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DESIGN LIVE LOAD ON BOX CULVERTS

PROBLEM STATEMENT

In 1998, the Department adopted the AASHTO LRFD code to design all of the structures for Florida's highway system. Box culverts are one of the structures affected by this new code. The Structures Design Office has found several areas in which the new code is very conservative and difficult to apply, when compared with the present code. The live load distribution mechanism and the calculations used to obtain the most critical combination of the live loads constitutes one such area.

OBJECTIVE

The project objective was to determine a new method for generating design live loads for concrete box culverts that would be sound but not overly conservative. By simplifying this portion of the design process, a significant savings in design time could be achieved.

FINDINGS AND CONCLUSIONS

The project resulted in a simple equation to calculate live loads for the design of box culverts. In developing the equation, the superposition method (based on the integration of the Boussinesq solution over a rectangular loaded area) was used to develop a load distribution on a culvert for various depths of fill and various loadings. The live loadings used corresponded to the AASHTO design tandem and design truck geometries, placed either in a one or two loaded lane configuration. Based on the load distributions generated on the top slab on the box culvert, the controlling shears and moments were determined. These values were then used to determine the uniform distributed load that would generate the same maximum moment or shear in the culvert. These uniformly distributed loads were then plotted against the depth of fill, and an equation was found that best represented the data. The resulting equation is shown below. The results, determined using this equation, were found to compare well with the results generated using the more complicated AASHTO method. The equation is based on the design of a typical one foot strip of the top slab with an equivalent uniformly distributed load q, with units of plf, and depth of fill z with units in feet.

$$q = \frac{2300}{z}$$

BENEFITS

The results of this project provide recommendations for a simplified design method for box culvert systems. Use of the simplified method should result in a significant savings in design time for these systems

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