Project Information Form

Project Title	Evaluation of Anchor Bolt Clearance Discrepancies
University	University of Alabama at Birmingham
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Funding Source(s) and Amounts Provided (by each agency or organization)	UTC: $50,000 ALDOT (Matching Source): $50,000
Total Project Cost	$100,000
Agency ID or Contract Number	DTRT12GUTC12 NCTSPM 2013-047
Start and End Dates	To be determined (18 month duration)
Brief Description of Research Project	The objective of the research is to evaluate the effect of non-uniform clearance distances on the distribution of stresses to the anchor bolts. The clearance distance is defined as the length from the underside of the base plate to the foundation. These connections are typical for highway overhead cantilever sign support structures, consisting of a double-nut-moment anchor bolt joint to concrete foundation. The presence of the non-uniform clearance distances were due to topographical limitations and leveling procedures performed at the site during construction. Previous experimental studies indicated a portion of the anchor bolts were exposed to stresses that were significantly larger than calculated design values, as well as the fatigue endurance limit for the particular connection detail. The structure—designed for an infinite life with respect to fatigue—would likewise have a finite life resulting in

	premature fatigue failure, and may have higher consequences during extreme wind events. The ongoing research will investigate the effect of non-uniform clearances on the distribution of stresses to the anchor bolts due to fatigue wind and extreme wind events, assess the severity of structures with this condition, and develop an improved structural analysis procedure on anchor bolts stresses for future planning and design. A design of experiment (DOE) approach will be used by setting specific factors with associated levels and relating their effect on anchor bolt stress and distribution. Factors include but are not limited to uniform and non-uniform clearances, number of anchor bolts, bolt tightening, fatigue wind and extreme wind loading events, and altering loading scenarios (e.g. bending moment, torsion, etc.). Finite element analysis (FEA) modeling will be used to determine the anchor bolts stress distribution with respect to the different factors and associated levels. The ANSYS FEA software package will be applied for this task, utilizing higher-order quadratic isoparametric hexahedral elements (i.e. brick elements that can map complex shapes with mid-side nodes) for geometric modeling and solutions. A factorial analysis will be used to evaluate the FEA results by providing a level of significance of a single factor or level or a combination of factors and levels on anchor bolt stress and distribution. The primary innovation of the research is to provide analysis on the effects of construction methods such as leveling and clearance distances on the stress distribution to the anchor bolts. If successful, the research will provide assessment measures to monitor the current and future structural health and state-of-good repair for these structures. The anchor bolt clearance discrepancy problem raises considerable safety issues in regards to the transportation infrastructure and the general public. The severity of this condition will be addressed and can be used for early identification of structures in the field that are susceptible to damage. By raising this issue, design concerns and construction methods can be altered to reduce the risk of anchor bolt damage in the future and contend with existing anchor bolt conditions, which could potentially produce considerable cost savings for state DOT's.
Describe Implementation of Research Outcomes (or why not implemented)	Nothing to report at this time

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(Attach Any Photos)	
Impacts/Benefits of Implementation (actual, not anticipated)	Nothing to report at this time
Web Links • Reports • Project website	Nothing to report at this time