



Project Summary

Texas Department of Transportation

0-5834: Study of Elastomeric Bearings for Superelevated U-Beam Bridges

Background

The Bridge Division of the Texas Department of Transportation (TxDOT) utilizes a Texas U-beam section developed in the mid 1980's as an aesthetic alternative to the conventional I-beam. Standard practice requires that these U-beams be supported by three uniform-height steel-reinforced elastomeric bearings. When used on relatively flat grades and negligible transverse superelevations, the standard bearings perform well. However, when the U-beams are placed on a significant transverse superelevation the bearings undergo transverse shear deformations. The Texas Tech Center for Multidisciplinary Research in Transportation (TechMRT) was tasked to investigate whether there was a need to consider the transverse superelevation during new bearing design (and if so, how) and also whether or not there was a need to address existing U-beam bridges that have already been constructed.

What the Researchers Did

TechMRT researchers first determined the current state-of-practice by performing a literature review focused on current design methods for elastomeric bearings and the triaxial state of stress. Next, a survey was mailed to all 50 state departments of transportation (DOTs) which yielded an 80% response rate. Based on results of the state-of-practice review and meetings with TxDOT, TechMRT developed a plan to both inspect existing U-beam bridges and to perform full-scale laboratory testing on the standard TxDOT bearings. In one of the field studies, bearings were instrumented with high-elongation strain gages and monitored from prior to placing the U-beams until after placement of the deck.

Current American Association of State Highway and Transportation Officials (AASHTO) Method A elastomeric bearing design provisions were modified to allow for the inclusion of the transverse superelevation. The results of the inspections and the laboratory testing were compared to the modified design provisions in order to confirm the validity of the proposed changes.

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What They Found

The state-of-practice review revealed that there has not been much research on the specific issue of triaxial loading of elastomeric bearings. Some designers contend that an elastomeric bearing should never be allowed to permanently resist a transverse load such as the load caused by placing a U-beam on a transverse slope. The survey confirmed that the state DOTs are nearly evenly split on this issue with 50% responding that they allow for members to be placed on a transverse slope and 47.5% responding that they do not allow for members to be placed on a transverse slope.

The proposed modifications to the AASHTO Method A design provisions showed that including the transverse slope in new bearing design does significantly impact the design of new bearings. The proposed modifications were compared to observations in the field and to the full-scale laboratory testing. Overall, the proposed modifications matched the observations well.

Electronic monitoring of existing bearings was found to be unreliable primarily because of the bulging that occurs on the sides of a steel-reinforced bearing. Instead of electronically monitoring existing bearings, TechMRT devised a way to record the condition of the bearing during the routine bridge inspection.

What This Means

The transverse slope should be considered in new design. Proposed revisions to the AASHTO Method A design have been suggested. Unless special provisions are made and the design calculations show that it is acceptable, U-beams should not be placed on a transverse slope exceeding 4%. For existing U-beam bridges, TechMRT recommends that the condition of the existing bearings be monitored as part of the routine bridge inspection. Recommended changes to the TxDOT "*Elements*" *Field Inspection and Coding Manual* should aid in the monitoring of the existing bearings.

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