FACT SHEET

MASH Evaluation of NETC Steel Bridge Rail and Transition Details using Finite Element Analysis

RESEARCH PROJECT TITLE

Development of MASH Computer Simulated Steel Bridge Rail and Transition Details

STUDY TIMELINE

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MORE INFORMATION

https://www.newenglandtransportationconsortium.org/projects/netc-18-1/#

The New England Transportation Consortium, a cooperative effort of the transportation agencies of the six New England States, funded this research. Through the Consortium, the states pool professional, academic and financial resources for transportation research leading to the development of improved methods for dealing with common problems associated with the administration, planning, design, construction, rehabilitation, reconstruction, operation and maintenance of the region's transportation system.

Introduction or What was the Problem?

The current policy for roadside hardware installed on federal-aid projects requires upgrading non-conforming systems to *MASH* acceptance level for full system replacements, certain structural rehabilitations such as deck replacements, or repairing a critically damaged bridge rail system. The predominate bridge rail and approach guardrail transition (AGT) systems used in Maine, as well as the other New England states, include details for 2-bar, 3-bar and 4-bar designs, which were developed and tested under prior crash testing and evaluation standards. It was of interest to the New England DOT's to determine if these existing NETC bridge rail systems met the strength and safety criteria of the current test standards of *MASH*, which involve higher impact severities than previous crash testing standards.

Methodology

A critical review of current standard details and specifications for NETC style bridge rails and transitions used by MaineDOT, NHDOT, RIDOT and VTrans was conducted to identify differences in material specifications and dimensional details. An initial performance assessment was made for each bridge rail design based on strength calculations and rail geometrics calculations for *MASH* loading conditions according to procedures in NCHRP 20-07 (Task 395). Preliminary recommendations were made for NETC bridge rail and AGT design details for further crash performance evaluations in this study.

The crash evaluations were conducted using finite element analysis (FEA) to assess crashworthiness under *MASH* conditions. Detailed FEA models of the bridge rails and transition systems were developed, and the FEA software LS-DYNA was used to simulate existing full-scale crash tests to assess the validity of the models according to the procedures of NCHRP Document 179. The validated models were then used to assess crash performance of the NETC designs under *MASH* impact conditions and evaluation criteria.

Conclusions

The results of the study showed that the NETC 2-bar and 3-bar designs meet *MASH* TL3 and TL4 requirements, respectively. The NETC 4-bar design was also shown to meet *MASH* TL4 requirements, albeit with considerable damage to the system. Redesign of the bridge rail systems was not a primary focus of this study; however, in some cases general recommendations for design improvements that the research team believes would further improve crash performance were provided, such as increasing the size of the HSS rails to improve system strength, revising the splice design to minimize lateral movement in the splice connections by reducing internal gaps, tapering the tops of the posts to mitigate snagging on the posts when parts of a vehicle (e.g., cargo-box on single-unit trucks) overhang the top rail.

What are potential impacts?

The NETC bridge rail designs have been in service for more than 20 years, and, based on discussions with the State DOTs, there have been no known instances of serious injuries from crashes with these systems. The results of this study provide further evidence of the crashworthiness of these designs, which will aid State engineers in making informed decisions on their continued use. As with all safety hardware, in-service evaluations should be routinely performed to ensure proper installation and maintenance, as well as, crash performance.