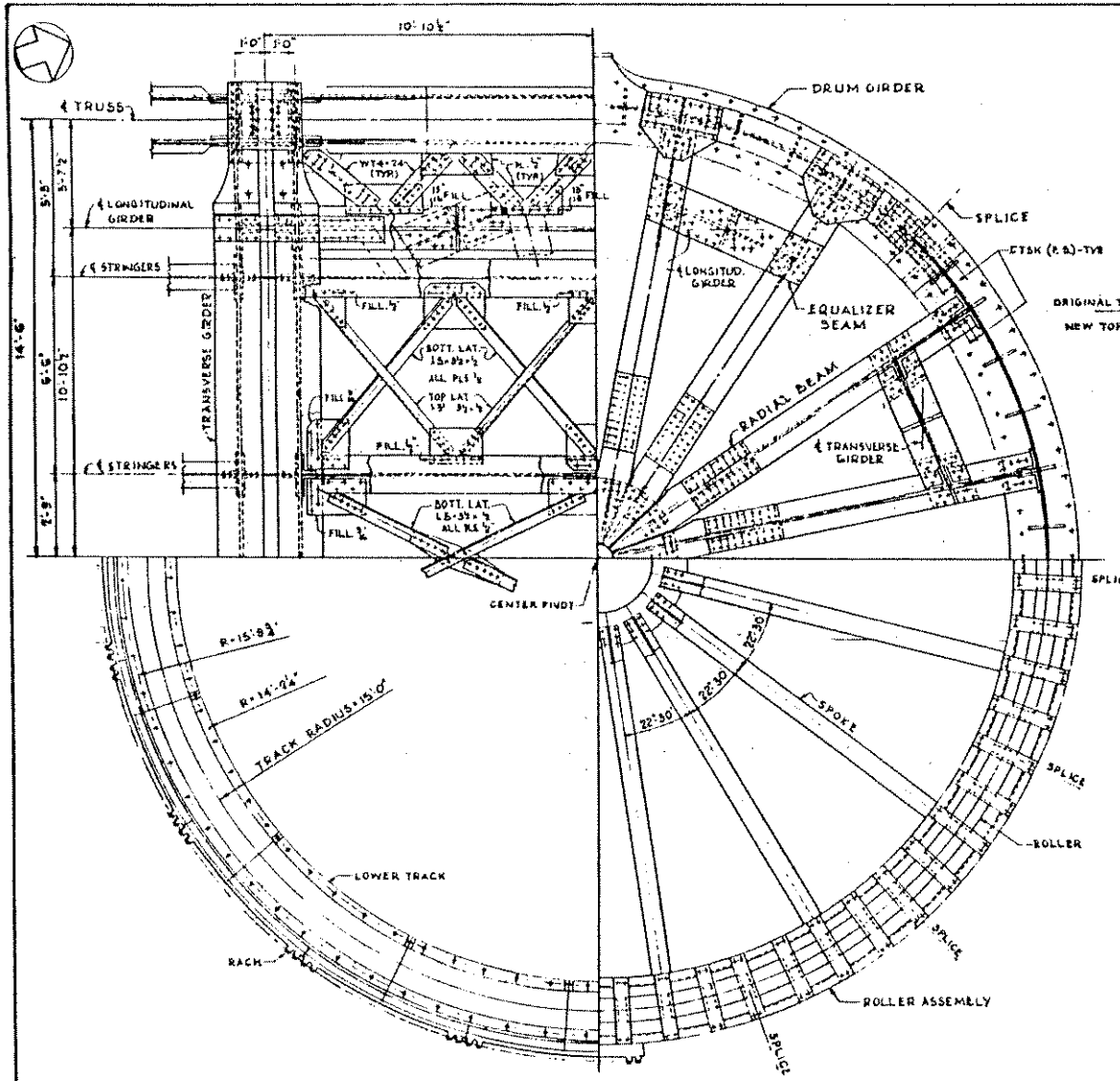


ELEVATION

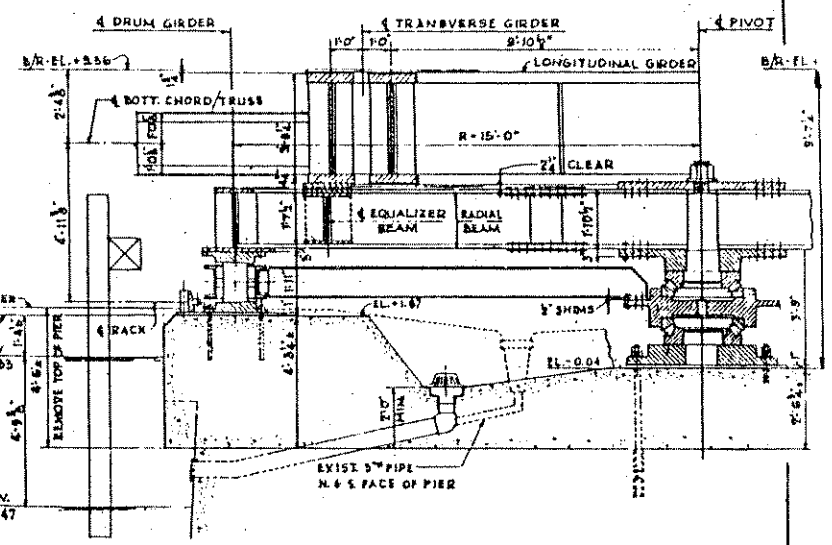
SPUYTEN DUYVIL BRIDGE

- 16 W-beam steel spokes.
- 16 heavy section W-Shape steel radial beams.
- 8 heavy section W-Shape steel equalizer beams.
- One 30' diameter heavy section steel drum girder.
- Four transverse steel girders and two longitudinal steel girders, with 4" thick flange plates and 2" thick web plates.
- One tapered roller beam, center pivot assembly.

A half section of the turntable at the pier showing the major elements is given in the accompanying sketch.



SECTIONAL PLAN
SCALE: ½"=1'-0"



SECTION AT PIVOT
SCALE: ½"=1'-0"

TURNTABLE