HMS

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SESSION WORKSHOP PRESENTATIONS

"ROLLING LIFT REPAIRS"

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INTRODUCTION

This paper describes two repairs performed on the movable span of the Tacony-Palmyra Bridge which carries four lanes of highway traffic over the Delaware River. The bridge is 3,660 feet long including a 550 foot tied arch span and a 260 foot double leaf rolling lift span. The Tacony Palmyra Bridge is owned and operated by the Burlington County Bridge Commission and is financed by tolls collected from the bridge users. The four lanes of this bridge carry over 55,000 vehicles per day between Philadelphia and New Jersey making it one of the area's major river crossings.

The rolling lift span developed two problems commonly found on bridges of this type:

1. A bronze bushing for one of the main pinion bearings spun and moved axially in the bearing housing preventing lubrication.

2. The angles attaching the tread plates to the segmental girder developed cracks in the vertices of the angles due to corrosion of the bearing surfaces of the webs.

Temporary measures were implemented to mitigate symptoms until long term repairs could be executed under contract. The design objectives in both cases were to provide a long term reliable repair which could be undertaken with reasonable certainty of successful completion, while having the absolute minimum effect possible on highway and marine traffic.

Closing the bridge to highway traffic would inconvenience motorists as well as cause a loss of toll revenues.

Rendering the movable span inoperable would prevent the passage of any ship with a height above water of more than fifty five (55) feet. Many of these large ships are involved in international commerce and treaties require that the waterways be unobstructed. Delaying such a vessel is costly in terms of crew overtime and lost revenue.

The U.S. Coast Guard has many requirements for restricting navigable channels on this type of waterway. In order to minimize the length of time a waterway is restricted, they require the following:

1. Minimize the amount of work to be done during the restriction by completing all possible tasks in advance.

2. Prepare for alternatives in the event the intended repair cannot be completed as planned and have additional tools and supplies available.

3. Work continuously (24 hours per day) along the critical path.

PINION BEARING

Maintenance personnel were unable to lubricate the New Jersey upstream main pinion bearing using a grease gun during routine maintenance. The bushing had moved inboard in the bearing housing causing a misalignment of the lubrication ports between the bushing and the housing. Over many years, the bushing had moved a total of 2 inches, and 1/4 inch since the bridge was last painted. Scoring was found on the outside diameter of the bushing indicating that the bushing had spun in the bearing housing.

An automatic grease pressure lubricator was installed in place of the existing grease fitting and oil was applied to the shaft adjacent to the bushing. The bushing was monitored for movement, but no additional movement was recorded.

The existing bushing was 16 inches long and had an inside diameter of 16 inches. It was held in place within the housing by a "Force Fit" and six 1/4 inch diameter dowel screws, 1 1\2 inches in length according to the original plans. This proved to be inadequate. Current AASHTO Standards require that bushings be held against a rotational force of one sixteenth of the maximum bearing load at the outside diameter of the bushing. The dowel screws were not of sufficient capacity to resist rotation.

The pinion shaft acts as a cantilever to support the pinion. Deflections of the pinon shaft due to high loads tend to create a thrust load in the inboard direction. Misalignment of the span to the pier could also result in a thrust load in the inboard direction.

Various repair options were considered including the following:

1. Move the bearing to its original location using jacks and secure it.
2. Replace the bushing with a split type bushing.
3. Remove the pinion and bushing, install a new bushing and re-install the pinion.
4. Replace the pinion shaft and bushing with a new shaft and bushing.
5. Remove the pinion shaft, machine the bearing journal, install a new bushing and reinstall the pinion shaft.

Option number 2 was selected because of its low cost, certainty of success and minimal downtime. Forcing the bushing back to its original position appears inexpensive, but there was risk of damage to the bushing that would render the span inoperable. That same risk would exist when installing an identical bushing with an interference fit in the field. The options requiring removal of the pinion or pinion shaft would result in a considerable increase in expense and down time due to the rigging, additional equipment, and labor required.

The extent of the damage to the existing bearing journal surface was unknown. Although replacing the pinion shaft or removing it and machining the bearing journal would correct any damage to the journal, repairing the journal surface in place was considered feasible and was far more cost effective.

The following procedure was developed for the project:

Perform the following prior to the four day restriction of the navigable channel.

- Measure the outside diameters of the shaft and bushing.
- Fabricate and perform preliminary machining of a new four piece bushing.

Perform the following during the four day restriction of the navigable channel.