Review of Past MnDOT Barrier Types: Literature Search
IdeaScale #137

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Prepared for: Bruce Holdhusen
Prepared by: Sheila Hatchell
Resources searched: MnDOT Library Catalog, TRIS Database, TRID Database, RIP Database, Internet

Summary: My interpretation of this proposal request is that the Bridge Office would like to create a survey/inventory of the older barriers and parapets currently in use to determine which no longer meet code and current standards. They would further like to determine the capacity of each barrier type and develop guidance and criteria for determining when an existing barrier should be upgraded or replaced with one that meets current standards. Because this project is MnDOT centric-specific, it was highly unlikely that I would find any relevant existing research, and this proved to be true. I spent the majority of my time looking for references on how to determine the capacity of barrier types, and any existing criteria to use for determining when an existing barrier should be upgraded or replaced with one that meets current standards.

Most Relevant Results
I was able to locate no relevant results for this search.

Least Relevant Results
Title: Traffic Ancillary Structures Inventory & Inspection Manual
Virginia Dept. of Transportation
Structure and Bridge Division
June 30, 2014

Abstract/Preface
The purpose of the Traffic Ancillary Structure Program is to provide the Virginia Department of Transportation (VDOT) with the inventory and inspection information necessary to determine the ancillary structures’ physical and functional condition. This information will be used to develop priorities for their maintenance or replacement. Due to their typically non-redundant structural configuration and proximity to the roadway, these ancillary structures have the potential to directly affect the safety of the roadways. This program primarily focuses on structural evaluation, with a secondary focus on functionality. This focus is mandated by the level of impact a structural defect could have on the roadway. As an example, a sign with poor legibility may cause distraction or hazards along the roadway it serves, and the program should address such a defect. However, a collapsing sign may land in the roadway, posing a much larger danger. For this reason, the primary focus of the program is on the structural evaluation of the traffic ancillary structures. Due to several significant failures
having occurred throughout the US, increasing focus has and is being placed by many States, as well as the Federal Highway Administration (FHWA), on the proper management, inventory, and inspection of these structures. VDOT has long recognized the value of such a program, having officially issued the first inspection manual in 1999 with an update in 2006. Throughout the years, more structure types have been identified as necessitating inspection, better inspection methodologies developed, and the program has continued to grow. The purpose of this manual is to provide the most current inventory and inspection practices and procedures that will continue to ensure safety on the roadway. Due to the vast variation of the elements, configurations, and inspection techniques of ancillary structures, it is not practical to capture all of these variations within the manual. The intent of the manual is to outline some of the most common of these variations. Through comparison to what has been provided here, and through judgment and experience, the inspector should be sufficiently equipped to distinguish the appropriate approach to the inspection.

Title: Frequently Asked Questions: Barriers, Terminals, Transitions, Attenuators and Bridge Railings
FHWA
March 31, 2017

Abstract:
FHWA barrier guidance is contained in the AASHTO Roadside Design Guide. However, FHWA field offices often raise numerous issues that involve interpretations, extrapolations, device selection, hardware deployment, or simply trying to fit safety devices into real world conditions.

These questions and answers offer clarification on the use of roadside hardware for issues not covered by FHWA policy or topics that simply need additional explanation. They are the considered opinions of engineers in the FHWA Office of Safety Design and the FHWA Resource Center with helpful input from members of the American Traffic Safety Services Association's Guardrail Committee.

In general the questions relate to rigid and semi-rigid barrier systems. The Office of Safety's July 20, 2007, memorandum on Cable Barrier Considerations dealt with numerous issues of cable barrier design, selection, and placement. Additional guidance on cable barrier selection and placement on sloping terrains and adjacent to median ditches will be provided in conjunction with National Cooperative Highway Research Project 22-25, scheduled for completion in early 2010. A similar project (NCHRP 20-7(257)) synthesizing information on portable concrete barrier shapes, connections, anchorages, and other considerations will also be completed soon.

As noted at the end of the FAQ list, we expect to develop additional guidance in this format. Please contact Mr. Nicholas Artimovich at nick.artimovich@dot.gov if you have a special need for guidance in any of those areas, or to suggest others

Title: Network Wide Assessment of Bridge Barrier Safety (contact Sheila for full report)
Andrew Sonnenberg - Australia
National Bridge Engineering Manager, PittSherry
April 2017

Abstract:
The need for higher performance bridge barriers has been reflected in changes in barrier design over the last 100 years. These changes have lead to improvements in safety. There exists however many aging bridges with barriers that do not meet current standards. In order to manage the risk of these substandard barriers Asset Owners require tools to rate the risk and to prioritise the upgrade of barriers. Pitt & Sherry has developed a method for rating the risk of barriers across a network in a manner that allows asset owners to allocate their limited funding where it is most
needed. This method has been successfully applied by Pitt & Sherry to the prioritisation of bridge barrier upgrade for a number of Councils as well as a State Road Authority.

Title: Bridge Rails and Barriers
CALTRANS and California Coastal Commission
Undated

Abstract
This guide has been prepared as a tool to help stakeholders and participants in bridge and railing design to better understand options available for potentially successful application in future projects. Hopefully, this information will help to streamline the processes of rail selection and coastal development permitting. Part II, Rails and Barriers, presents fundamental design standards as well as a wide array of rail examples of (both preliminary designs and final selections) exhibiting site-specific features; aesthetic designs and treatments; and design features to ensure safety, ease of maintenance, and versatility. The successful combination of these characteristics supports compatibility and compliance with both Caltrans standards and Coastal Act/LCP policies. Several examples in this document reflect projects that have been approved, and in some cases already constructed, in the coastal zone. As noted above, not all of the railing and barrier types contained in this guide would be appropriate for every project. Furthermore, some of the built examples provide useful guidance for potentially improving railing designs in future applications. Again, while the use of railings depicted in this document does not guarantee coastal development permit approval for any given project, since each project must be evaluated within its specific context, this compilation represents the currently available palette of railing types that may be successfully tailored for upcoming projects. Part III, Reference Material, is a list of sources and links that provide additional in-depth information for more detailed study and project development.

Title: Bridge Railing Manual
Texas Dept. of Transportation
July 2016

Abstract / Purpose and Contents:
This manual summarizes current policies governing the use of bridge railing in Texas, and it provides information on acceptable Texas bridge railing types.

The revisions in this version add new railing types T221P and T224; update the test lever (TL) for select railings; add the AASHTO/FHWA joint memo for MASH implementation; add steel barriers for temporary use; update combination railings acceptable for high-speed use.

Title: Highway and Bridge Barrier Rail Report
State of Maine Department of Transportation
November 2016

Abstract/Introduction:
Recent guardrail and bridge barrier rail issues at the national and state level have raised concerns and prompted statewide inspections and investigations into the general condition of barrier and the ability of the barrier to function as intended. In 2015 the Department completed a detailed inventory of the Trinity ET-Plus guardrail end terminals installed along our highways as well as inspections of a random sample. The results show that 14% of these systems are
considered nonfunctional while another 24% have some deficiencies when compared to manufacturer’s installation details. This prompted a similar 2016 investigation into other end terminal systems to determine if the problems are limited to only one type and manufacturer. The results of this study show 8% to 14% of the end terminals are nonfunctional while 22% to 33% have some deficiencies. Meanwhile the Department has closely inspected bridge rail similar to the Bath Viaduct after a vehicle tumbled over the rail during icy conditions. Finally MASH standards for crash testing barriers are being adopted by AASHTO and the Department needs to develop an implementation plan.

Title: Anchorage Capacity of Concrete Bridge Barriers Reinforced with GFRP Bars with Headed Ends
Hossein Azimi and others
September 2014

Abstract
An experimental program was conducted to investigate the application of headed glass fiber-reinforced polymer (GFRP) ribbed bars at the barrier wall-deck anchorage. Six full-scale barrier models of 1,200 mm in length were erected and tested under static monotonic loading to determine their ultimate load-carrying capacities and failure modes with respect to the barrier wall-deck anchorage. Four PL-2 barrier specimens were cast: two of them were of tapered face and the other two specimens were of parapet type with constant thickness. Each set had a steel-reinforced specimen as the control model and a GFRP-reinforced specimen. In addition, two PL-3 GFRP-reinforced specimens were erected with different spacing of GFRP bars. Each specimen was loaded laterally until collapse. This paper presents the results from these tests in the form of crack pattern, deflection history, and ultimate load-carrying capacity. Experimental results were compared with the design values specified in the Canadian bridge code for barrier anchorage into the deck slabs, showing a large margin of safety for the proposed GFRP-reinforced barriers. In addition, a parametric study was undertaken using finite-element analysis to investigate the applicability of resultant design loads prescribed by the Canadian bridge code for the design of the barrier wall-deck anchorage. The key parameters considered in this study were deck overhang length and thickness and barrier length. The data generated from this parametric study were used to develop set of empirical expressions for the factored applied moment at the barrier-deck interface, as well as the factored tensile force required to design the deck slab cantilever.

Title: Repair of GFRP-Reinforced Concrete Bridge Barriers
Ehab El-Salakawy and Mohammad Rubiat Islam
June 2014

Abstract
The Canadian highway bridge design code provides dimensions and reinforcement detailing of concrete bridge barriers reinforced with glass fiber–reinforced polymer (GFRP) bars. However, there are no guidelines on the repair of such concrete elements in case of damage caused by vehicle accidents. Therefore, the main objective of this study is to evaluate the feasibility and efficiency of available techniques to repair damaged GFRP-RC bridge barriers. To fulfill this objective, three full-scale, 6.0-m-long, PL-2 concrete bridge barriers, totally reinforced with GFRP bars, were constructed and tested under an equivalent static load, simulating a vehicle crash test. Two different repair techniques, planting and near-surface-mounted (NSM) fiber-reinforced polymer (FRP) bars, were used to repair the damaged barriers. Repaired barriers were retested under similar conditions to evaluate the effectiveness of the repair techniques. It is concluded that the repaired GFRP-RC bridge barriers achieved similar capacities to their counterpart control (undamaged) barriers.