New Hampshire DOT

Research Record

Determining a Strategy for Efficiently Managing Sign Retroreflectivity in New Hampshire

Final Report

Prepared by the New Hampshire Department of Transportation in cooperation with the U.S. Department of Transportation, Federal Highway Administration

Technical Report Documentation Page

1. Report No. FHWA-NH-RD-14282V	**2. Gov. Accession No.**	**3. Recipient's Catalog No.**
4. Title and Subtitle DETERMINING A STRATEGY FOR EFFICIENTLY MANAGING SIGN RETROREFLECTIVITY IN NEW HAMPSHIRE		**5. Report Date** May 2012
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9. Performing Organization Name and Address New Hampshire Department of Transportation Bureau of Traffic 18 Smokey Bear Blvd. Concord, NH 03301		**10. Work Unit No. (TRAIS)**
		11. Contract or Grant No. 14282V, X-A000(853)
12. Sponsoring Agency Name and Address New Hampshire Department of Transportation Bureau of Materials and Research 7 Hazen Drive, PO Box 483 Concord, NH 03302-0483		**13. Type of Report and Period Covered** FINAL REPORT
		14. Sponsoring Agency Code

15. Supplementary Notes

In cooperation with the U. S. Department of Transportation, Federal Highway Administration

16. Abstract

The Manual on Uniform Traffic Control Devices (MUTCD) has developed minimum retroreflectivity requirements for sign sheeting that will become a federal mandate for roadside signs in 2015 and for overhead signs in 2018. In 2012, the New Hampshire Department of Transportation (NHDOT) was required by the Federal Highway Administration (FHWA) to have a plan in place for meeting these requirements.

The MUTCD has identified five acceptable methods that fall into two categories for determining if signs meet the requirements. In the Assessment category, the methods listed are Visual Nighttime Inspection and Measured Sign Retroreflectivity. In the Management category, the methods listed are Expected Sign Life, Blanket Replacement, and Control Signs.

This project focused on determining a method that was most suited to the needs of the NHDOT. Each method has advantages and disadvantages that were considered during the selection of an appropriate plan.

Once all the methods were assessed, it was determined that Visual Nighttime Inspection would be the most economical due to the quickness that the review can be accomplished and the minimal resources required to conduct the inspection. Another major factor for selecting the visual night inspection was that a statewide sign inventory is currently not available. If a current inventory was available, other methods may prove to be more efficient.

17. Key Words Sign sheeting, retroreflectivity, test method, assessment, inspection,	**18. Distribution Statement** No restrictions. This document is available to the public through the National Technical Information Service, Springfield, Virginia, 22161

19. Security Classif. (of this report)	**20. Security Classif. (of this page)**	**21. No. of Pages**	**22. Price**
Unclassified	Unclassified	11	

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Determining a Strategy for Efficiently Managing Sign Retroreflectivity in New Hampshire

SPR Project # 14282V

May 2012

ACKNOWLEDGMENTS

This project was funded through State Planning and Research (SPR). A special thanks to NH Motor Speedway, members of the TAG and the Traffic Bureau sign section.

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EXECUTIVE SUMMARY

The Manual on Uniform Traffic Control Devices (MUTCD) has developed minimum retroreflectivity requirements for sign sheeting that will become a federal mandate for roadside signs in 2015 and for overhead signs in 2018. In 2012, the New Hampshire Department of Transportation (NHDOT) was required by the Federal Highway Administration (FHWA) to have a plan in place for meeting these requirements.

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INTRODUCTION

The MUTCD establishes the basic principles for the selection, design, installation, and maintenance of traffic control devices. Part 2 of the MUTCD addresses highway signing and includes the following requirements with respect to retroreflectivity:

"*Regulatory, warning, and guide signs and object markers shall be retroreflective or illuminated to show the same shape and similar color by both day and night*" and *"Public agencies or officials having jurisdiction shall use an assessment method that is designed to maintain sign retroreflectivity at or above the minimum levels."*

The MUTCD also states that one of the following methods should be used to maintain sign retroreflectivity:

A. Visual Nighttime Inspection - The retroreflectivity of an existing sign is assessed by a trained sign inspector conducting a visual inspection from a moving vehicle during nighttime conditions. Signs that are visually identified by the inspector to have retroreflectivity below the minimum levels should be replaced.

B. Measured Sign Retroreflectivity - Sign retroreflectivity is measured using a retroreflectometer. Signs with retroreflectivity below the minimum levels should be replaced.

C. Expected Sign Life - When signs are installed, the installation date is labeled or recorded so that the age of a sign is known. The age of the sign is compared to the expected sign life. The expected sign life is based on the experience of sign retroreflectivity degradation in a geographic area compared to the minimum levels. Signs older than the expected life should be replaced.

D. Blanket Replacement - All signs in an area/corridor, or of a given type, should be replaced at specified intervals. This eliminates the need to assess retroreflectivity or track the life of individual signs. The replacement interval is based on the expected sign life, compared to the minimum levels, for the shortest-life material used on the affected signs.

E. Control Signs - Replacement of signs in the field is based on the performance of a sample of control signs. The control signs might be a small sample located in a maintenance yard or a sample of signs in the field. The control signs are monitored to determine the end of retroreflective life for the associated signs. All field signs represented by the control sample should be replaced before the retroreflectivity levels of the control sample reach the minimum levels.

F. Other Methods -Other methods developed based on engineering studies can be used.

It is also permissible to combine different methods for different installation types based on the specific needs of an agency.

Over time, the retroreflectivity of traffic sign sheeting degrades due to ultraviolet rays, wind, road dust and debris, and snow plow and maintenance activities. Because of this, there is no specific length of time when a sign needs to be replaced. For instance a sign facing north may last substantially longer than a sign facing south. Due to these variables, a sign management method needs to be developed to minimize the number of signs that fall below minimum retroreflectivity requirements.

CURRENT NHDOT SIGN REPLACEMENT PRACTICE

NHDOT currently maintains an estimated 66,000 traffic signs statewide and prior to 2010 these signs would be replaced if:

- They were knocked down by a motor vehicle or plow operation
- They were damaged due to vandalism
- They were replaced as part of a capital improvement project
- They were in poor shape as determined by the sign maintenance foreman during a daytime inspection

None of these methods were directly related to the retroreflectivity of the sign and therefore the NHDOT had fallen behind sign maintenance for this important attribute of a sign.

ANALYSIS OF RECOMMENDED METHODS

Visual Nighttime Inspection: A nighttime inspection requires a trained inspector to review signing and determine if the sign meets the minimum retroreflectivity requirements. This method can be done quickly because the evaluation is performed at highway speeds. It does not require a sign inventory, but it does need to include a method to identify signs not meeting retroreflectivity so they can located later for actual replacement. Although fast and efficient, it is the most subjective of all measures, especially with multiple inspectors having varied eye acuity. In order to measure the effectiveness of the training, a quality control plan will be needed to ensure that the majority of signs being passed during night review meet the minimum retroreflectivity values in the MUTCD.

Measured Sign Retroreflectivity: The NHDOT has access to two retroreflectometers. There are 66,000 signs to measure. With no additional resources available to accomplish this, it was quickly realized that this would not be a viable option in the short term. However, if a sign inventory is created, and there is a way to document retroreflectivity at intervals of a signs life, this data could be used to target replacements based on actual retroreflectivity.

Expected Sign Life: For this method to be considered there is a need for a sign inventory that would document at a minimum; location, installation date, color, and facing direction. Since NHDOT does not have a sign inventory this method is not feasible. If a sign inventory is created, gathering this information would be useful.

Blanket Replacement: This method eliminates the need for a sign inventory; however, it does require documentation of when a corridor or an area of signs was replaced. As with expected sign life, the estimated service life needs to be established in particular for signs that have the shortest length of effectiveness. Although this method would be easier to track than a full sign inventory, many signs with some use left in them would be replaced prematurely. This will artificially increase our sign replacement budget.

Control Signs: This is similar to blanket replacement. Instead of replacing all the signs on a corridor or in an area, signs are replaced by color, sheeting type and/or facing direction based on a representative sample of signs. This method will reduce the number of signs removed with some service life left when compared to the blanket replacement method. Similar to the expected life method, it will require a sign inventory to know where and when signs need to be replaced.

NHDOT does not currently have a sign inventory that could be used for any of the methods that would require such to be effective. Therefore, those methods were not considered. NHDOT does realize the importance of having a sign inventory and that remains a high priority for the Traffic Bureau. If an inventory is established, then the methods discarded during this study could be reconsidered.

The other data that the NHDOT does not have, which would be useful for other replacement methods, is expected sign life. This service life can be affected by many variables but the most influential are average annual precipitation, elevation, seasonal temperature swing, and the exposure of the sign. Age of sign, sheeting color and sheeting type are additional factors that increased the rate of damage (Boggs, 2013).

SELECTED METHOD

NHDOT selected the Visual Nighttime Inspection method due to the short time for implementation, the miles of assets to evaluate and the absence of a sign inventory. This approach enabled the Department to meet the 2012 compliance date of having a method in place and a process to comply with the 2015 date for all ground mounted signs to meet minimum retroreflectivity values. Reaching the mandated minimums is possible by using existing resources in the short term and developing a sustainable plan moving forward. The number of substandard signs to be found by night review is unknown, and funding will play a role in the rate that progress is made.

NHDOT also installed a sign sheeting field at its maintenance office in Concord, NH. This sheeting field will be monitored over the course of time to determine expected sign life for different sheeting colors, types and facing direction. Figure 1 and Figure 2 is a photo of the sign sheeting field installed January 2, 2009 and a sample data set respectively. The sheets continue to be monitored for retroreflectivity.

Figure 1: Sheeting field at Concord maintenance office.

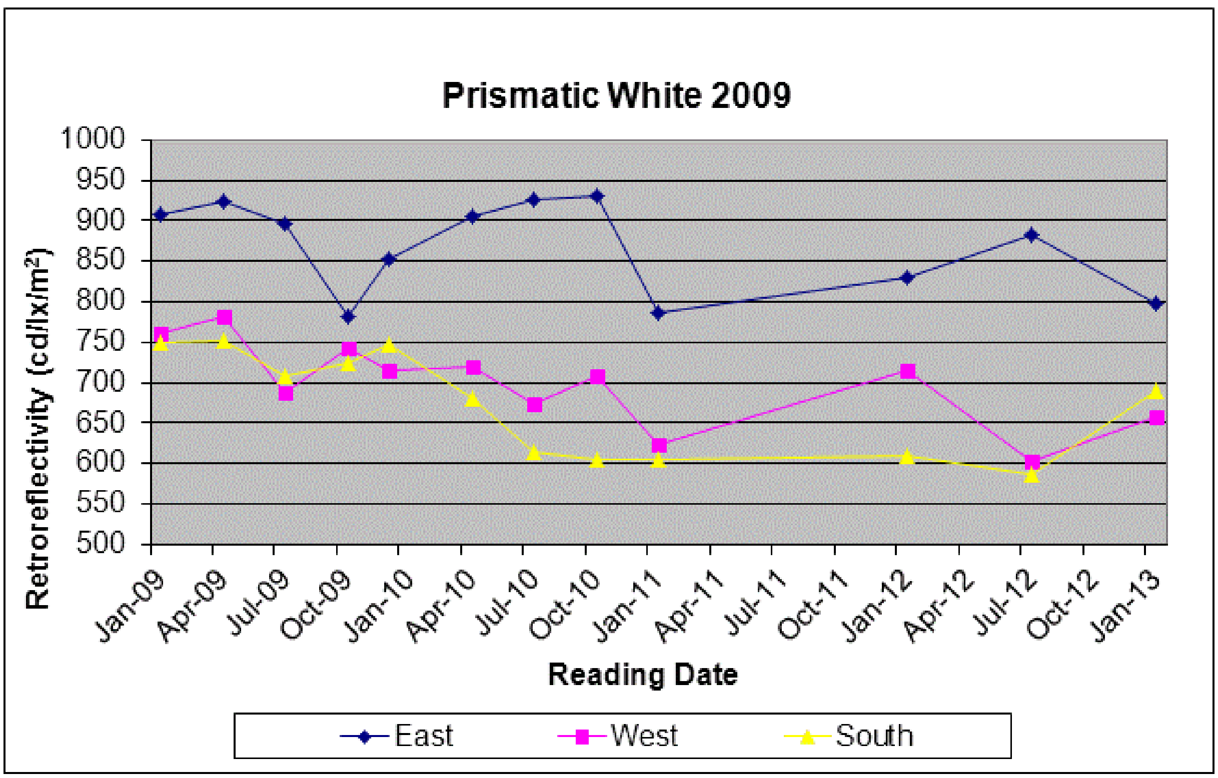

Figure 2: 2009 reflectivity measurements on white sign sheeting based on facing direction.

TRAINING FOR VISUAL NIGHTTIME INSPECTION

During the fall of every year, eight two-man crews will review signs on 1/5 of the Department's secondary roadways and every two years they will review signs on all interstates and turnpikes. Weather permitting, this process takes three to five nights per crew to complete.

Training for night review is taught by the Traffic Bureau and it includes classroom and field training. The classroom training is approximately four hours long and covers the basics of sign retroreflectivity, factors that influence the retroreflectivity (i.e. dew, pitch, sign angle, etc.), and why this program is important. The field training takes place on the New Hampshire Motor Speedway (NHMS) access road.

FIELD TRAINING

The access road around the NHMS is approximately 2 miles long and five lanes in width. The roadway is paved on rolling terrain with a good variety of tangent and back-to-back curve sections that mimic conditions around the state.

The south access is located off NH Route 106 approximately one mile from the main entrance to the speedway and the northern access joins Route 106 approximately 1.2 miles north of the speedway.

The vehicle used for training was a 2005 Chevrolet Malibu. All evaluations were done using the headlights on the low beam setting. Prior to testing, headlights and windshield were sufficiently cleaned and the headlight alignment checked. One trainee and instructor were in the vehicle.

The field training concentrates on the sign types that have been included in the MUTCD for minimum retroreflectivity. These include Green Guide, Yellow Warning, Red Stop, Yield and White Regulatory/Route signing.

Beginning at the south entrance and traveling north, signs were placed in sequences of five signs. The first one falls below the minimum retroreflectivity standard and then the following progress with improvement until the last brand new sign. This sequence is repeated for each color and required a total of 40 signs. The 40 signs were installed in the northbound direction at spacing of 250'±. The sign offset and height from the traveled met installation guidelines. The intent of this set-up was to get the evaluator familiar with the appearance of a failing sign.

Returning southbound along the same route, 15 random colored signs of differing levels of retroreflectivity were installed at varying separation distances to create conditions of an actual roadway. The new evaluator was tested during this portion of the training to determine if additional review is necessary.

FIELD IMPLEMENTATION

Each year, Traffic Bureau assigns the crews roadway sections for sign evaluation. The goal is to complete the entire state over a five year period. Maintained vehicles are utilized from the Traffic Bureau and Bureau of Mechanical Services.

Prior to an evaluation, the crew will clean the headlights and windshield. Once at the location, the crew sets a global positioning unit (GPS) to zero as a start mileage and document their location using a handheld voice recorder. As they proceed along the route, they vocally record notes of their location and the description of the sign that is below the minimum retroreflectivity. Voice notation of any turnaround or movement to a different road is documented enabling a sign replacement crew to locate that sign.

Following the drive-by evaluation, the administrative staff creates a log of signs that need replacement from the voice notes taken during the night review. These logs are then used by the sign maintenance crews over the course of the next year to replace all signs identified during the nighttime inspection.

QUALITY CONTROL

In order to evaluate the effectiveness of the training, all replaced signs are stockpiled and measured with a retroreflectometer. The measured retroreflectivity is compared to the minimum replacement value to provide an indication of how well the manual evaluation is working. In addition, a random section of a reviewed road is selected and then each sign not identified for replacement is measured in the field with a retroreflectometer. This determines if signs being noted as passing should have failed. In performing this evaluation each year, modifications are made to the training to reinforce issues that tend to occur.

CONCLUSIONS

Due to the absence of a sign inventory, the analysis of the management methods provided in the MUTCD quickly led to the selection of Visual Nighttime Inspection. With a complete sign inventory, other methods could be feasible and possibly more efficient. The Visual Nighttime Inspection is the most subjective of the methods and can lead to varied opinions regarding the service life of signs.

Following through with the quality control, some problems were discovered and the training was adjusted to correct them. An example of our findings was discovered during a random field inspection on a section of roadway that had a large percentage of engineering grade yellow warning signs. The evaluators failed some of the poorest signs; however, when field retroreflectivity readings were taken, nearly all of the engineering grade sheeting failed for minimum retroreflectivity. This was attributed to the evaluator adjusting their failure threshold because of the overall poor condition of the signs on this roadway. This shortfall is now covered in the training.

REFERENCES

Boggs, W., Heaslip, K., Louisell, C. Analysis of Sign Damage and Failure: A Case Study in Utah, http://docs.trb.org/prp/13-4054.pdf, 2013