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# REHABILITATION OF A RAILROAD SWING BRIDGE UNDER TRAFFIC

by


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## INTRODUCTION

The Walk Bridge is a 91 year old Railroad Structure that carries four (4) tracks of Passenger and Freight traffic over the Norwalk River in Norwalk, Connecticut. It is operated by Metro-North Commuter Railroad in New York City. The tracks also carry Amtrack's mainline passenger traffic between Boston and Washington, D.C. and ConRail freight service.

Originally scheduled for rehabilitation during the Northeast Corridor Improvement Project, it was dropped from the program due to budget cuts. Increasing operational problem became a major concern to Metro-North. Difficulty in closing the Bridge often prompted the Railroad to dispatch maintenance crews to the site to assist in the operation. Metro-North engaged Lichtenstein Engineering Associates to inspect and report on the Bridge Condition.

## Problems and Solutions

An In-depth Inspection of the Bridge turned up many significant defects. The movable portion of the Bridge is a Rim Bearing Swing Span. The tread plates were severely worn; of the 90 roller wheels, most were out-of-round with many cracked and flattened edges. Racks and pinions showed considerable wear and one of the two pinion shafts were bent.

The existing electrical system was powered by a 25 cycle supply which is no longer available. Motor generator sets had been installed to convert from the present day, 60 cycle, supply to the 25 cycle bridge equipment. The equipment was old and required increasing maintenance to keep it operating. Replacement parts were becoming more difficult to obtain.

Based on conditions found, it was decided to provide for a major overhaul of the mechanical-electrical system. This included replacement of all roller wheels, tread plates, rack and pinions. Also, a complete replacement of the electrical equipment was scheduled with 60 cycle components and included a solid-state control system.

## Marine and Rail Considerations

The proposed work would prohibit operation of the Bridge during periods of the rehabilitation construction. A disadvantage of this particular structure was that it carried all four of the operating tracks. In the open position, it completely shut down this major rail line. (Note: Metro-North's other 4 movable bridges are side by side, two track bridges, which allows the flexibility of operating on two tracks while repairs are underway to the adjacent 2 track structure). Rehabilitation while the bridge was in the open position was therefore unacceptable.

Marine traffic on this river was studied. The major users were fuel oil transports. Review of the frequency of River movements indicate a high frequency of openings required during the winter as expected. Also frequent openings were required during the warmer months due to fuel demand to generate electricity. The traffic was at its lowest for a brief period each spring. After review and coordination with the US Coast Guard, a thirty day channel closure was allowed for the entire month of April. This agreement required the Contractor to work a minimum of 2-ten hour shifts, seven days a week, during this period of channel closure.

## Shoring and Jacking

It was therefore planned to perform the critical work with the span immobilized in the closed position. The replacement of the tread plates and wheels presented another problem. They are the sole support of the center of the swing span and carry not only the dead load, but the live load of train traffic. The superstructure would have to be jacked and shored to allow this replacement work to proceed. In the shored condition, the span would still have to support train traffic. The existing pivot pier consisted of a ring of granite under the existing tread plates, but the interior is filled with a rubble concrete fill. Investigation was required to determine an allowable capacity for the fill concrete. Cores were taken and compression test performed. An allowable bearing of approximately 400 psi was assigned.

The superstructure of the swing span consists of three deck trusses supporting floorbeams and stringers. The trusses sit on four (4) cross beams which in turn are supported by the circular drum girder (see Sketch 2).

The interior of the deck girder is crowded with 90 axles rotating at from center pivot to the roller wheels. This further complicated the installation of the shoring. The wheels are beveled inward and therefore, the weight of the structure exerts an outward thrust on the wheels. The axles resist this force and allow adjustment of the wheels.

A procedure was developed to perform the shoring.

1. Sections of the existing tread base plate are to be burned off in areas of the temporary shoring and a non-shrink grout leveling course is to be placed and cured prior to the navigation restriction period.

2. At shoring locations, the roller wheels are to be wedged so that sufficient tie rods can be removed to allow installation of shoring materials.

3. Timber and steel beams and plates, and jacks are to be installed.

4. During weekend periods of no train traffic, the structure is to be raised 1/2" at the pivot pier and steel shims added between the shoring and raised structure, jacks are then released. Train traffic is not allowed on structure while supported on jacks.

   This 1/2" rise is approximately half of the lift provided by the end wedges. No jacking is being performed at the span ends and therefore, no track realignment was required.

5. The Contractor will then proceed with the replacement of tread plates, wheels, axles and rack sections. The 1/2" raising will allow the tapered wheels to be removed. Then there is sufficient room to remove upper and lower tread plates.

6. After all replacement is completed, jack structure to remove shoring and lower onto new treads and wheels.

The shoring scheme consisted of blocking the four cross beams as close to there existing support points as possible. The outer trusses are supported on cross beams which cantilever over the drum girder. (see Sketch 4). Moving the supports to the inside increased the overhang. This required reinforcement of the beam at the port of support. The inner truss is supported by the short beams which span very close to the deck girder. Although the beam can be shored directly below the truss, because of the close alignment with the drum girder, only a portion of the beam could be supported. The cross beams are box shapes with three webs. The inside web is a solid plate and the two outside webs are made up of lacing bars (see Sketch 5). By reinforcing one web, the beam was turned into a two web system that could transfer the loading to the shoring.

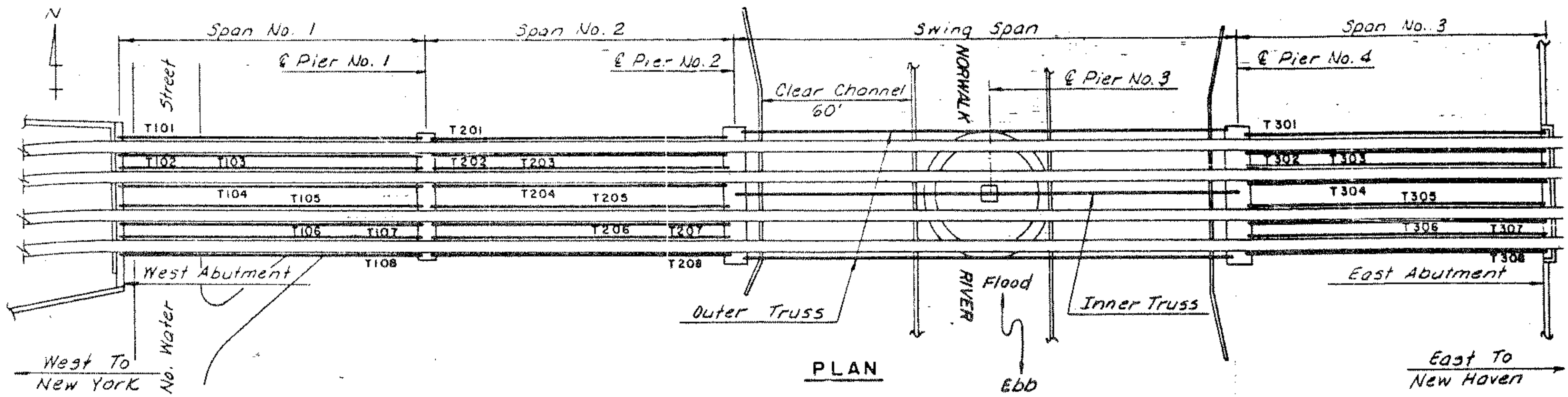
While this span is immobilized, the final electrical change over will occur. All equipment that can be installed prior to the navigation restriction will be done to minimize the required work during this short operation outage. This includes bringing in the new power source, placing submarine cables and installing all equipment where room permits without affecting existing operating equipment.

## Scheduling

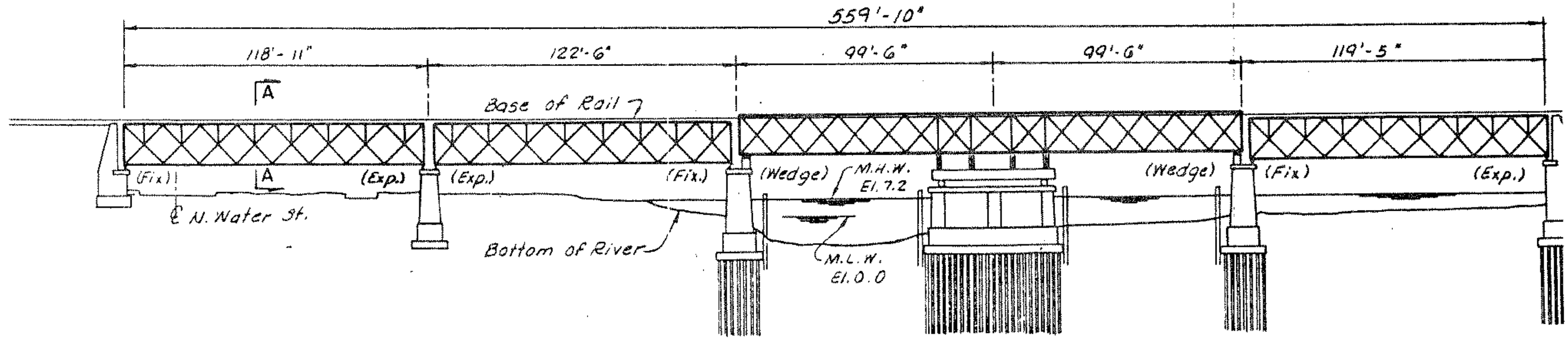
The project which also includes three other movable railroad bridges within a 30 mile range was bid in 1986 and will run 30 months. The Walk Bridge Navigational Outage is scheduled for April, 1988. Single and double track outages are scheduled for structural rehabilitation to all four bridges. An operating plan was developed by the Railroad for minimizing disruption to on-time service during the construction period. Scheduling remains an integral part of the project.

The cost of the rehabilitation of Walk Bridge is approximately $4,300,000 of which the mechanical and electrical work described herein is about half.

The project is being performed for Metro-North Commuter Railroad with co-sponsorship of Connecticut Department of Transportation's Office of Rail Operations and the Federal Railroad Administration.



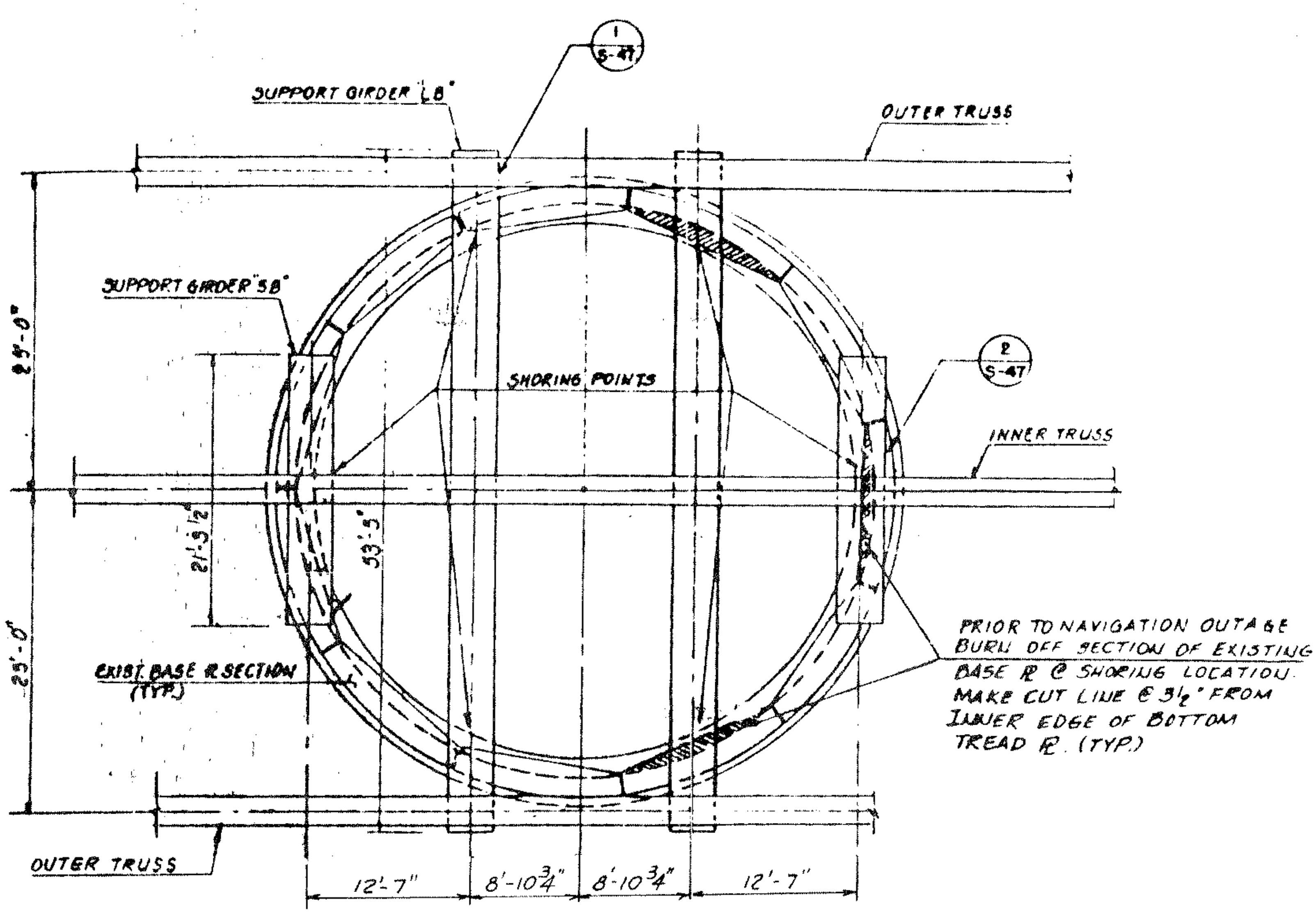

PLAN




ELEVATION

# WALK BRIDGE

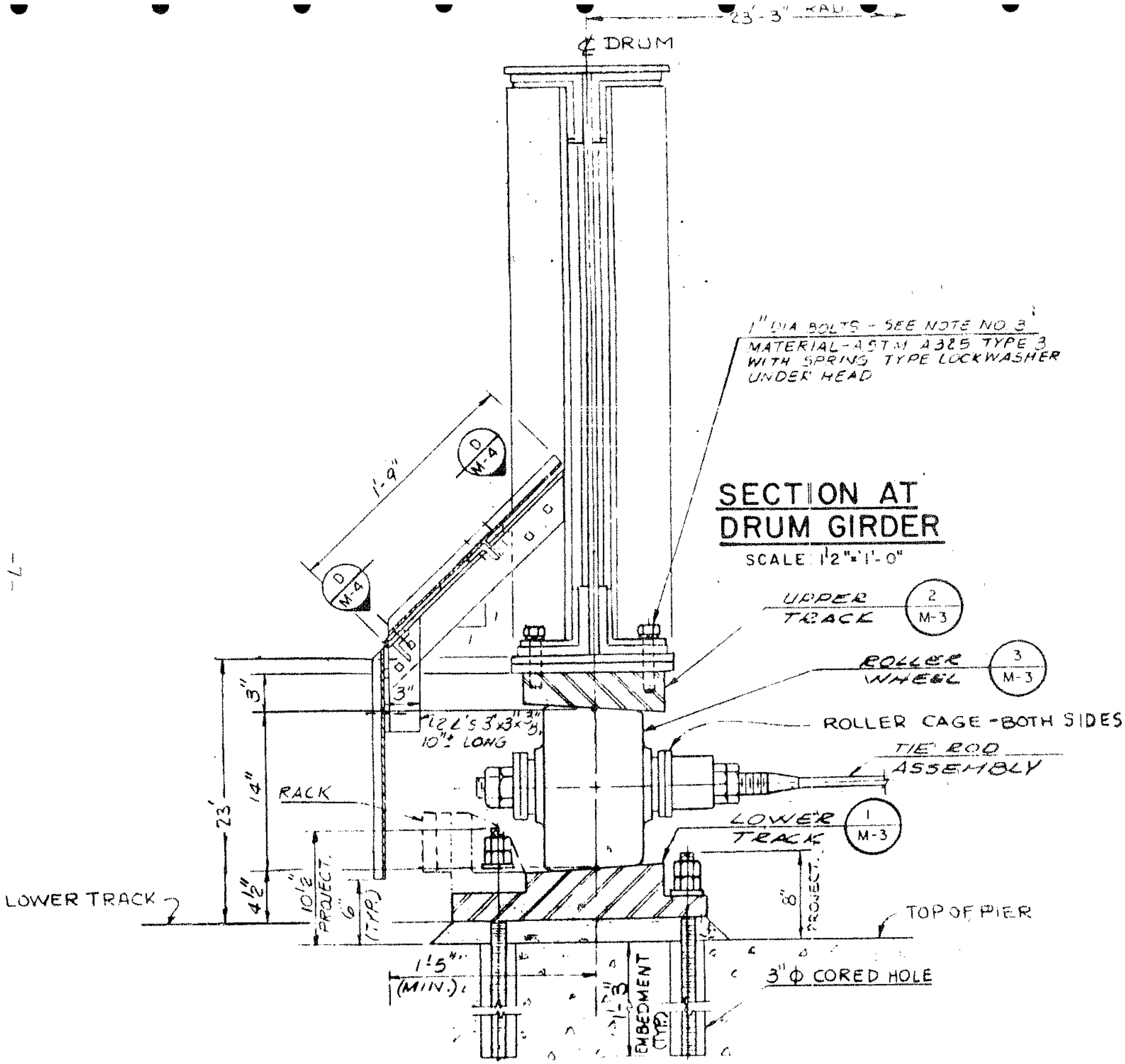
SKETCH # 1



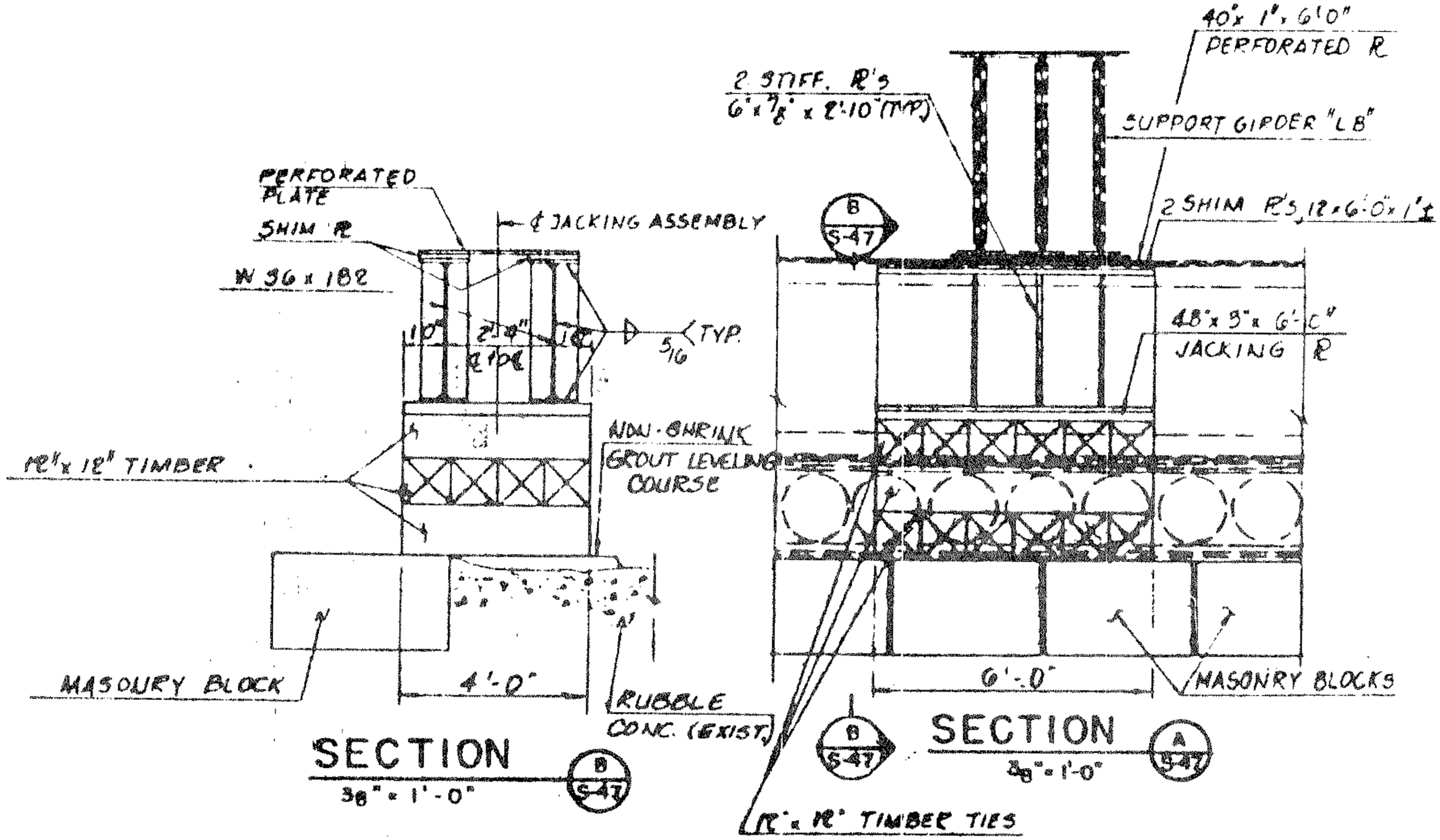

PLAN - SWING SPAN PIVOT PIER

WALK BRIDGE

SKETCH #2

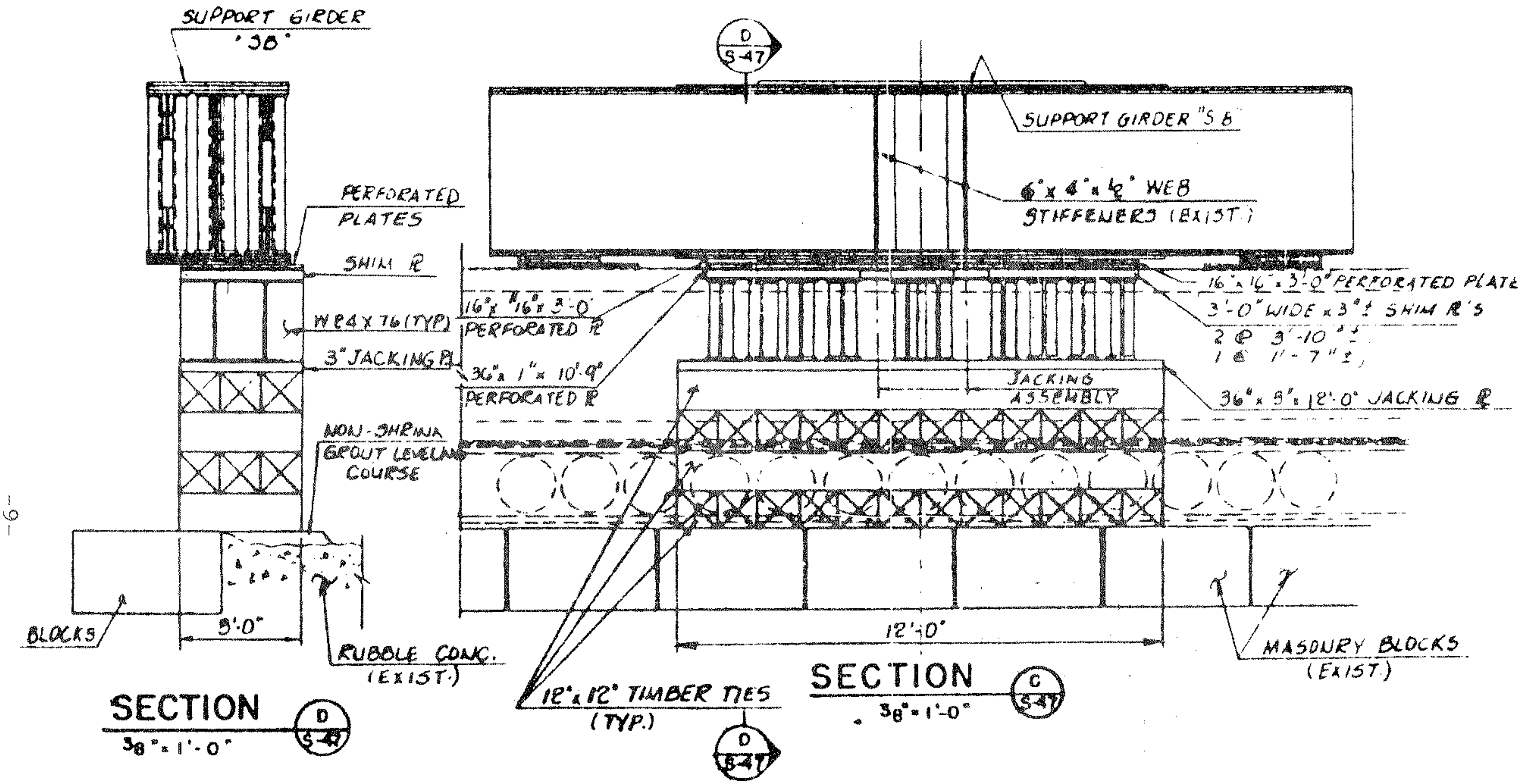



WALK BRIDGE - SKETCH #3




# WALK BRIDGE

## SKETCH #4




# WALK BRIDGE

SKETCH #5