Project Summary

Texas Department of Transportation

0-6438: Evaluation of Superheavy Load Criteria for Bridges

Background

Permitted vehicle loads classified as “superheavy loads” are ones that trigger a bridge review. TxDOT Superheavy Load Criteria for Bridges cover trucks with combined gross vehicle weights (CGVWs) over 254,300 lb, or CGVWs over 200,000 lb if less than 95 ft in length. The average bridge-review-trigger load in the United States is 165,000 lb. Compared to those of many states, the TxDOT criteria are less conservative.

TxDOT criteria were initially developed to protect Texas bridges from overloads due to tire cranes in use at that time. The number of superheavy loads in Texas continues to increase. TxDOT now permits over 1000 superheavy loads per year. It is not unusual for a hauler to request to move a load with a CGVW of more than 1,500,000 lb. For comparison, a legal semi-trailer truck, commonly known as an 18-wheeler, has a CGVW of 80,000 lb.

Bridges are designed for occasional loading with heavier operational-level loads; however, some bridges in the state carry these loads often enough that it is no longer occasional use. Repeated heavy loading of bridges may cause the bridges to experience rapid deterioration or a reduction in service life. Therefore TxDOT needs to evaluate the criteria and verify that they adequately protect Texas bridges from the increasing weights and frequency of superheavy loads.

What the Researchers Did

Researchers used ANSYS 12 to perform solid modeling of a 3-span continuous steel girder unit of the Brazos River Bridge on SH 159. The model was calibrated with a bridge test. The bridge testing measured girder displacements under known vehicle loads. The calibrated model was used to conduct a parametric study. The service life extension of Texas bridges from reduced stress levels was studied using approximations for fatigue life, mean stress effects, and the effects of variations in stress amplitude.

What They Found

Axle loads distribute throughout the width of the bridge much better than is assumed during design. Lateral-load axle distribution factors of 0.28 and 0.45 were experimentally determined for interior and exterior girders, respectively. The results of three-dimensional solid modeling gave the same axle distribution factors.

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Results of the parametric study showed that the Texas superheavy load criteria are valid for this bridge type. Bridge permit load rating numbers were high, and flexural stresses were low (less than 20 percent of yield stress). A study of service life extension showed that operational-stress-level loads applied as little as 5 percent of the time to a particular structure may have a significant effect on the service life of the structure, and that the number of fatigue load cycles per truck cannot be assumed to be one.

What This Means

Although frequent application of operational-stress-level loads reduces the service life of bridges, research shows that this stress level is not often or easily reached. This is due primarily to the criteria and evaluation procedures. Other factors include lateral distribution of load that is better than is assumed in code, decks that are composite with girders, and bridge rails (barriers) that contribute strength. Because the TxDOT criteria are based on an empirical curve, a graphical version of the bridge-review trigger (load-length curve with existing axle allowances and restrictions) might serve TxDOT and heavy-haul carriers better than the gross vehicle weight triggers alone. The graphical version of the criteria would allow carriers to attempt to configure their loads such that the loads do not trigger a bridge review, and could save them time and expense. This would reduce the number of superheavy permits, while continuing to protect Texas bridges from overloads.

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