Project Summary

Texas Department of Transportation

0-6363: Improvements to Large and Small Roadside Sign Hardware and Design

Background

Many Texas Department of Transportation (TxDOT) design practices for sign mounting may no longer be appropriate given changes in sign materials, fabrication methods, and installation practices. In addition to being crashworthy, a sign support should withstand anticipated service loads and be cost-effective in terms of installation, maintenance, and repair.

What the Researchers Did

- Researchers compared the two acceptable methods of calculating wind pressures as described in AASHTO's *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.
- Since the actual material properties of sign supports supplied to TxDOT are significantly greater than the minimums set by TxDOT, researchers performed static testing to see if a 42 sq. ft sign panel could be supported on a single schedule 80 support.
- TxDOT has two types of 2.5-inch nominal pipe sign support thicknesses in inventory: 10 British Wire Gage (BWG) and schedule 80. Researchers analyzed schedule 40 supports to determine maximum sign area and the calculated capacity was compared to the two current section capacities.
- Researchers reviewed the current wind load charts used by TxDOT and examined major differences between the W8×18 and W8×21 slipbase connection details to determine if they could be unified.
- Researchers performed static tests to determine the panel torsional capacity relationship without vertical stiffeners and the additional torsional stiffness gained with the addition of vertical stiffeners.
- Researchers selected a 10-ft × 16-ft sign panel with 81.1 kip-ft static torsional capacity for crash testing without a fuse plate to verify that the sign panel without stiffeners would provide capacity to fail the optimized W8×18 fuse plate connection without failing the *Manual for Assessing Safety Hardware (MASH) occupant impact Velocity* (OIV) requirements. Researchers performed a second test to verify the fuse plate would fail before the weakened post would yield/buckle when struck by a vehicle.
- Since the cost savings of placing larger signs on smaller supports did not equate to enough savings to compensate for the cost of the torsional stiffeners, TxDOT decided to proceed with updating support selection charts for current fuse plate designs and generating the wind load charts according to the Legacy Method of calculating wind pressures.
- After finite element simulations predicted impact location and severity, researchers performed full-scale crash tests in accordance with *MASH* test levels 3-61 and 3-62 to establish a minimum sign area to be mounted on a slipbase system.

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Project Completed: 8-31-11

- TTI investigated the possibility, from a crashworthiness point of view, to allow 30-inch × 36-inch and 36-inch × 48-inch chevron sign sizes on a 4 ft mounting height.
- TTI reviewed instances of "U-bracket" failures in the field to evaluate witnessed failure modes, completed analyses, and performed static tests on U-bracket supports.

What They Found

- Both AASHTO methods for calculation of wind load pressure should result in similar wind pressures; however, for a given location either method may be greater than the other depending on associated factors. To use the new method, may require the update of TxDOT wind zone charts that are also utilized by other supports and luminaries.
- The maximum sign area for a schedule 80 support due to wind loading can be increased to 42 sq. ft if the minimum yield stress is increased to 66 ksi. Further risk analysis showed that a majority of the posts being supplied have sufficient yield stress to support a sq. 42 ft sign panel.
- Analysis of schedule 40 sign supports demonstrated that it is not economically efficient to add them to current inventories unless minimum yield stresses are increased significantly.
- Static testing showed that the W8×18 post section may benefit in some situations from using the stronger W8×21 slipbase configuration.
- Torsional stiffeners have no bearing on the structural capacities of sign panels and can be removed from TxDOT standards.
- New optimized fuse plates were developed and tested according to *MASH*. TxDOT has decided that the added cost of the torsional stiffeners outweigh the cost savings of the optimized fuse plates, and therefore will not be utilizing the design.
- Since TxDOT has decided to maintain the use of current fuse plate designs, TTI prepared new large sign support post guide selection charts meeting current wind load design requirements.
- Signs with an area smaller than 14 sq. ft should be mounted on a 13 BWG pole with a wedge and socket system. Signs with an area greater than 24 sq. ft should be mounted on a schedule 80 pole with a slipbase support system.
- While investigating standards for chevron installations, the current TxDOT D&OM standard sheets were revised and suggestions made for more efficient presentation of material and installation information.
- Engineering analysis shows that the capacity of U-brackets exceeds that of the schedule 80 support. Static load capacities far exceed values calculated as part of wind load analysis. Failures seem to be limited to older designs.

What This Means

The new roadside safety hardware developed and other analyses performed under this project will improve motorist safety, reduce material and installation costs, and improve operations.

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