TECHNICAL SUMMARY

Investigation of Elastomeric Bearing Pad Failures in Louisiana Bridges

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INTRODUCTION

Elastomeric bridge bearing pads act as a medium to transfer girder loads to the substructure. In addition to transmitting compressive loads, the pads are capable of translation and rotation movements. These latter movements include the effects of temperature, creep, shrinkage, and impact. Lateral forces developed from these effects are transmitted from the girder to the abutment through friction as shear forces. While providing a medium for the transfer of forces, elastomeric bearing pads protect the structure by preventing abrasion at the connection and absorbing any vibrations due to dynamic live loads.
Elastomeric bearing pads are commonly used because of their low cost, effectiveness, and low maintenance requirements. Converse to the many advantages of elastomeric bearing pads; however, various failure modes are associated with their use. These failure modes include delamination, crystallization, and slippage. This research project addresses the failure mode of slippage.

OBJECTIVE AND SCOPE

The researchers' intent was to investigate DOTD's neoprene bearing pad slippage problem in order to:

- determine the cause of the problem and develop remedial procedures for existing bridges
- determine bridge characteristics where bearing pad failure has occurred and identify bridges that, although failure may not have occurred, may have the potential for bearing slippage
- recommend modifications to the current Louisiana Bridge Design Manual to avoid future bearing pad slippage problems.

A clear understanding on the behavior of elastomeric bearing pads, in particular neoprene bearing pads, was needed to develop any type of corrective measure to the slippage problem. Existing field surveys conducted by the Louisiana Department of Transportation and Development were used to determine locations for an extensive study. Selected sites were monitored for bearing movement over the project study period. These study sites aided in assessing if there were any particular bridge characteristics that were influential in causing bearing pad slippage. Laboratory testing was conducted on the bearing pads to determine bearing pad material composition. The two types of investigations, field and laboratory, provided an approach to analyze the behavior of elastomeric bearing pads and determine the cause of bearing pad slippage.

RESEARCH APPROACH

The research for this project consisted of five focus areas. Initially, a literature search was conducted in order to gain extensive knowledge on the subject. Secondly, surveys including other state Departments of Transportation (DOTs), bearing manufacturers, and researchers were conducted. Thirdly, a continuous field investigation was established to document the behavior of bearings in service. The fourth task included a laboratory investigation to determine the material composition of neoprene bearing pads that had experienced slippage. The fifth and final step summarized the previous phases and derived conclusions for the slippage problem.

Field Investigation

The field investigation consisted of two different procedures. In the first procedure, bearing movements were measured at three sites in conjunction with maximum girder thermal movements over study periods of approximately two weeks. In the second procedure, video equipment was installed at a site to monitor bearing pad movement, temperature, and traffic continually taking a snapshot at three-second intervals. Through these field investigations, bearing pad behavior could be better understood.

Laboratory Investigation

Laboratory tests were conducted on bearing pads that had experienced slippage. Through infrared spectrometer tests, pads were evaluated to determine their material composition. Results of these tests found that the majority of the neoprene pads had some type of wax content that bloomed to the surface of the pad.

CONCLUSIONS

As a result of the tasks performed during this project, the following was concluded:

- Wax is being added to neoprene bearing pads to account for ozone attack.
- Wax blooms to the bearing pad surface and reduces the coefficient of friction and results in bearing pad slippage.
- During girder thermal movements, slippage occurs between the pad-girder interface for tapered bearings on a daily basis.
- Laboratory investigation conducted on ten bearing pads that had experienced walking revealed that at least 80 percent of these pads contained wax.

RECOMMENDATIONS

The investigators concluded that the primary cause of bearing slippage is due to wax blooming to the surface of the bearing pad. In order to remedy this problem, bearing pads should be ordered from bearing manufacturers that do not add wax. In retrofit cases, wax on the surface of the bearing pad and on the concrete contact surfaces need to be removed using a degreasing agent. Wax bloom is a function of the pad hardness. As rubber hardness increases, wax bloom rate increases. Therefore, pads should be designed using a lower hardness to reduce the wax bloom rate. In addition, softer pads allow for greater shear deformation.